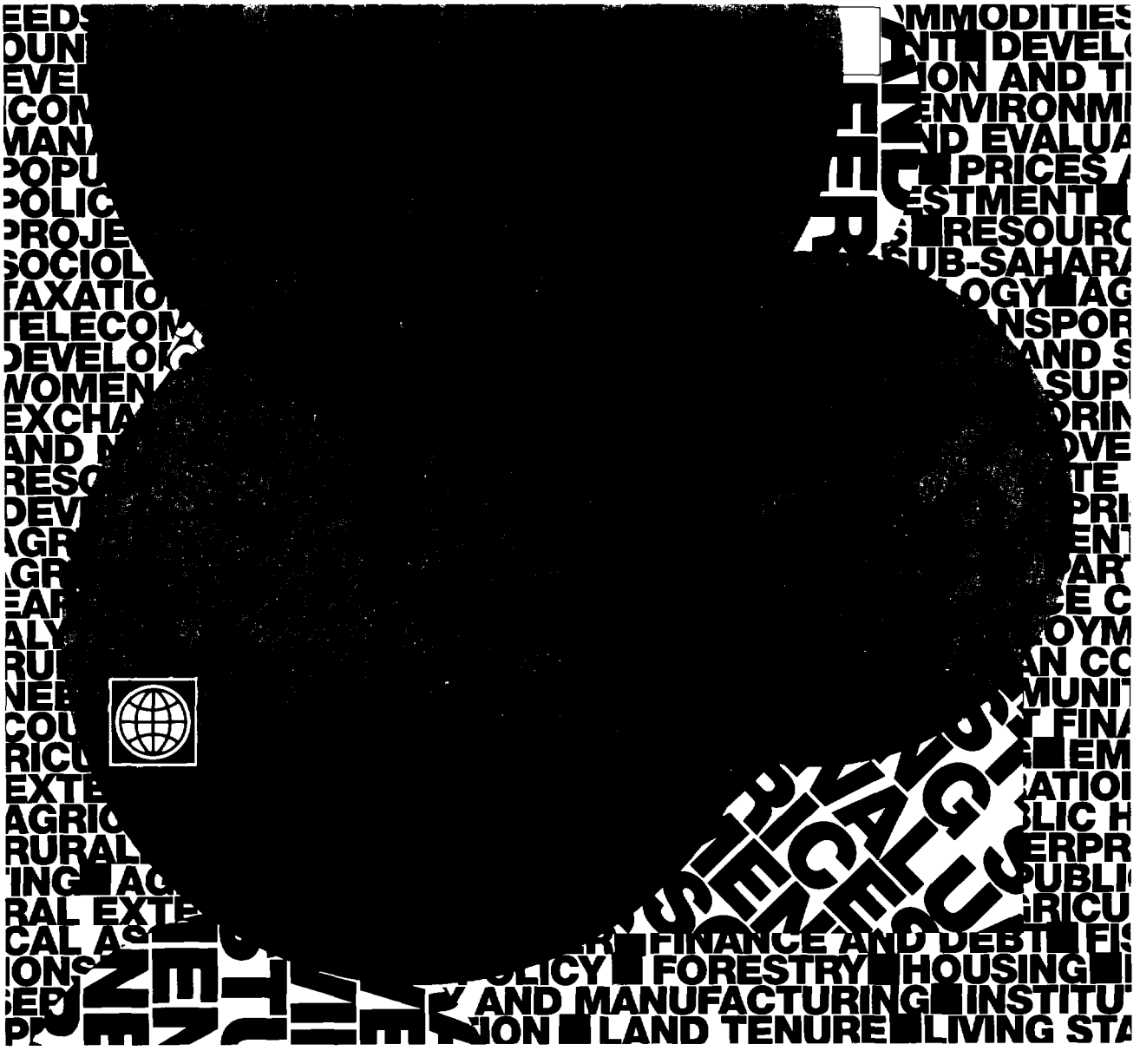
WORLD BANK TECHNICAL PAPER NUMBER 212
ASIA TECHNICAL DEPARTMENT SERIES

Water Resources Management in Asia

Volume I
Main Report

Harald D. Frederiksen, Jeremy Berkoff, and William Barber



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Harald D. Frederiksen, Jeremy Berkoff, and William Barber

The World Bank
Washington, D.C.

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ISSN: 0253-7494

Library of Congress Cataloging-in-Publication Data

Frederiksen, Harald D., 1930–
Water resources management in Asia / Harald D. Frederiksen, Jeremy Berkoff, and William Barber.
p. cm. — (World Bank technical paper, ISSN 0253-7494 ; no. 212. Asia Technical Department series)
Includes bibliographical references.
Contents: v. 1. Main report —
ISBN 0-8213-2527-2 (v. 1)
1. Water-supply—Asia. 2. Water resources development—Asia. I. Berkoff, Jeremy, 1943– . II. Barber, William, 1924– . III. Title. IV. Series: World Bank technical paper ; no. 212. V. Series: World Bank technical paper. Asia Technical Department series.
TD299.A1F74 1993
333.91'0095—dc20 93-26158
CIP

ABSTRACT

The report, Water Resources Management in Asia[1/], has three objectives: To describe the situation confronting the region's borrowers, devise approaches to better deal with the present and future water related problems that affect their well-being and equip the staff to actively participate in the regional and Bank-wide efforts to strengthen the sector. The principal water resources problems and issues have been placed in four categories: Institutional, long-term management and planning, real-time management and operations, and financial. Such an arrangement provides a perspective for examining concerns across all economic sectors and allows formulation of solutions that will constitute a truly comprehensive, balanced approach to the critical situation encountered in managing these resources. A summary of past Bank activities has confirmed that an historic approach is not adequate to address the pressing problems of today and the future. In parallel, a review of successful resources management throughout the world has identified basic principles and best practices that apply across a range of governmental structures, cultures and physical conditions. The proposed strategy for the Bank to use in addressing the challenges at the regional and the Country Department levels comprises fundamental policy and program changes tailored to each individual country and is built into each respective country strategy.

1/ The title "Water Resources Management in Asia" was earlier called the Asia Water Resources Study (AWRS)." The text still refers to the report by AWRS in numerous locations.

FOREWORD

The World Bank has been engaged in water resources development and management since its inception. Nowhere has the impact of this program been greater than in Asia. It has helped provide adequate food for the population (about 52 percent of the world's total), water for its immense urban centers and energy that both improves the people's quality of life and underpins the region's overall development. Several of the countries are emerging from conditions of extreme poverty to participate in Asia's accelerating economic growth. But the task of timely, effective development and management of water resources is far from complete.

Indeed, it is this very growth in Asia's population and economic development that has multiplied the demands on water resources. In the case of water supply today these demands are exceeding availability in several areas. And the excess demand works against normal runoff creating conditions for disaster under the inevitable drought conditions that will occur. These countries now confront requirements that cannot be met by additional development alone. New institutional arrangements, more sophisticated management and altered uses of water are essential to meet their needs.

The report, Water Resources Management in Asia, will serve as one of the references for formulating the type of changes that can meet this challenge. It identifies and categorizes the problems and issues from a broad perspective on water resources management. Building largely on the experiences of successful management elsewhere, alternative programs and projects are set forth within a framework of proven practices. But improvement in water resources management can only be realized if the leaders of the individual countries and participating agencies have the foresight and political will to aggressively address the most daunting issues -- many of which are very unpopular. Otherwise, reports such as this are of little value.

Daniel Ritchie
Director
Asia Technical Department

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PREFACE

At the beginning of the 20th Century, the world's population was about 1.6 billion. By 1990, the population had increased by 330 percent to around 5.3 billion and, according to the forecasts of the United Nations Population Division, will grow to around 8.5 billion people by 2025. In 1990, some 2.9 billion people (55 p222ercent of the total world population) were living in East and South Asian countries. But the U.N. forecasts indicate that the populations of these countries will increase to a total of around 4.2 billion in 2025. These Asian countries occupy only about 16 percent of the world's total land surface.

In 1990, about 24 percent of the populations of the developing countries of East and South Asia (about 2.7 billion people) were living in urban areas. United Nations forecasts indicate that the proportion of urban populations in these countries will increase to about 50 percent by 2025. Converted into numbers of people, the last figure indicates that around 2.1 billion out of the total forecast population of about 4.2 billion will be living in urban centers in 2025. This figure also implies a small increase in rural populations in these countries by 2025. Thus, roughly the same number of farmers may be attempting to grow the food to feed a population that will be around 55 percent larger in 2025 than it was in 1990. The basis for increased food production in East and South Asia countries was first, expansion of the cultivated area and, more recently, massive expansion of the area under irrigation. But the forecast growth in urban populations will undoubtedly result in significant encroachment on agricultural land to accommodate urban dwellings and the industries on which the urban population will depend for a livelihood. Moreover, large increases in water demands for urban water supplies and industries will result. And of course, large increases of the problems associated with urban and industrial waste water disposal and pollution will follow.

The increase in food production in developing Asian countries over the past 25 years is remarkable and has been contrary to the Malthusian vision that prevailed in the 1960s. In average per capita terms, basic food production has increased throughout the region, and although the number of undernourished people has increased in absolute terms, it has probably declined in percentage terms in most countries. This agricultural production success has been due to a variety of factors, including expansion of croplands, expansion of irrigated area, use of high-yielding varieties of seeds, and heavier applications of fertilizers and pesticides.

These changes have not been achieved without significant environmental costs. Moreover, the slowed rate of increase in food grain production recently observed indicates that the easiest gains of the Green Revolution have occurred. Though further gains are expected, they are unlikely to match the increases of the past two decades. Most countries of the region have limited opportunity for expansion of croplands. In addition, most of the easily developed irrigation water supplies have already been mobilized for that purpose. Major opportunities exist in some parts of the region for capturing additional water supplies for irrigation and other (often competing) purposes. However, these opportunities are created by the construction of dams, which is always costly, and almost invariably excites opposition because of environmental and social concerns.

Meanwhile, populations continue to grow inexorably and to erode any real gains made by water development for all sectors of the economy. And, the occurrence of a prolonged and severe drought affecting an extensive area of the region is certain to occur. Consequently, the impacts of present and growing water shortages in many parts of the region will be greatly exacerbated. Doubtless, supplies will be provided to communities and perhaps some industries, albeit rationed, under the action of *force majeure*. But supply to agriculture will have to be reduced, and, if the drought is prolonged, the threat of major food shortages may loom again in Asia. History has shown that high levels of food grain production and of cereal stocks in the developed world are of limited use to combat large shortages in an extensive area of Asia. The stocks cannot be mobilized, transported and distributed either in the quantities required or rapidly

enough to have much impact on an Asian famine. Moreover, there is no assurance that the developed world will continue to maintain high levels of food grain stocks in the future.

As urban populations grow and as rural people continue to migrate to urban areas, the cities of the region will be increasingly hard pressed to provide even the most basic requirements for community water supply and sanitation. Such services are particularly important because of their impact on the health of the urban poor. They are, of course, no less important for rural populations. In most developing Asian countries, the effort to deliver relatively safe water supply has far outweighed the commitment to treat and safely dispose of waste water. The resulting environmental quality problems appear to have grown much worse during the last two decades as rivers, estuaries and coastal waters and the groundwater systems are polluted by sewage and industrial wastes, particularly in the vicinities of urban centers. The surge in domestic water supply in many Asian countries during the 1980s far outpaced the provisions for waste water treatment and disposal.

Industrial processes frequently produce waste, some of which is toxic even in small quantities. The wastes, broadly categorized as heavy metals, gases and synthetic organic compounds, reach bodies of water as direct discharges by leaching from waste dumps and, in some cases, through the atmosphere. In developed countries, many industrial discharges are now strictly controlled. But in these countries, pollution of water bodies continues from industrial wastes discharged over the past century or longer. In addition, clean-up operations through regulation and interprovincial or international agreements can be difficult to achieve. The Rhine River runs through a heavily industrialized area and still is polluted severely with heavy metals and other wastes (though conditions have improved over the last 15 years). In many Asian countries, industrial and sewage pollution of water, still, is uncontrolled to a great extent. This problem is a major concern in China, India, Indonesia and Pakistan, and, perhaps, is the outstanding water related problem in Malaysia (particularly when effluents from mining operations are included). The legal instruments to control industrial pollution of water (and other components of the environment) often are lacking. When they exist, the associated regulations seldom are fully applied.

The World Bank's *World Development Report 1992 -- Development and the Environment* 1/ discusses water pollution and water scarcity with respect to development consequences. The overall conclusions of the report are upbeat, and it argues that continued and even accelerated economic and human development are sustainable and can be consistent with improving environmental conditions. But the report recognizes that sustainable development will require major policy, program and institutional shifts by governments. The report highlights that "policies for economic efficiency and for environmental management are complementary." This outlook certainly implies that the environmental and social impacts of future water resources development, which will be inevitable if human society is to survive, will have to be evaluated in a totally unbiased manner. Thus, the parochial benefits of the "do nothing" approach for preserving a local environment or society will have to be measured properly against the harm caused by the approach to society and the environment as a whole.

1/ The World Bank, *World Development Report 1992: Development and the Environment*. (Washington, D.C.: May 1992).

EXECUTIVE SUMMARY

I. INTRODUCTION

ASIA'S WATER PROBLEMS AND ISSUES

Water plays a critical role in the welfare of Asian countries and has widespread linkages to many aspects of their national economies. So long as water is abundant, its particular characteristics as a limited and highly variable unitary resource may be of little consequence for its development and use. But as populations increase and development intensifies, these characteristics assume an ever increasing importance, resulting in conflicts and pervasive externalities. Thus Asia, along with the rest of the world, now confronts serious water resources problems including: The rising costs of flood damage as economic activity expands into flood-prone areas; the stress of meeting human and industrial needs in exploding urban centers; the approaching full economic exploitation of irrigation potential in many areas; and pollution of rivers, lakes, coastal waters and groundwaters and other (sometimes irreversible) environmental effects. Growing competition for water between economic sectors under normal runoff conditions is greatly aggravated at times of drought. Large regions already face acute water shortages (e.g., North China, parts of Pakistan, West and South India). Essentially all urban areas and many rural areas, confront serious issues of water supply quantity and quality and of sanitation. All governments are faced with major long-term and short-term decisions on water allocation, regulation and use.

In specific contexts, these problems are critical in view of some potentially irreversible environmental effects. But in a more general sense, water scarcity is a question of economic efficiency and adjustment. In virtually all Asian countries, irrigation is by far the largest water user and consumer, and in principle, water could be diverted to other uses at the admitted cost of lost agricultural production and incomes. Pollution and related problems in theory could be tackled by an appropriate mix of investment and regulation. Consideration of water quantity and quality issues in economic terms, however, in no way understates the difficulties and costs of adjustment. Existing irrigation developments in Asia are on an enormous scale. Reallocation from agriculture could create massive problems of resettlement, not to speak of its impact on food security and other national objectives. Moreover, in all countries, water is embedded in complex institutional structures that tend to persist, even if responses suited to one period constrain optimum use in subsequent periods. The freedom and ability of governments to regulate and reallocate water is therefore frequently restricted. Moreover, water's well known characteristics lead to market failure and preclude the efficient use of most market mechanisms to achieve reallocation objectives.

It is thus the ability of countries to evolve and adapt their institutions in the widest sense (e.g., laws and customs, rules and regulations, regulatory and market mechanisms, public and private agents) that to a large extent determines how effectively they can plan, develop and manage their water resources to meet national and regional objectives. However, even if difficult institutional issues can be resolved, there remain the underlying dynamics of population growth and economic development. Given the potential of many of Asia's river systems, the needs of the populations served, and the costs and dislocations of large-scale reallocation from agriculture, further major water development programs appear inevitable. Since poor countries cannot themselves generate the financial resources required, the need for the Bank and other donor agencies to help fund these programs will continue.

THE BANK'S ROLE IN ASIAN WATER

The Bank's past involvement in Asian water has been extensive and diverse. An important early example was its role in facilitating the 1960 Indus Treaty between India and Pakistan. Since then, in addition to supporting multipurpose and single purpose projects in essentially all sectors (agriculture, fisheries, water supply, sanitation, hydropower, navigation, etc.), the Bank has cooperated in a range of national, regional and basin planning activities, environmental reviews, sector and subsector studies, and policy-based programs and projects. Most Bank activities have focused on country-specific and sector-specific problems, and Bank operations are organized primarily by the economic sector. However, environmental divisions and specialist advisers and units have increasingly addressed intersectorial issues. Country Water Resource Committees (CWRCs) are being established in the region to strengthen coordination and provide a focus for cross-sectorial activities. Together with these initiatives is a renewed interest in rethinking water strategies so as to strengthen guidance given to Bank staff and its borrowers. *The Asia Water Resources Study* (AWRS) is one component of a Bank-wide effort to address these issues.

The AWRS complements other Bank efforts to evolve explicit strategies for addressing inter-sectorial water issues in a comprehensive manner. The study has three primary objectives: (i) To mobilize the Asia region's input into, and enhance their ability to interact with and benefit from other Bank initiatives in water resources; (ii) to strengthen the region's capacities to provide advice to borrowers in support of coherent water resources development; and (iii) to promote programs and projects in borrowing countries that advance the integrated and efficient planning and management of water resources. This report aims to establish a framework for considering water resource problems; evaluate how water resource issues are addressed in the region; identify preliminary strategies to guide the Bank's water resource activities; and propose follow-up activities for the Bank. Direct interchanges with borrowing countries will be initiated subsequently with the aim of developing country-specific strategies and promoting joint activities in the water resources sector.

The main report of the AWRS is supported by three annexes contained in Volume 2. Annex 1 provides a summary of "best" practices based on principles that have proved successful worldwide that are reflected in this report. Annex 2 reviews water resource problems and issues in fifteen major Asian countries. Annex 3 summarizes the Bank's past role in supporting water resources development in the Asia region. In addition to the main report and its annexes, eight background topic papers have been prepared. They are listed in the table of contents and are referred to at appropriate points in the report. (Further topic papers are scheduled under the ongoing program). Earlier papers have been prepared by Asia Technical Agriculture (ASTAG) in the course of the division's work in water resources, which have also been used in compiling the report: Notably, the *Selected Guidelines for Engineering Staff in the Review and Supervision of Irrigation, Drainage, Flood Control and Broader Water Resources Programs.*[1/]

II. A WATER RESOURCES FRAMEWORK

Water resource issues can be discussed under four headings: (i) Institutions, (ii) planning and long-term management, (iii) real-time management and operation and maintenance (O&M), and (iv) economic and financial policy. Though by no means the only possible approach, this

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1/ The World Bank Asia Technical Department, Agriculture Division (ASTAG) Water Resources Unit, Consultants and U.S. Bureau of Reclamation Staff, *Selected Guidelines for Engineering Staff in the Review and Supervision of Irrigation, Drainage, Flood Control and Broader Water Resources Programs.* (Washington, D.C.: February 1990).

framework recognizes the central importance of institutions and facilitates formulation of proposals in a consistent way.

INSTITUTIONS

Customs, laws, regulations and organizations are interdependent, and reform with respect to one aspect must be considered in the context of arrangements for the entire water resources area. The various elements vary widely depending on such factors as culture, climate, relative water scarcity, population pressure, the pace and stage of development, and the government and legal systems. Nevertheless, water is also a substance that has given physical characteristics, is obtained from similar sources, and is applied to similar ends. Thus, certain common principles govern good water management, and important lessons can be learned from experience elsewhere in the world. Change arises from government action in three main areas: Legislation, regulation and operations.

Legislation

Legislation establishes the basis for regulatory and operational action and provides the context in which nongovernment entities and individuals take actions. It is extended across country, provincial and other legislative boundaries by interjurisdictional agreements. The constraints of a federal structure are felt most severely in India and to a lesser extent in Pakistan. But even in Malaysia and China, provinces are aggressive in forwarding their interests. In unitary states, central government legislates on all water matters, although powers may be administratively delegated to local government (e.g., as in Indonesia and Sri Lanka). Some countries have adopted comprehensive water codes (e.g., China, the Philippines). Others have accumulated legislation incrementally, sometimes resulting in ambiguities in water rights and overlapping administrations. However, a water code is neither strictly necessary nor sufficient for orderly development. Korea has no such code yet and has perhaps the best water management record in the region. The Philippines has a water code, but finds difficulty in making its provisions work.

Interjurisdictional rivers raise particular issues. Of Asia's major international basins, riparian differences have been settled only for the Indus. The 1960 treaty is rightly regarded as a major achievement, even if it was a far from an optimum economic solution and failed to cover vital drainage issues. However, the Indus and its tributaries could be divided unambiguously between the riparians. But other international basins typically require cooperation in storing and allocating variable annual flows and are therefore inherently more problematic. There is a history of cooperative planning for the Mekong, but difficult riparian issues remain in this still largely undeveloped basin. Not even data are shared for the Ganges-Brahmaputra. Each riparian undertakes separate and partial planning, and development has been piecemeal. Similar problems are faced on interprovincial rivers in federal countries, and even in unitary countries where powers are delegated. The most acute problems arise in India since neither legal awards nor voluntary agreements are normally expressed in ways that provide for optimum development and management. This has undoubtedly proved very costly, in particular for basins approaching full development (e.g., the Cauvery, Krishna and some Ganges tributaries). Problems are encountered in all other countries although they are generally less severe. There is always a strong *prima facie* case for comprehensive agreements on international and interprovincial rivers and for clearly articulated basin operating rules and regulations on all basins. However, realism usually dictates a step-by-step approach in specific instances.

Regulation

Regulation comprises the enforcement and monitoring of established laws, agreements, rules, regulations and standards. Aspects typically included are: Water and land-use rights, real-

time allocations, standards of service, water quality and other environmental impacts, and the safety of facilities. A wide range of other regulatory functions also impact on water, notably those pertaining to public administration, markets, finance, labor and private enterprise. Regulatory functions are often developed weakly and inconsistently in Asian countries, and implementation is often a major constraint. Setting realistic priorities is therefore essential. For instance, ambiguity in water rights and allocations is often most damaging at the river basin level. If rights at this level cannot be assured, they may have little meaning at the level of the user group or individual.

Operations

The operational area includes data collection, planning, design, construction and O&M. Public agencies dominate in Asia, at least for surface water, and are usually organized by sector. Functional linkages between water and land, surface and groundwater, and water quality and quantity are often weak. Inconsistencies between hydrological and administrative boundaries have few disadvantages for broad data collection, planning and regulatory activities, provided there are effective basin agencies or other coordinating mechanisms. China is possibly most consistent in this respect with basin commissions established for all the main rivers. In contrast, India has few and inadequate basinwide arrangements. On the other hand, sound O&M at the level of service (e.g., supply, distribution, waste collection, drainage and flood protection) requires that agencies reflect hydrological boundaries and that beneficiaries of a given system are all included within the jurisdiction of the responsible entity.

In assigning functions, two basic principles are often ignored: Separation of regulatory and operational functions, and operational specialization. For instance, water is almost always appropriated (allocated) during the process of development, and if developers also regulate the resource, there is an inevitable tendency to overdevelop. Inconsistencies similarly arise if water supply agencies enforce quality standards; industrial ministries regulate land use; facility owners oversee their safety; and O&M agencies enforce environmental standards. The need for operational specialization arises from jurisdictional coverage and specialist knowledge and skills. Thus, data collection requires full coverage; planning requires interdisciplinary teamwork and appreciation of policy; design requires technical knowledge; construction oversees quality of work; and O&M requires the discipline of sustaining a service to end-users. Transfer of assets from construction to O&M is a particular case where ambiguity can result in deficiencies being passed to the O&M agency and, ultimately, the customer. Another weakness in public agencies is inflexibility. Future workloads are often inadequately addressed. Sound private sector practice goes by default (use of subcontracting, consultants, limited-term appointments, etc.). And priority is given to expansion rather than full accountability.

Few Asian countries have a strong data collection, processing and dissemination system -- Korea is an exception -- though such a system is fundamental to all development and management aspects of water resources and is a first requirement. Similarly, though coordinating bodies may advise government on water matters, in only a few cases (e.g., the Philippines) are these supported by permanent policy and planning agencies independent of sectorial bias. Even if leadership is assigned to a water resources ministry (as in China and India) this often has an irrigation, drainage and flood control bias. With respect to O&M, experience worldwide has shown that measurable water services are best provided by autonomous entities organized as utilities providing a readily defined service for a fee. The entity can be a national agency, local government unit, user association or private company. But, by isolating the service function from other influences, the utility form encourages operational efficiency, service accountability and sound financial management. Other than for water services that are difficult to measure (drainage, flood protection, river training, environment, etc.), the utility form is common in Asia. The most notable exception is irrigation in South and most of Southeast Asia where line departments predominate. In contrast, irrigation in east Asia is organized on a utility basis. For example, in China, each level in the water distribution hierarchy (multipurpose facility, conveyance system, irrigation service area

or municipality) is in principle required at least to cover its O&M costs from service fees and be fully accountable to its customers.

Conclusions

Institutional reform is at once the central problem in most Asian countries and one of the most difficult. No standard solutions are possible and, in all cases, reforms must reflect the particular country context. Nevertheless, there is little evidence that such reforms occur as a matter of course and much to suggest that reforms become more difficult as pressures on water resources increase, at least in the highly politicized countries of South Asia. Failure to tackle these crucial issues is resulting in rising costs to the countries concerned. It appears that the Bank could be much more forceful in promoting the themes suggested above, though realism and persistence will be required.

PLANNING AND LONG-TERM MANAGEMENT

General

All Asian countries prepare national plans setting out their broad goals and medium-term objectives and policies. They range from detailed control mechanisms (e.g., in countries with centrally planned economies, such as China) to little more than rolling investment programs (e.g., in the Philippines). Feasibility studies and project plans are also universal though their quality varies greatly. The main deficiencies reside in long-run regional and basin planning, and in their aggregation into national water plans. As a result, inconsistencies frequently arise in the use and allocation of water and in the development programs of sector agencies. Conflicts become increasingly serious as the resource approaches full development. Integrated multipurpose planning has been undertaken by some countries. But with notable exceptions (e.g., China and Korea), there are few agencies with unambiguous responsibility for such planning so that development is overtaken by the momentum of sector-specific programs.

National and Provincial Planning

National plans, although set within a longer-term perspective, are typically detailed for only five years. Funding is a real constraint, but a five-year time frame is far too short to achieve most water resource objectives that may require decades rather than years. Since water programs typically account for 20 to 25 percent of total public investment, their ripple and linkage effects can be extensive, and the need for reliable methodologies for relating water to the macroeconomy is a generic issue, as illustrated by the unforeseen effects of Sri Lanka's Mahaweli program (see Annex 2, Chapter 12). Some countries have consolidated basin plans into an "outline" national plan (e.g., China) or have undertaken separate national planning with mixed success (e.g., Bangladesh). In other cases (e.g., India and Thailand), intentions have been confined to broad policy statements with limited practical impact.

Regional Planning

Regional planning frames resource development in regional physical terms. It is commonly adopted in managing major urban development; in support of accelerated industrial development (e.g., Thailand's eastern seaboard or China's special development zones); and for rural settlement programs (e.g., the Federal Land Development Authority schemes in Malaysia). Regional planning is less widely applied in support of infrastructural investment in already populated rural areas, even though large irrigation programs in particular can transform population patterns and economic activity. Gujarat's Narmada program, for instance, was planned primarily as an irrigation and power project, yet could best have been regarded as a regional planning program impacting broadly on much of the State.

Basin Planning

Basin planning should provide the basis for allocating water and verifying compatibility of programs and projects within a hydrological system. Several countries have made the basin the basic planning unit. For instance, China, where basin plans and control are required under the 1988 water law; Korea, which manages its main catchments as total water supply/demand operations; and the Philippines, where 36 basin plans provide the basis for all water licensing and project clearance. Basin level planning is, in principle, also required in Indonesia; although, in practice, a 1982 law has had little impact. Other countries have generally followed less systematic approaches. Thailand, Myanmar and Sri Lanka (and, for that matter, Indonesia) are among those that have prepared numerous individual plans to help prioritize development but have generally failed to institutionalize and update them. In India, not even this approach has been accepted, and only for the Damodar in eastern India has a serious attempt been made to plan and implement development on a basin basis. India's tribunal awards and interstate agreements, of course, require that allocations reflect some assessment of basin development, and most states have some institutional capacity for basin planning. But, of all the countries in the region, India has possibly done least to ensure that water resources are allocated to meet specific objectives within the framework of the hydrological system.

International basins present special problems. Subsequent to the Indus Basin Treaty between India and Pakistan, each riparian has planned its activities separately, despite the benefits that would arise from joint planning of drainage facilities. A lack of cooperation has characterized planning for the Ganges-Brahmaputra, although both India and Bangladesh have undertaken perspective planning studies proposing major storages in Nepal and India and transfers from the Brahmaputra to the lower Ganges. And Nepal and India have studied specific major projects. Only on the lower Mekong has joint international planning been seriously attempted; but development to date has been limited. There remains the possibility that the riparians will go their own ways, at least on the tributaries.

Project Planning

Feasibility studies are required in all countries for project clearance and are invariably a condition for external funding. Study guidelines are provided by international and national planning agencies. Planning for more diffuse programs (land reclamation, groundwater and pollution control) is typically less formalized. The quality of planning varies greatly. A main source of weakness has been failure to integrate projects and programs within systematic regional and basin plans. Other difficulties arise from inadequate data; failure to anticipate O&M constraints and environmental effects; poor financial and construction planning; and unrealistic system efficiency and benefit assumptions. Many problems relate directly to the concept of the project or program itself. Given the variety of projects and programs, a litany of problems and deficiencies may have little relevance. Nor should the above be taken to imply that there have been no good projects in the region. However, in almost all countries, deficiencies in planning at the project and program level have led to waste and inefficiency, which warrants substantial attention and improvement.

Real-time Management and Operation and Maintenance

General

All planning and design projects assume that facilities will be operated and maintained to provide defined services over time. In practice, however, services may differ from those intended, and expected benefits are not always attained. Failure to give adequate priority to O&M is a pervasive problem increasingly recognized over recent years. However, many of the most

intractable problems date from initial design and construction. Plans of Operation and Maintenance (POMs) neither account for the impact of external factors on system performance nor provide detailed guidance. Poor construction quality reflects a common failure to adopt proven construction management practices.

Basin Operations

Basin operations are normally the key to effective project operations. Many basins in Asia are now developed to levels that make formal operating plans of critical importance. Korea is preeminent in implementing real-time management at the basin level. Surprisingly, however, countries that implement effective real-time procedures are not always those with effective institutions and/or long-term planning. For instance, political factors have driven Mahaweli development in Sri Lanka without precluding one of the more objective real-time operations in the region. Basin agencies in China focus on long-term planning and are seldom responsible for unified basin management, though flood management is relatively advanced. With few exceptions real-time basin operations in India are poorly coordinated, in particular for interstate river systems, as is also the case in Indonesia. In Bangladesh, the major concerns are associated with flooding for which forecasting and preparedness measures are generally inadequate.

There are real-time management issues of varying importance in the three most critical international basins in the region. The Indus Treaty minimizes the need for real-time cooperation. India has evolved fairly effectively in crude capabilities for managing its share of Indus waters while a recent interprovincial agreement provides hope that management in Pakistan will improve. An accord between India and Bangladesh for operations at Farakka barrage on the Ganges has lapsed, and it is now virtually impossible for Bangladesh to plan its operations during the dry season. Interstate arrangements within India for Ganges tributaries are unsatisfactory. The arrangements made between India and Nepal are straightforward but simplistic. India and Bangladesh are both constructing projects on the Teesta in the Brahmaputra Basin without the benefit of a water-sharing agreement. Under these circumstances Bangladesh cannot begin to develop a rational plan for dry season operations. Proposed main stem projects on the Mekong would require international agreement for their construction and subsequent operation, but none have yet proceeded beyond the early stages of planning.

Scheme Operation and Maintenance

Generally, water operations in China and Korea are basically service-oriented. Elsewhere, rights and obligations are often less clearly formulated. Approaches have evolved in individual sectors with rules and regulations elaborated in general O&M manuals. Irrigation rules have a long history. They are more or less successful depending on how they respond to external conditions such as rainfall. Operating procedures in other sectors are generally more standardized and straightforward, though there are frequent deficiencies in implementation. Real-time surface water management is normally more effective if storage facilities are provided, though single-purpose reservoir systems are often operated according to fairly narrow operating rules. These may be a pragmatic response to past experience and perform well under normal conditions. But they are less suited to extremes of drought and flood and often fail to make optimum use of regulating capacity.

Irrigation management raises particular issues, given the large size of many schemes, the inadequacy of O&M funding and low staff morale. External factors are crucial. Regulation is relatively easy if demands are predictable, supply is favorable, control is localized and natural drainage is good. It is much more difficult if demands are uncertain, supplies unpredictable, control is centralized and drainage is impeded. If failure to anticipate O&M problems is added to adverse external factors, it is not surprising that effective management of large public irrigation systems often proves elusive. A wide range of institutional, administrative and technical reforms

have been suggested and sometimes introduced to improve real-time irrigation management, although this often proves intractable. Maintenance of other types of public water related facilities is also often problematic. It is commonly underfunded, and concerned agencies give it low priority. If routine maintenance is inadequate, facilities deteriorate and full rehabilitation may become necessary. Maintenance schedules and budgets rarely provide for the "replacement" category. And finally, planning for emergencies is another area of particular weakness.

Regulatory and Demand Management

A range of regulatory and demand management measures and programs complement real-time operations and maintenance at the basin and scheme levels. With regard to the regulatory aspects, the effective and continuous administration of systems of water rights and allocations, land-use zoning, quality standards, structural safety and the administrative and financial integrity of service entities, are among critical aspects to be addressed. These issues are integral to the institutional issues discussed above. Concerning demand management, numerous technical programs and economic incentives to reduce water losses and promote efficiency in water use can be envisaged. Programs of this type are typically managed by a variety of service and regulatory agencies which, though overlapping with those responsible for management of specific schemes, also respond to broader administrative and area jurisdictions.

ECONOMIC AND FINANCIAL POLICY

Constraints on Economic Pricing

Few governments in Asia are willing to charge for water at levels that even approach its true economic value. Charges at best are limited to recovery of O&M costs and, perhaps, a share of capital costs. In many contexts, water is provided free or any payment is confined to an indirect charge through a land tax or, implicitly, the general tax system. Besides considerations that commonly limit the **level** of water charges, there are also major constraints on the use of price as a **mechanism** in water allocation. Market failure is a generic issue associated with water's characteristics. In addition, there are important institutional constraints more specific to the Asian context. These include: (i) The lack of clearly administered and enforced systems of property rights, which severely limits the potential for sale and exchange of water allocations; (ii) line agency structures--notably in irrigation--which provide few incentives for efficient management; (iii) practical considerations resulting from large differences between the value of water and its price, which leads to rent-seeking behavior and places a heavy burden on regulatory and operational agencies; and (iv) the lack of physical conveyance interlinkage of potential users, reliable means of measurement and controls. If institutional constraints restrict the use of the price mechanism, then priority may have to be given to institutional reform if charges are to have any practical effect beyond public resource mobilization. Price can begin to have a significant impact on the efficiency of agency performance or water use only if the institutional preconditions are met.

Financial Requirements

The need for sound financial planning and budgeting is self-evident. The utility form provides a transparent framework for accounting for all income and expenditures and for clarifying the extent and nature of any direct financial subsidies. Governments almost invariably expect autonomous agencies to cover O&M expenditures, but typically, subsidize capital investment wholly or in part. Subsidies are much less transparent in line department accounts, particularly since income from water charges returns to the government's general revenue account. Moreover, regular government financial procedures provide fewer incentives for efficient financial practices than do those of an autonomous agency. A particular problem is that few countries in Asia apply consistent cost allocation procedures for multipurpose projects. As a result, there may be hidden

cross-subsidies, in particular where a lead agency constructs a joint facility. Even if subsidies are given to compensate for distortions in the economy or to meet regional or equity objectives, a first need is to clarify direct costs and provide financial transparency.

Cost Recovery

Cost recovery practices typically differ in the different sectors. Power agencies often account for all their costs and charge their customers full direct (even marginal) costs; whereas irrigation charges are often set administratively and independent of cost. Some sectors (flood control, navigation, environmental management, etc.) have few effective mechanisms for cost recovery, and these sectors may be completely ignored in cost allocation procedures. Numerous mechanisms can be used to recover costs, although those that relate payment to service--in terms of quantity, quality and reliability--are generally greatly preferred. The utility form provides a transparent basis for accounting for such income, while sliding scale and other techniques can manage demand, encourage water-use efficiency and maintain service quality.

Funding Capital and Operation and Maintenance Expenditures

Sound financial planning is critical to the implementation of major water resource investments. Failure to ensure adequate **capital** financing is a frequent cause of delays and reduced benefits. Where water services remain with line agencies there is no financing alternative to central or state government funding, perhaps supported by external assistance. Once the utility form is adopted, additional financing options become available, including revenue earnings and borrowing through the local or international capital markets. Borrowing, however, is only possible if such entities remain viable business enterprises. **O&M funding** often receives low priority in public sector water resource operations in the region. As a result, facilities frequently deteriorate and cannot be operated to provide the intended and promised services to the customers. Where line agencies are responsible, it is critical that O&M expenditures are sufficient to sustain the facilities, irrespective of whether it is government policy to recover full O&M costs from the beneficiaries. Utilities are usually required to at least cover O&M expenditures. However, if governments retain control over the level of water fees or in other ways limit the utility's ability to follow sound business practices, then it is important that such agencies are reimbursed for any subsidies implicit in such decisions.

III. The Bank's Role and Future Strategies

The Bank's Past Role

The Bank's involvement in Asian water has been extensive and diverse, accounting for a major share of the region's total concerns. **The lending program** has included investment projects in essentially all water related sectors and subsectors (irrigation, fisheries, hydropower, water supply, sanitation, navigation, etc.) though, to date, there have been surprisingly few multipurpose projects. Implementation performances and development impacts have been variable, although the Bank has made a major contribution to infrastructural expansion in all sectors. Irrigation has accounted for the majority of Bank water projects (155 projects out of a total of 274 in directly-identifiable sectors by 1990), and recent Operations Evaluation Department concerns relating to performance in this sector should be noted. Other important sectors have been water supply and sanitation (60 projects), hydropower (26 projects) and flood control (22 projects). Sector investment projects (e.g., irrigation O&M) are increasingly seeking to address problems encountered in investment projects. Also, urban and rural area development and financial intermediary operations (especially in agriculture) often have large water-related components. Finally, policy-based lending has on occasion included conditionality in the water area, and the

Bank has financed many operations in subsectors with linkages to water (e.g., watershed management, roads in irrigation schemes and resettlement of those ousted).

Economic work seldom addresses water issues directly, although these issues are covered along with other sectors in general economic and investment reviews. **Sector work** typically fails to address water issues directly. Water issues are discussed in the context of individual sector reviews and memoranda, for which numerous examples have been prepared, namely, in agriculture, irrigation, power, fisheries, transport and water supply and sanitation. Environmental reviews are an exception to this sectorial parochialism. But, by addressing water resources within the context of the environment rather than development, they risk giving insufficient attention to the full range of institutional and technical issues. What seems to be lacking is a combination of the breadth and balance of environmental reviews with a full recognition of traditional water management practice -- in the context of development of the resource and of individual sectors. Such an approach would be well suited to a water sector review considering water in all its dimensions.

Technical assistance (TA) in water-related activities has been varied, including: (i) TA components in water-related project lending; (ii) free-standing technical assistance projects with water-related sub-projects; (iii) United Nations Development Programme (UNDP) programs for which the Bank is executing agency; and (iv) activities financed under Trust Funds and from other sources. Notable programs have included national water planning (e.g., the UNDP-funded exercise in Bangladesh); river basin and multipurpose project planning; multicountry programs in support of specific subsectors, including two important UNDP-funded programs in water supply and sanitation; sector-specific policy studies and sector reviews; and project preparation activities. **Training**, in association with TA and lending activities, has also been substantial and the Economic Development Institute has implemented several water resource training activities in the region. Lastly, Bank **research** has included a number of water-related activities that have led to a range of research publications and proposals.

The Bank provides support through aid consortia, cofinancing of major projects, and in other contexts to a wide range of activities involving other donors and international agencies. The Bank's **aid coordination** role has in a few cases extended to cover large water-related programs, including: The Indus in Pakistan (managing large investment funds to which it also made contributions); the Mahaweli program in Sri Lanka (sponsoring donor meetings in parallel with regular aid group meetings); and, currently, the Bangladesh flood protection program (coordinating major TA activities). Besides involvement in specific programs, the Bank has also had a major role in supporting international initiatives that have important implications for the region. Examples are: Through the Consultative Group on International Agricultural Research, in the creation of the International Irrigation Management Institute, and under the recent Irrigation and Drainage Research Program.

A CHANGE OF EMPHASIS

There are three broad ways in which the Bank could approach the varied and complex issues in Asian water: (i) As predominantly in the past, by responding to borrower and donor requests; developing sector specific strategies, programs and projects; supporting complementary studies and related research; and seeking broader institutional reform and resource planning more as a byproduct of operations than as an end in itself; (ii) as under ongoing initiatives, by tackling water resource issues within the context of environmental concerns while continuing with varied sector-specific and related activities; or (iii) as is recommended, by addressing water resource issues directly on a comprehensive basis; actively seeking international and interprovincial basin agreements; requiring institutional reform as a condition for lending in specific sectors; and actively helping to develop capacities for integrated water planning and management in borrower countries.

Arguments in favor of the third of these approaches are persuasive. Such an approach would build on past activities but would also seek to broaden and develop the various instruments available to address water resource issues. Past emphasis on specific projects, each with a "given" water requirement, is inherently inadequate for managing a complex unitary resource coming under increasing pressure. Projects formulated in isolation do not constitute a strategy. Nor would consideration of water under an environmental banner provide a sufficient basis for sound management. No doubt water is always a critical--often the critical--factor in sustaining a balanced environment. But, as argued above, water resources planning and management go beyond what is typically of environmental concern. No doubt Bank initiatives in water would compete for resources with other vital activities, and water issues are difficult and sensitive. However, if large water resource programs are, as indicated in this report, inevitable, then the Bank's financial strength, technical experience, international perspectives and operational involvement suggest that water is an area in which it has an explicit comparative advantage. At the very least, the Bank will be an essential partner in assembling the finance needed for large water resource programs. If the Bank uses this leverage to promote reforms in borrowing countries, it could contribute in important ways to orderly development in an area of critical importance for long-term prosperity and well-being.

General Strategy

Bank strategy must be tailored to subregional and country conditions. Even so, four main elements of a broader strategy can be identified:

1. Water must be viewed as a fixed resource to be developed and managed to best meet all a nation's objectives (economic, social, security and environmental) rather than as an input into specific sectors.

2. The focus should be on capacity building and institutional strengthening to help sustain policies, programs and projects.

3. The Bank should evolve lending instruments to promote its objectives supported by the economic and sector work program, TA, research and donor coordination.

4. Particular attention should be given to international and interprovincial river systems since these have high priority in their own right and the Bank has a strong comparative advantage in this area.

Policy Guidelines

The Bank needs to establish and maintain clear policies to guide its work at the regional level and, in greater detail, at the country level. Content can be considered in the four areas: institutions, planning, real-time management, and economic and financial management. The country departments (CDs) should clarify water resource objectives for each country individually, and formulate all Bank activities to promote these objectives. The Bank should clearly articulate its revised approach to the government concerned, including the conditions under which it would support operations in the water sector, and should jointly agree to a country-specific strategy at the senior government level. Borrowers should be encouraged to undertake systematic assessments to help formulate comprehensive approaches to water resources development and management. Assistance would be provided as necessary in undertaking such an assessment, which in principle could lead directly to a Bank-supported sector operation.

Bank Activities

Bank activities need to be undertaken both at the level of the resource and at the level of individual sectors. At the **resource level**, emphasis should be on comprehensive approaches to water resources development and management with emphasis on institutional capacity building at the national and provincial levels, as appropriate. Lending instruments should be developed to promote agreed upon objectives in each of the four framework areas and supported by appropriate economic and sector work and TA. A more proactive approach to interjurisdictional disputes could also lead to a stronger role in aid coordination and in the mobilization of the financial and technical resources of bilateral donors and other international agencies. Initiatives in the environmental area should complement and be coordinated with this approach. Environmental efforts should focus primarily on the regulatory function--promoting clear objectives, measurable criteria, and competent review and enforcement procedures that hold water service agencies accountable for their actions--while seeking to establish complementary incentive mechanisms.

Activities in **individual sectors** should be fully consistent with the overall country water resources strategy, and activities in specific sectors should be made conditional on satisfactory progress in meeting general water resource objectives. Within each sector, approaches should be adopted that complement those at the level of the resource, with emphasis on comprehensive analysis, and institutional strengthening and capacity building. Multipurpose and single-purpose investment projects should be framed within national, regional and basin plans; and their priority should be established within the context of total sector investment programs.

In most cases the **lending program** will remain the primary vehicle for achieving the Bank's objectives. As in the past, the Bank should stand ready to provide TA, training and research support, but other agencies (e.g., the UN and its specialized agencies, bilateral donors, private organizations and academic institutions) are well placed to focus on such activities. While cooperation with such agencies will be critical, the particular strength of the Bank will remain in its lending activities. If large financial flows are required to help resolve major water resources problems, then the Bank--and regional banks such as the Asian Development Bank--are well placed to use the leverage of resource transfers to enable solutions. In areas where water resources are fully developed, "the age of large dams" may be over, but, even so, substantial resources will still be needed to consolidate, modernize and sustain infrastructural facilities. Elsewhere, further large, new water resource development programs, including dams, are inevitable and may be a necessary precondition for agreement on contentious interjurisdictional issues.

LENDING INSTRUMENTS IN THE WATER SECTOR

Four types of lending instruments are proposed below for addressing water resource issues across sectors and jurisdictional boundaries: (i) Country water resources sector projects, (ii) county water resources support projects, (iii) interjurisdictional development and management projects, and (iv) multipurpose and single purpose sector projects.

Country Water Resources Sector Projects

Water resource conditionality has on occasion featured in policy-based lending (e.g., agricultural, irrigation or urban sector loans) and in environmental operations. But such activities fail to address a nation's water resources development and management in their entirety. A country or provincial water resources sector project could be designed to fulfill this objective, and provide a mechanism for going beyond individual sectors or implementing agencies. Such an approach

would be consistent with operations in other broad-based sectors (e.g., energy and transport).1/ Scope would need to be tailored to the requirements of the country or province concerned. Consistency would be facilitated if the four framework areas were covered, as this would provide a coherent approach with an institutional focus so that proposals in any one area could be formulated in the context of decisions in all other areas. Issues that might be addressed include the following:

1. **Institutions.** Allocation policies for all uses; water rights systems and their administration; other regulatory areas (water quality, pollution control, environmental, financial, dam safety, etc.); agency functions, organization and accountability; personnel policies; consumer responsibilities, obligations and rights; and agency programming and budgeting.

2. **Long-Term Planning.** Goals, objectives and policies; scope of national, regional, basin and project planning; data collection and processing systems; planning criteria and methodologies; value of water for economic and noneconomic uses; allocation of resources and sites for future generations; and implementation of priority planning activities.

3. **Real-Time Management.** Preparation of plans of operation and maintenance; basin and scheme operations under normal and emergency conditions; maintenance programs and procedures; organizational and management capabilities; legal powers; rules, procedures, guides, equipment, staff training and oversight consistent with sound management and business practice; and public awareness and participation.

4. **Economic and Financial Policy.** Pricing principles and policies; subsidies and taxes; agency finances; identification and allocation of capital and O&M costs between sectors; composition of service charges and their link to the service; cost recovery schedules and mechanisms; demand management tools; environmental and pollution control charges; and water markets.

Once agreement has been reached with the government concerned on a general country strategy, a comprehensive water resource assessment could provide the initial mechanism for defining in detail what might be involved. Loan or credit arrangements could vary. In countries facing balance-of-payments problems, a quick-disbursing loan or credit could be consistent with macroeconomic requirements, prove useful in creating an institutional framework in water, and help initiate planning, management and policy measures. In other cases, a sector investment credit might be more appropriate. In yet others, broad water resources conditionality could be associated with the investment program of a dominant agency or even one or more selected investment projects. Hybrid arrangements could have the merit of being attractive to both a finance ministry, and sectorial agencies, although it is understood that these have encountered difficulties in other contexts. A broad-based water sector operation would appear particularly suited to medium-sized countries (Thailand, Sri Lanka, Bangladesh) or provinces (Gujarat, Rajasthan, Tamil Nadu) that are facing difficult water resource problems. It could be framed as the first of a series of water sector operations or help establish the preconditions for subsequent lending for multipurpose projects and individual sectors.

Country Water Resources Support Projects

Most countries that require support in strengthening their water resources management capability must remedy generic sector-wide deficiencies that obstruct sound management. In small and medium-sized countries or provinces, such deficiencies may be best tackled under a country-based operation. But in larger countries, there may be merit in tackling generic issues in their own right. Possible areas include: (i) Data collection, processing and dissemination programs to meet

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1/ Similar proposals have been made for the Middle East and North Africa Region.

national and provincial needs in planning, implementation, operation and regulatory activities for government, the private sector and public at large; (ii) dam safety assurance incorporating both investigative and strengthening activities, together with funding of substantial corrective work (as under the recent India Dam Safety Project); (iii) operation and maintenance (O&M) issues across sectors or in the context of improvements in real-time management of multipurpose facilities (although O&M may be best tackled in a sector context); and (iv) environmental control covering the regulatory framework and remedial works in regions under immediate stress (as under the Beijing Environmental Project) or in a province or country.

In federal countries, in particular, it may be appropriate to implement a countrywide operation focused on high priority areas to complement comprehensive provincial programs and sector-specific activities. A combination of different but complementary lending activities could represent a suitable compromise since not all provinces will be ready for comprehensive treatment.

Interjurisdictional Development and Management Programs

The Bank's role in interjurisdictional development and management of water resources will evolve on a case-by-case basis. In some cases, Bank involvement could be confined, at least initially, to its good offices (e.g., in support of data pooling, planning or other joint activities). In most cases, however, the promise of funding and donor coordination for joint projects could provide the Bank with a unique role in catalyzing agreement. Indeed, additional water may be a precondition for obtaining agreement since only then can the necessary incentives for participation be provided to all the riparians.

Any project on an **international watercourse** is subject to international law and to the Bank's own operational directive.[1/] Even so, the Bank has considerable leeway in the extent to which, and the stage at which, it becomes involved. This is not the place to propose specific solutions, which depend on detailed feasibility studies, discussions and requests from the countries concerned. However, tentative approaches with respect to the three main international river systems might include: (i) The Ganges-Brahmaputra, ensuring that Bangladesh is party to any multipurpose storage dams constructed in Nepal; (ii) the Indus, linking future assistance for drainage in both Pakistan and India to a joint study, possibly leading subsequently to India's participation in the Left Bank Outfall Drain; and (iii) the Mekong, ensuring that Bank initiatives seek active riparian cooperation with respect to specific activities within the framework of basin agreements and planning. The sensitivity of any international issue is self-evident. Only the countries concerned can reach an agreement, and the Bank has a role to play only if it is acceptable to all parties. Even so, the Bank could indicate at an early stage and at the highest levels of governments, the conditions under which it would be willing to be involved. Though such an approach carries risks, the potential benefits could also be very substantial.

Conflicting interests are also inevitable on interjurisdictional **national rivers** in federal countries, and even in unitary countries where local government has developed strong management control of resources. There is no operational directive for national rivers comparable to OD 7.50 but, as a condition of its involvement, the Bank requires that allocations among jurisdictions be spelled out in directives, tribunal awards or interprovincial agreements. For instance, in India, it has declined projects in the Cauvery Basin, which has no such arrangements; delayed participation in the Narmada Basin until an award had been made; and financed projects in other basins and sub-basins where awards or agreements were in place. In China, irrigation components of province-based agricultural development loans in the Yellow River Basin have similarly been predicated on allocation directives from the central government.

1/ Operational Directive 7.50, "Projects on International Waterways" (April 30, 1990).

As for international rivers, the Bank could be more proactive and consistent in facilitating agreement on resource use plans and real-time management for interprovincial rivers. In the case of the Narmada, for instance, the Bank conditioned all support on an award that detailed water allocation among the riparians, the configuration of basin projects, the joint ownership of facilities by the riparians, rules for real-time operations, and institutional arrangements for its implementation. In contrast, for the Subernarekha, the Bank financed primary storage and diversion features identified under a tripartite State agreement that failed to clarify real-time rights, operating rules and water quality constraints. As in the case of the Narmada, the Bank could use its lending leverage for specific projects to encourage effective agreement. Alternatively, it could use total lending in the country as a whole, or in the states concerned, to the same end.

Multipurpose and Single Purpose Sector Projects

Activities in individual sectors (irrigation, inland fisheries, water supply and sanitation, hydrogeneration, navigation, etc.) need to be consistent with the overall country water resources strategy, and be conditional on satisfactory progress in meeting general water resource objectives. Within each sector, there may be opportunities for developing approaches comparable to those suggested above at the level of the resource. Emphasis again should be on comprehensive analysis, and institutional strengthening and capacity building. Options might include: Comprehensive support projects to strengthen an agency's institutional capacity; creation of public and private utilities; investment consolidation and rehabilitation programs; and O&M strengthening programs.

Comprehensive agency support projects would focus on an agency's capacity and performance as a whole (institutional, programing, areas of work, etc.) rather than on implementation of individual projects. Such operations could be designed to strengthen the agency's performance within a water resources framework; clearly identify and clarify functional responsibilities, with due provision for functional specialization; and support activities to meet all of an agency's functional responsibilities formulated to balance priority needs in each area and across areas within an assured multiyear budget. The **principles of a utility form** could be introduced--either in a comprehensive agency program or in separate lending operations with this objective--and complemented by appropriate regulatory and related measures and organization.

Investment of consolidation and rehabilitation and O&M strengthening programs would focus on important aspects of a particular sector and would be comparable to a number of recent operations in several countries. Investment priorities would be clearly established, with emphasis on completion of outstanding works. Recent proposals for provincewide irrigation consolidation projects in India would fall into this category. The aim would be to create the necessary pre-conditions for sustainability, reliability of service, reasonable maintenance costs, service charge collection and ultimate turnover of appropriate facilities to beneficiaries. In each case, investment and/or O&M activities would be conditioned on sound facilities and appropriate policies and administrative arrangements. In addition to broad-based sector programs, there will continue to be important opportunities for more traditional multipurpose and single purpose investment projects. As in the case of other sector-specific activities, they could be placed within a multipurpose water resources context with flexibility to accommodate changing resource demands. Investment projects would in all cases need to be framed within national, regional and basin plans, and their priority established within the context of total sector investment programs.

IV. An Asia Water Resources Program

Regional and Country-specific Strategies

Four major steps are recommended for implementing a strategy to address water resource issues in a more comprehensive manner and to prepare lending operations as suggested above. First, an internal regional consensus is required that such a strategy is necessary and feasible. If so, policies should be formulated to guide the CDs in preparing country-specific programs and internal organizational arrangements should be established to facilitate implementation. Second, within the framework of the regional strategy, the CDs should formulate country-specific water resources strategies that integrate ongoing sector programs and provide a coordinated basis for discussions with concerned governments. Third, discussions should be held with governments at appropriate levels and in appropriate forums to agree on a coordinated approach to activities in the water resource sector as a whole and to identify an appropriate lending program and supporting studies and technical assistance, both at the level of the resource and in relation to individual sectors. Fourth, in the light of agreed country strategy, project preparation and other associated activities should be initiated by the country concerned. These steps could include a full water resource assessment following agreed upon guidelines and with as much support as possible from the Bank, the UN and other sources.

Besides helping initiate new proposals, ongoing activities will benefit from being placed within a broader water resources initiative; for instance, in terms of their priority and greater consistency of approach. The regional consensus would be based on the review of this report. Guidelines would be prepared for preparation of the documentation necessary for each of the subsequent stages. With respect to international waters issues, possible approaches and Bank involvement would be discussed informally with the countries concerned. Subject to the response, the concerned region(s) would prepare a strategy and program of activities specific to each basin concerned.

Regional Organizational Arrangements

Regional Policy and Coordination

This report comprises the outcome of Stage I of the AWRS and has proposed a strategy for the Asia region. If there is a consensus in the regions that such a strategy is both feasible and necessary, subsequent efforts would be directed to follow-up activities. Responsibility within the Bank would therefore shift from the Technical Department (TD) to the Country Departments (CDs), though the TD should continue to have an important role in regional coordination and support.

The TD should be strengthened to assist the CDs in: (i) Promoting cross-sectorial programs and projects; and (ii) initiating programs for shared international waters. TD responsibilities would also include: (i) Furthering technical agreement on the scope and content of country and basin water resources assessments; (ii) detailing guidelines for the preparation of such assessments; and (iii) sponsoring implementation of individual studies on water resource issues. In addition, it is recommended that a standing committee on water resources be created in the TD as a forum for reviewing regional water resource policies and guidelines. The committee should become acquainted with water related programs and projects in the region and discuss technical and other issues in the field.

Country Water Resource Committees (CWRCs)

The CDs remain fully responsible for all country-specific programming, but CD divisions are sector-specific and mechanisms are needed to ensure consistency in water resources policies

among divisions operating in the same country. Informal country-based working groups--CWRCs--have been proposed, and in part, established as a flexible vehicle for achieving this objective. The CWRC for Indonesia has shown its utility over almost three years. Those for other CDs have been less active in part because they have not received any Country Assistance Management (CAM) allocation. The essential aim is to create a mechanism for reviewing all water resources initiatives--especially at the stage of conceptualization and project formulation--to ensure consistency and avoid subsequent conflicting demands and problems. Regular membership would be drawn from each of the divisions concerned, but attendance would depend on the particular activity or item under discussion. Subject to any decision on a regional strategy, it is recommended that CWRCs be activated for all CDs and that they should be provided with formal CAM resources.

International rivers that traverse countries in more than one CD obviously call for special considerations. One option would be to establish separate informal working groups related to the river basin concerned. Alternatively, joint meetings could be called of the two CD working groups concerned. In the event that the Bank becomes active in the manner suggested above, regular review of the lending activity itself could be undertaken within the framework of the country working groups acting jointly as required.

Divisional Programming

Activities in water resources, as in all sectors, would be subject to normal Bank and Regional staffing, budgeting, programming and review procedures. In the event that a lending or sector work activity is identified, a task manager would be appointed from one of the divisions concerned, and provisions would be made in divisional work plans and budgets. Any task manager would need to have particular regard for the intersectorial nature of the water resource activity, and it would be essential to draw members of the project team from each of the main concerned divisions.

Staffing Implications

The proposals made in this report have staffing implications in the CDs and the TDs, in the numbers of staff involved in water resources issues and in the skill mix required. Subject to the outcome of the review of these proposals, it is recommended that the staffing position be reviewed and the necessary augmentation of staff be scheduled to handle the proposed strategy.

Country Discussions

Management approval of the proposed regional water resources strategy would be followed by discussions with selected borrowers. These discussions would have two primary objectives: To explain the aims and scope of the water resources strategy and obtain reactions, in principle, to the country's interest in participating in joint water resource activities; and, secondly, to initiate a process of preparing country or basin strategies to define the basis for specific-lending operations or other activities. Discussions could be held at two levels: the level of government to obtain agreement in principle that action is warranted, and the level of sector agencies to help create a consensus in favor of such an initiative and to encourage participation by those responsible for implementing water resource programs. Joint sponsorship of an intersectorial country seminar or workshop would be an integral part of this effort.

The form of any follow-up discussions on **international water issues** need not be pre-judged in this context. However, if consensus was reached in the Bank on the conditionality that might be attached to Bank-lending, then it might be advisable informally to obtain the reactions of all the riparians concerned and so as to ensure that there is no subsequent ambiguity. This process that would clearly need very sensitive handling.

Documentation for Country Strategies

Evolving a detailed country-specific strategy is necessarily an iterative process. Though based primarily in a domestic country consensus, it must also be consistent with the objectives of the regional strategy. To this end, three principal types of document are envisaged: (i) A draft strategies paper to guide the Bank's initial discussions with the borrower, to be finalized once agreement has been reached with the government; (ii) project preparation documents to be prepared by the borrower with appropriate Bank and consultant assistance, to comprise the detailed basis for evolving the scope of specific projects and activities; and (iii) detailed planning and other studies defined during project and activity preparation for agreement during further discussions, for inclusion as project components, as conditions for tranche releases, or as free-standing TA activities. These procedures are no different to those required for any lending operation. However, particular attention would be given to cross-sectorial issues and to ensuring that a coherent approach is followed in respect of all water resource-related issues.

1

INTRODUCTION

I. THE IMPORTANCE AND CHARACTERISTICS OF WATER

Water plays a critical role in Asia's welfare, with pervasive linkages to many aspects of economic development. Perhaps 35 to 40 percent of the cropland is irrigated, producing 60 to 70 percent of the continent's output of food.[1] Hydrogeneration accounts for about 20 percent of electric power production. Industry, thermal power (for cooling), water transport, inland fisheries and aquaculture are among other sectors dependent in varying ways on access to water. Its availability for domestic use and waste conveyance is an overriding factor in maintaining health standards, but only about 62 percent of urban and 38 percent of rural populations are served by safe drinking water supplies, despite the efforts of the U.N. water decade. Floods and droughts annually affect millions of people with often devastating results, while polluted waters and related impacts pose increasing environmental and health problems. Perhaps 20 to 25 percent of public investment goes directly to water related programs, the size of which can determine regional, and even national, development patterns. Though little understood, the macroeconomic impacts of water policies are undoubtedly large.

Other primary, intermediate and service sectors (energy, transport and financial services) play a similarly pervasive role in a nation's economy. Nevertheless, water has characteristics that set it apart.[2] First, it is a limited resource with few substitutes; for many purposes, no substitutes. Second, it is a unitary resource. Interventions in one part of the hydrological cycle invariably impact on water quantity and/or quality elsewhere in the cycle. Third, it is highly variable in space and time: response to variability is a continuous management requirement. Fourth, it is relatively immobile, due both to the costs, investment indivisibilities and "plumbing" constraints associated with its physical transfer, as well as to the complex social and institutional arrangements governing ownership and use. These characteristics, and the externalities to which they give rise, constrain the role of markets in balancing supply and demand, and create complex and difficult regulatory problems. Moreover, the marginal value of water almost invariably greatly exceeds the financial costs incurred by users. Powerful interests are, thus, created with important efficiency and distributional consequences at the national, regional, local and household levels. These consequences are not limited to the present day but are passed to future generations through the preemption of water use and through the lasting impact of environmental effects.

As long as water is abundant, its particular characteristics may be of little consequence. Individual users decide in their own interests whether to incur the costs of extraction, and others are largely indifferent to the outcome. However, even under conditions of general abundance, variability may result in temporary shortage (i.e., in a drought or during the dry season), and there are relatively few examples of unrestricted availability at all times. As demands increase, the limits on water quantity and its unitary nature result in growing conflicts and externalities. Prior rights, vested interests and market failure preclude the ready transfer of water from low return to higher return uses, while regional development, equity and environmental objectives also help determine allocation and use. Conflicts may be resolved in a planned or *ad hoc* manner, and institutions evolve more or less successfully to manage this process. Water management in all countries, therefore, comprises an accumulation of informal and formal practices with water imbedded in

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1/ These and the following estimates are approximate values for the fifteen major Asian countries discussed in Annex 2 and Chapter 2.

2/ Peter Rogers, "Concept Paper for World Bank Water Resources Management Policy Paper," (Washington, D.C.: July 19, 1990).

complex legal and institutional structures. These practices tend to persist even though responses suited to one period may act as constraints on optimum use in subsequent periods. It is, thus, the ability of countries to evolve and adapt their institutions in their widest sense (laws and customs, rules and regulations, regulatory and market mechanisms, and private and public agencies) that greatly determines how effectively they can plan, develop and manage their water resources to meet national and regional objectives.

II. Water Pressures and Development in Asia

Asia, along with other regions of the world, is facing major water resource problems due to escalating populations and economic development. In specific contexts, and in association with improper land use, these factors may lead to potentially irreversible environmental impacts (soil erosion, floodplain encroachment, and pollution of groundwater and its excessive use leading to saline intrusion and land subsidence). In a more general sense, however, such problems are primarily those of economic efficiency and adjustment. In virtually all Asian countries, irrigation is by far the predominant use of water. In both theory and practice, water can be diverted to other uses at the cost of lost agricultural production and incomes. Also, in principle, pollution and similar effects can be tackled through investment, regulations and incentives. Even without the option of seawater desalinization, therefore, shortages are not, in a development sense, absolute. As for any other good or service, demand and supply of differing water quality can be equalized at some implicit price--varying from place to place and time to time--which would ensure that the resource is used in the most efficient and economical manner. As pressures on a fixed resource mount, this price rises, extraction of more costly supplies becomes viable and marginal uses become uneconomic.

Definition of scarcity, in economic terms, does not preclude adoption of policies to satisfy objectives other than those of strict economic efficiency. Governments normally have to be willing to incur significant economic costs to achieve regional, social, security and environmental objectives, which are difficult to value in economic terms. Though techniques can, in theory, be developed for internalizing most externalities, intergenerational issues have yet to be dealt with adequately in conventional economic analysis. Moreover, even if a theoretical equilibrium price could be estimated, the particular characteristics of water and the problems of market failure to which these give rise are such that the theoretical price cannot be translated into an actual price for "clearing the market." Reallocation from agriculture, for instance, can lead to major problems of resettlement and adjustment, not to speak of its potential impact on food security and other national objectives. Such factors may be very difficult to reflect in a pricing system. Regulatory policies and controls will, therefore, always be needed to ensure that allocation and use are in accordance with society's overall goals and objectives.

However, the failure to recognize the true economic cost and value of water in investment and management decisions can lead to massive waste. The scale of water development in Asia is difficult to comprehend, whether in large river basin projects or innumerable small-scale investments in irrigation tubewells or water supplies. Box 1.1 describes representative examples drawn from South Asia, while Annex 2 provides greater detail on these and other programs in Asia. Such programs have the potential for great harm as well as great good, and the failure to anticipate their long-term positive or negative economic impacts can be costly. This is true not only in the sense that direct expenditures may or may not achieve the direct benefits expected, but also in that the opportunity costs and externalities associated with either investing or not investing can dwarf the direct consequences. Once started, these massive programs continue yearly with results that can be beneficial or damaging, and lead to a virtuous circle of sustained development or a vicious circle of stagnation. What would Bihar's growth have been if it had allocated the resources devoted to Gandak and Kosi surface irrigation schemes to private groundwater, urban and rural infrastructure, power generation or some other priority sector? How would Sri Lanka's economy have performed if the Mahaweli Basin investments had been limited to levels consistent with

Box 1.1: WATER PROGRAMS IN SOUTH ASIA: CONTRASTS IN SUCCESS AND FAILURE

Bhakra in Northwest India. The Bhakra dam on the Sutlej was completed in 1966 primarily for irrigation and power. Today, the irrigation systems served in Punjab and Haryana support one of the most successful agricultural regions in Asia. Without surface irrigation, these states would be marginal for agriculture with rainfall of 300 to 700 mm and limited groundwater. Crop surpluses cannot be attributed wholly to Bhakra, but its role in supporting the most prosperous states in India and in meeting a remarkably large part of the India's food is undoubted. Moreover, power generated at Bhakra balances the North Indian grid, and Delhi receives water that would otherwise be much more costly.

Drainage in the Indus Basin. Irrigation in Northwest India and Pakistan allows productive agriculture in what would otherwise be semidesert. But inadequate natural drainage has led to waterlogging and secondary salinity, which now threaten large areas. As long as drainage problems are limited, localized and interim measures are possible. For the longer term, however, the only feasible solution, identified in the 1960s, includes the massive Left Bank Outfall Drain in Pakistan, the first stage of which is now under construction with Bank assistance. This remains the only realistic alternative not only for Pakistan but also for large areas in Northwest India. Any other approach would be overly costly or damaging to third party interests. Doing nothing would threaten the prosperity of important regions. Failure to reach a timely agreement among the countries and states concerned would prove expensive.

The Rajasthan Canal, Gandak and Kosi Schemes in North India. These large projects face severe problems. Constructed at great cost over decades, they remain incomplete with their agricultural impacts, at best, ambiguous. The Rajasthan Canal passes through sandy deserts, requires settlement in an inhospitable region, and is intended to serve land that is largely unsuitable for agriculture and is environmentally vulnerable. Should it have been built, at least to its full length? Could systems in Punjab, Haryana or the Jamuna Basin have made more profitable use of this water? The problems of Gandak and Kosi are different. Two enormous, silt laden rivers are diverted onto land already vulnerable to flooding, with drainage in many areas impossible when the Ganges is at high stage. There have been remarkably modest changes in yields and cropping intensities, effective irrigation management is virtually impossible, farmers petition to be excluded from the schemes, and the abundant groundwater is only now being developed on a large scale. Bihar and Rajasthan remain among the poorest states in India, yet expenditures on irrigation relative to their population and economy are in the same orders of magnitude as those in Punjab and Haryana.

Groundwater in Bangladesh. Few large surface irrigation schemes have been constructed in Bangladesh, due more perhaps to donor opposition and financial constraints than government policy. Dry season irrigation has, therefore, largely been from groundwater and low lift pumps. Increasingly, over the years, the Bank has advocated and the Government of Bangladesh has accepted policies to encourage small scale irrigation, privatize facilities and equipment markets, and reduce ineffective regulation. Crop output has risen at rates well above those of East India, indeed of all India. Despite massive calamities from floods and cyclones, and its huge population, Bangladesh now approaches self-sufficiency in rice production with major potential for further growth along similar lines. No doubt the rice production has severe problems, and comparisons are invidious, but the contrast with poor growth and wasted investment in neighboring East India is striking.

Narmada in West-Central India. The Narmada program has been controversial. Environmental concerns have delayed work on the second main dam (Narmada Sagar) despite the pollution-free power foregone. Sardar Sarovar dam and its delivery facilities are questioned by nongovernmental organizations despite ongoing works. Meanwhile, estimates of benefits continue to justify costs even without accounting for regional multiplier effects. Revised estimates suggest that 25 percent rather than 10 percent of the water supply will go to urban and industry, a share that will undoubtedly increase further. In the drought of the late 1980s dry season, irrigation ceased in large areas and large costs were incurred in meeting water, food and fodder requirements. Moreover, irreversible seawater intrusion damaged aquifers in Saurashtra. Without Narmada water, major allocation from irrigation to urban and industry will be inevitable. Existing facilities will be abandoned, resulting in rural/urban migration and lower agricultural production. Direct environmental concerns and resettlement issues must be resolved. But the economic, social and environmental consequences that will arise if Narmada water is not developed to support Gujarat's population and regional economy must also be taken into account.

Mahaweli: Sri Lanka. The Mahaweli program is an illuminating contrast to Narmada. In proportion to size, its environmental and resettlement effects are probably comparable. Rather than bringing water to a settled area with a developed infrastructure and a drought-affected population, the program involved large expenditures to create a low return in subsistence paddy farming in generally unsuitable and largely uninhabited areas. At its peak, the program accounted for an astonishing 40 percent of public expenditures that put enormous pressures on the macroeconomic balances. Meanwhile donors stampeded to support the program--contrast their timidity over Narmada--foreign aid flows supported an overvalued exchange rate, and investment expenditures put pressure on wages and other costs. No doubt power benefits have been substantial and new settlers have improved their lot. And, no doubt some level of development in the Mahaweli and neighboring basins was justified. But these factors must be weighed against the way the program was implemented, and the apparent damage it did to the country's prospects for export-led growth and industrialization, its only real hope for sustained income growth.

macroeconomic stability so that the benefits of liberalization and foreign aid could have flowed to sectors with production potential rather than to subsistence agriculture? On the other hand, how will Gujarat deal with the population that will be driven off the land if Narmada water is not developed and when the state's groundwater is totally exploited? The environmental costs of large projects have rightly received attention. But the environmental costs of not undertaking such projects can also be substantial. The question is not whether a project is big or small, but whether, on balance, it is good or bad. Box 1.1 suggests that both situations are found in the Asia region.

Given the size of Asia's river systems, the populations concerned, and the costs and dislocations that would result from large-scale reallocation from agriculture, further massive water resource development programs appear inevitable. For example: The only way that dry season flows in the Ganges can be augmented to serve huge populations and contain further sea water intrusion in the delta is through large dams to capture surplus monsoon runoff; the only way that the long-run needs of a population of more than 300 million living on the North China Plain can be satisfied without catastrophic overuse of Yellow River or groundwater supplies is through transfers from the Yangtze; and the only way that Bangkok can be supplied and further land subsidence avoided while accommodating agriculture in the Chao Phraya Basin will probably be through water imports, possibly from the Mekong. The underlying dynamics of population growth and economic development are inevitable, and, therefore, major water development programs are inevitable. Since poor countries faced with the diverse needs of rapidly growing populations cannot generate the necessary investment resources, support from the international donor community, including the World Bank, will continue to be essential.

III. THE BANK'S ROLE IN ASIAN WATER

The Bank's involvement in Asian water development has been extensive and diverse. An important early example was its role in facilitating the 1960 Indus Waters Treaty between India and Pakistan. Since then, in addition to supporting both multipurpose and single purpose projects in essentially all sectors (agriculture, fisheries, energy, water supply, sanitation, navigation, etc.), it has cooperated with national and international agencies in a wide range of policy and planning activities, including national water resource planning studies, river basin planning studies, environmental strategy reviews and assessments, regional and urban planning activities, sector and subsector reviews, and policy-based programs and projects. Most of the Bank's activities have focused on country-specific and sector-specific problems, though guidelines exist covering the Bank's involvement in international waterways.

During the 1960s and 1970s, the Bank was active in developing comprehensive planning approaches, and it has sponsored many planning studies. Nevertheless, it is only now that the Bank is evolving an explicit policy for addressing intersectorial water resource issues in a comprehensive manner."[1] As in the civil administrations of our borrowers, Bank operations are organized primarily by economic sector and intersectorial issues sometimes go by default. Environmental divisions and specialist advisers and units have begun to address these issues. In the Asia region, some informal Country Water Resource Committees are being established to strengthen coordination, to provide a focus for crosssectorial activities, and to link operations to a standing committee informed about the Bank's dialogue with the country concerned. In the case of Indonesia, this has already provided the context for a coordinated review of institutional issues in the water sector. Together with these initiatives, a renewed interest in rethinking strategies in water development and management has arisen to strengthen guidance given to Bank staff and its borrowers. The Asia Water Resources Study (AWRS) is one component of a Bank-wide effort to address these issues.

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[1] The World Bank, Agriculture and Rural Development Department, Agricultural Policies Division, "Comprehensive Water Resource Management Policy Review," Draft Memo. (Washington, D.C.: February 20, 1991)

IV. THE ASIA WATER RESOURCES STUDY

AWRS aims to complement similar activities elsewhere in the Bank in an effort to evolve explicit strategies for addressing intersectorial issues in water in a comprehensive manner. These other activities include the preparation of a Bank policy paper, initiatives by Regions and sector and research activities by the Agriculture and Natural Resources Department and several Country Departments.

OBJECTIVES

The AWRS has three primary objectives: (i) To mobilize the Asia Regions' inputs into, and enhance their ability to interact with and benefit from other Bank initiatives in water resources; (ii) to strengthen the Regions' capacities to provide advice to our borrowers in support of coherent water resources development; and (iii) to promote programs and projects in borrowing countries that advance the integrated and efficient planning and management of water resources.

SCOPE OF WORK

The study, aims to: (i) Establish an agreed framework for considering water resource problems and their associated issues; (ii) evaluate, within the context of this framework, how major water resource issues are being addressed in the countries of the Asia region; (iii) and identify preliminary strategies to guide the Bank's water resource activities in the region. Its audience is, thus, Bank management and staff. The follow-up to the report will comprise studies on high priority regional and country-specific issues, and devise actions for the borrowers and the Bank to best address these issues. Direct interchanges with individual borrowers will follow.

REPORT FRAMEWORK

The report groups its discussion of water problems and associated issues under four headings: (i) Institutions, (ii) resource planning and long-term management, (iii) water operations and real-time management, and (iv) economic and financial policies. This framework allows proposals in one area to be formulated in the context of other problems and issues affected by decisions in the same area. For example, the problem of operation and maintenance entails consideration of issues in each of the framework areas, but then so do all other problems. Recommendations in one area must, therefore, provide a compromise that facilitates solutions to all problems in the same area.

The report has five main interdependent components:

1. The *Main Report* focuses on strategies recommended for the Asia region. Following this introduction and a brief review of resource constraints, Asian experience is assessed under the four framework areas. This is done with respect both to "effective" practice as described in Annex 1, and in the light of the country-specific assessments given in Annex 2. This is followed by a summary evaluation of the Bank's past role in Asian water, drawing in particular on Annex 3. In light of earlier sections, recommendations for future priorities and strategies are presented together with suggestions as to how these might be implemented in the context of the Bank's work. Implications for the Bank are reviewed and proposals made for further work.

2. *Annex 1* provides a detailed statement of "effective" practice, reflecting principles that have proved successful worldwide. It is not specifically addressed to the Asia region although some reference is made to representative regional issues. The aim is to establish a standard by which to judge performance in Asia and to guide future initiatives.

3. *Annex 2* reviews water resource problems and issues in 15 major Asian countries. For each country a summary description and assessment of water resources is provided, with present and potential development evaluated in the context of each of the framework issues. Where countries are federations and/or important rivers cross international borders, the status of and need for additional water sharing agreements is discussed. Following this introduction, the major water resource development problems and their associated issues in each country are briefly reviewed.

4. *Annex 3* assesses the Bank's past role in supporting water resources development in the Asia region. In addition to providing statistical information on the Bank's involvement, the annex evaluates the performance of Bank lending, sector work and technical assistance with a view to draw general conclusions on implementation performance, development impact and general effectiveness.

5. In addition to the main report and its annexes, eight background Topic Papers have been prepared, six of which have been issued in the Bank's Technical Papers series. The subjects covered are: Planning for droughts; water-use efficiency; water allocation and rights in the Western United States; water rights in Japan; environmental issues in the countries of the European Economic Community; water resource institutions; water pricing in the western United States; and a review of selected experience in developed countries, worldwide. These papers' full titles are listed in the table of contents and lessons learnt from them are incorporated at appropriate stages in the report.

Mention can also be made of earlier papers prepared by Asia Technical Department, Agriculture Division (ASTAG) in the course of its work in water resources, which have also been used in compiling the report, notably the *Selected Guidelines for Engineering Staff in the Review and Supervision of Irrigation, Drainage, Flood Control and Broader Water Resources Programs*, dated February 1990.

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EMERGING WATER AND LAND CONSTRAINTS IN ASIA

I. INTRODUCTION

GENERAL

Rainfall in Asia is typically variable and uncertain, and seasonal water shortages and flood events occur in most countries. Their impact varies greatly, depending on the resource base, population pressure and stage of development. In desert areas, for instance in Northwest India and Northwest China and Pakistan, water shortages are persistent. In more developed areas with low-to-moderate rainfall and large populations, as in South India and North China, shortages may arise on an annual basis with very little usable water lost to the sea. In higher rainfall areas, as in East India and in much of Southeast Asia, surpluses occur in the wet season and shortages at other times. Even if water resources are generally adequate, a weak monsoon can be damaging to agriculture and reservoir storage. Conversely, in areas subject to heavy rainfall or cyclonic storms, devastating floods can create massive disruption. The sizes of the floods on the Ganges-Brahmaputra, Yangtse, Yellow, Mekong and other rivers makes flood protection a formidable task. Besides too much or too little water, quality and environmental issues are becoming increasingly serious. Population and industrial concentrations in rapidly growing cities pose enormous problems for water supply and effluent disposal. Continuous irrigation in arid areas leads to loss of land due to waterlogging and secondary salinization if adequate drainage is not provided. Agricultural settlements encroach on increasingly marginal lands, adversely affecting erosion and runoff patterns. Providing water and other services to large, poverty stricken rural populations is a major task.

In common with the rest of the world, Asia's supply of natural fresh water is limited and is not distributed spatially or in an equitable manner. Rainfall varies widely, from negligible amounts in the deserts of Northwest China, Northwest India and parts of Pakistan to more than 4,000 mm/yr in Western Ghats, Northeast India, and the Arakan and Tenasserim coasts of Myanmar. About half of China receives less than 400 mm/yr and extensive areas of Northwest, central and South India are classified as drought-prone. Moreover, most of the region receives rainfall predominantly during a single monsoon lasting from four to six months, with the remainder of the year relatively to very dry. A few areas--notably, parts of South India, Sri Lanka, central Indonesia, Malaysia and parts of the Philippines--receive two monsoons with only a short dry period within the year. In contrast, the monsoon does not penetrate into West and Northwest China. The marked seasonality of the rainfall means that much of the runoff it generates is destined to flow into the ocean as waste if reservoir storages are not provided. (The groundwater resources are much less dynamic as they are regulated in their natural reservoirs.) Moreover, irrigation is essential for dry season cropping and necessary to obtain high yields even in the wet season over much of the area. In the arid to semi-arid zones, irrigation is essential for agriculture in any season when other climatic factors permit crop growth.

POPULATION PRESSURE ON LAND AND WATER RESOURCES

Dependence on irrigation for agricultural production is a common feature throughout the region, with irrigation by far the greatest user and consumer of water among sectors. Large populations and high population densities put pressure on the availability of land suitable for cultivation of crops and, along with water availability, land is a severe constraint in many countries.[1/] Land holdings are often very small in relation to their productive capacity, and a large

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1/ This situation will be exacerbated as populations increase in the future and massive growth in urban populations is foreseen. See Chapter 7.

proportion of farm families in some countries live at or below subsistence level. In this situation, the drive to acquire additional land for cultivation is overriding and leads to expansion of agriculture into marginal and fragile lands and to the invasion of forest areas using wasteful and unsustainable agricultural practices. Data tabulated in Table 2.1 compares population, renewable water resources, and land-use statistics for the 15 countries in the region covered by Annex 2.

Table 2.1: **POPULATION, LAND USE AND RENEWABLE WATER RESOURCES INDICATORS**

Country	Land area					Water resource	Total population	Pop. density	Cropland/ capita	Water/ capita
	Total	Cropland	Pasture	Forest	Other	(BCM/yr)	(Millions)	(No/km^2)	(ha/cap)	(m^3/c/yr)
	('000 km^2)									
Bangladesh	133.9	91.5	6.0	21.3	15.1	1,357	115.6	840.4	0.079	11,740
China	9,326.4	976.7	2,856.9	1,345.3	4,147.5	2,800	1,135.5	120.1	0.086	2,470
India	2,973.2	1,690.0	118.0	673.3	491.9	1,850	853.4	281.1	0.198	2,170
Indonesia	1,811.6	211.1	119.0	1,217.0	264.5	2,530	180.5	98.1	0.117	14,020
Kampuchea	176.5	30.6	5.8	133.7	6.4	88	8.2	45.6	0.373	10,680
Korea	98.7	21.4	1.3	65.4	10.5	63	43.6	436.6	0.049	1,450
Laos	230.8	9.0	8.0	130.7	83.2	270	4.1	17.2	0.220	66,320
Malaysia	328.6	43.8	0.3	206.8	77.8	456	17.3	51.6	0.253	26,300
Myanmar	657.5	100.7	3.6	321.7	231.6	1,082	41.7	62.1	0.241	25,960
Nepal	136.8	23.3	18.5	30.2	64.8	170	19.1	136.6	0.122	8,880
Pakistan	770.9	206.9	50.0	31.5	482.5	298	122.7	189.2	0.169	2,430
Philippines	298.2	79.2	11.8	111.5	95.7	323	62.4	204.3	0.122	5,180
Sri Lanka	64.7	18.8	4.4	17.5	24.1	43	17.2	262.5	0.109	2,510
Thailand	510.9	199.2	7.4	146.6	157.7	110	55.7	107.5	0.358	1,970
Vietnam	325.4	64.9	3.1	130.0	127.3	376	67.2	201.9	0.097	5,600
Total/ Average	17,515.5	3,767.1	3,213.3	4,582.4	6,280.6	11,816	2,744.2	156.7	0.137	4,310

Note: Renewable water resources are the average annual flow of rivers and aquifers generated from endogenous precipitation. In some cases, these may include data for annual river flows to and from other countries. On the other hand, those for Thailand, Kampuchea, Laos and Vietnam appear to discount Mekong River flows.

Source: World Resources Institute (WRI), World Resources 1988-89 and 1990-91, (Washington, D.C.: WRI).

The 15 countries had a combined population of about 1.5 billion in 1960 and 2.7 billion in 1990 (an increase of about 80 percent). Their population is projected to increase to about 4.2 billion by 2025. This would be about 50 percent of the world's total, with India expected to have the largest population of any country (Table 2.2). It should be noted, however, that the projection for China assumes very slow rates of growth despite indications that population control may be relaxing. Moreover, general health improvement in China is causing people to live significantly longer on average. The increase in population will be accommodated only by massive shifts of the people into urban centers, a trend already evident from Table 2.2. It is notable that there has been a surprisingly slow rate of urbanization in China, perhaps indicating the success of rural industrialization policies.

populations is foreseen. See Chapter 7.

Table 2.2: POPULATION AND GNP PER CAPITA INDICATORS

Country	Population			Urban population		GNP/capita
	1960	1990	2025	1960	1990	1987
	(Millions)			(Percentage of Total)		US$
Bangladesh	51.4	115.6	235.0	5.1	13.6	164
China	675.5	1,135.5	1,492.6	19.0	21.4	294
India	442.3	853.4	1,445.6	18.0	28.0	311
Indonesia	96.2	180.5	263.3	14.6	28.8	444
Kampuchea	5.4	8.2	14.0	10.3	11.6	n.a.
Korea	25.0	43.6	54.6	27.7	71.1	2,689
Laos	2.2	4.1	7.7	7.9	18.6	166
Malaysia	8.1	17.3	27.9	25.2	42.3	1,820
Myanmar	21.7	41.7	72.6	19.3	24.6	212
Nepal	9.4	19.1	35.0	3.1	9.6	161
Pakistan	50.8	122.7	267.1	22.1	32.0	353
Philippines	27.6	62.4	111.4	30.3	42.4	589
Sri Lanka	9.9	17.2	24.4	17.9	21.4	406
Thailand	26.4	55.7	80.9	12.5	22.6	850
Vietnam	34.7	67.2	118.0	14.7	21.9	200
Totals	1,486.6	2,744.2	4,250.1	17.9	25.1	368 1/

1/ Weighted by 1990 population excluding Kampuchea.
n.a. Not available
Source: World Resources Institute (WRI), World Resources 1990-91, (Washington, D.C.: WRI).

Average population density ranges from 17 persons/km^2 in Laos to 840 persons/km^2 in Bangladesh (Table 2.1). Mean population density for the 15 countries is 157 persons/km^2 with seven countries (Bangladesh, India, Korea, Pakistan, the Philippines, Sri Lanka and Vietnam) having densities higher than the average. However, this relationship of population to total land area can be misleading. When cropland area is expressed as a ratio with population, a somewhat different situation emerges. Average cropland per capita for the 15 countries is 0.137 ha with a range of 0.049 ha/c (Korea) to 0.373 ha/c (Kampuchea). Six countries have lower than average cropland area per head of population, but in this case, they are China, Indonesia. Korea, the Philippines, Sri Lanka and Vietnam.

Because most of the countries, except Korea and perhaps Malaysia, have predominantly agricultural economies, there will be increasing pressures to expand the cropland base. However, few have additional productive land that could be brought under sustainable agriculture. A possible alternative is to expand or intensify the area under irrigation. But this would demand mobilizing additional water, and, in many cases, the readily utilizable water resource is also approaching practical limits. In the cases of India, Pakistan and China, development of additional surface water for irrigation is largely dependent on creation of reservoirs, which can involve difficult resettlement problems compounded in India by the necessity for interstate or international agreements. Both land and water availability are severe constraints to expanding agricultural production in China. Water and its overdevelopment are the main concerns on the North China Plain, but land is possibly the ultimate constraint given the physical potential for south-north water transfers, principally from the Yangtze. Development of the water resources of the Mekong is dependent on obtaining agreement among the principal riparians, which history suggests will not be easy.

Average GNP/capita in 1987 for the countries for which data is available -- Kampuchea is omitted -- indicates a range of US$ 161/c in Nepal to US$ 2,689/c in Korea. Five countries had per capita GNP less than US$215 -- the number would certainly increase to six if Kampuchea data were available -- and ten had less than US$445. Only Malaysia (US$1,820/c) along with Korea can be regarded as fairly affluent. The figures for most of the countries indicate that considerable proportions of their populations must be existing below the poverty level.

RENEWABLE WATER RESOURCES AND THEIR USE

Table 2.3 compares renewable water resources [1/] with annual withdrawal, indicates the proportion of withdrawal use by sectors, and shows the per capita use of water for all purposes. It should be noted that main stem flows on the Mekong are excluded from the estimates of renewable resources for Thailand, Laos, Kampuchea and Vietnam. Also, no allowance is made for instream uses of water for such purposes as power generation, salinity control, fisheries and navigation. With these provisos and with the exception of Pakistan, which has withdrawals of about 51 percent of renewable resources, the ratios of withdrawal to renewable water resources are generally relatively small. They range from 0.4 percent in Laos to 29 percent in Thailand when Mekong main stem water is discounted. A primary reason for the low ratio is the shape of the runoff hydrograph in all countries, with the bulk of the annual flow that occurs within a relatively short season making these flows unavailable for productive use. This problem can be corrected only by the creation of reservoir storages. But the potential for their creation may not be physically available or their creation may be constrained by their cost and/or resettlement and environmental problems. For example, both India and China need to develop additional water but their present use and renewable resource ratios remain relatively small at 20.5 percent and 16.4 percent, respectively, in large part for these reasons. Korea, on the other hand, chooses to use much of its water on-line for power generation and for storing at its coastal barrages. Other reasons for small water use/renewable resource ratios include very high levels of water availability, as in Malaysia and Myanmar, and very low levels of overall development as in Laos, Kampuchea, Myanmar and Nepal. The exception of Pakistan relates to the situation that much of the country is arid to semi-arid, and irrigation is essential for crop production in most of the area. The main river system, the Indus, has most of its lower reach in a desertic area where diversions are continuous throughout the year. Most of its runoff is generated, and most of the storage has been created in the upper part of the catchment.

Table 2.3: **RENEWABLE WATER RESOURCES, WATER WITHDRAWALS AND WATER-USE INDICATORS** [1/]

Country	Renewable water resource (BCM/yr)	Annual withdrawal (BCM)	Withdrawal renewable (Percentage)	Proportion of withdrawal by use (Percentage) Domestic	Industry	Agriculture	Withdrawal per capita (m^3/c/yr)
Bangladesh	1,387	22.5	1.7	3	1	96	211
China	2,800	460.0	16.4	6	7	87	462
India	1,850	380.0	20.5	3	4	93	612
Indonesia	2,530	84.0	3.3	3	3	94	465
Kampuchea	88	0.5	0.6	5	1	94	69
Korea	63	10.7	17.0	11	14	75	298
Laos	270	1.0	0.4	8	10	82	228
Malaysia	456	9.4	2.1	23	30	47	765
Myanmar	1,082	4.0	0.4	7	3	90	103
Nepal	170	2.7	1.6	4	1	95	155
Pakistan	298	153.4	51.4	1	1	98	1250
Philippines	323	29.5	9.1	18	21	61	693
Sri Lanka	43	6.3	14.7	2	2	96	503
Thailand	110	31.9	29.0	4	6	90	599
Vietnam	376	5.1	1.4	13	9	78	81

Notes: The data are for differing years and are therefore not strictly comparable.
Source: World Resources Institute (WRI), World Resources 1990-91 (Washington, D.C.: WRI).
Estimates from Thailand, Laos, Kampuchea and Vietnam appear to discount Mekong River flows.

1/ Renewable water resources are the average annual flow of rivers and aquifers generated endogenous precipitation. In some cases, these may include data for annual river flows to and from other countries. On the other hand, those for Thailand, Kampuchea, Laos, and Vietnam appear to discount Mekong River flows.

The figures on sector usage show that agriculture is always the major user--in eight of the 15 countries, agriculture accounts for 90 percent or more of total use. Only in Malaysia does agricultural use as a proportion of the total fall below 60 percent, which reflects a combination of a climate that allows rainfed cultivation, a fairly high level of industrialization and an affluent population with relatively high domestic water use. Agriculture's high share in industrialized Korea reflects the government's policy of supporting domestic rice production. Withdrawal per capita ranges from 69 m^3/yr in Kampuchea to 1,250 m^3/yr in Pakistan. Of the 15 countries, seven (China, India, Malaysia, Pakistan, the Philippines, Sri Lanka and Thailand) have per capita withdrawals that are greater than 460 m^3/yr, while Indonesia, Kampuchea, Myanmar and Vietnam have per capita withdrawals of 103 m^3/yr or less.

II. ECONOMIC SECTORS

IRRIGATION AND FOOD PRODUCTION

Table 2.4 compares cropland and irrigated area, and indicates the shift in per capita food production since 1979/81 in the 15 countries covered. Total irrigated area is about 138 M ha equivalent to about 37 percent of total cropland. These countries account for about 54.5 percent of the estimated world irrigated total of 253 M ha (Field 1990). India (56 M ha) and China (41 M ha) together account for 74 percent of the total within the 15 countries and 41 percent of the world total. Proportions of irrigated area to cropland range from 3 percent in Kampuchea to 77 percent in Pakistan. Six countries (Kampuchea, Laos, Malaysia, Myanmar, the Philippines and Thailand) have less than 20 percent of their cropland irrigated. This results from a variety of reasons including the following: A high endowment of rainfall, which is generally true for all six countries, though it is not necessarily well distributed; a low level of overall development (Kampuchea, Laos and Myanmar[1/]); and relatively low proportions of total cropland that is suitable for irrigation (the Philippines and Malaysia). Six of the countries (China, India, Indonesia, Korea, Pakistan and Sri Lanka) have in excess of 30 percent of their total cropland under irrigation, which reflects the need for irrigation to ensure food production to feed their ever growing populations and the prevailing rainfall conditions in much of their cropland areas.

Table 2.4: **IRRIGATION AND FOOD PRODUCTION INDICATORS: 1986-1988**

Country	Cropland area ('000 ha)	Irrigated area ('000 ha)	Irrigated cropland (Percentage)	Food production index per capita (1979/81 = 100)
Bangladesh	9,154	2,400	26.2	92
China	97,674	46,600	47.7	130
India	169,000	56,000	33.1	100
Indonesia	21,107	7,300	34.6	116
Kampuchea	3,056	90	2.9	136
Korea	2,143	1,200	56.0	96
Laos	900	120	13.3	118
Malaysia	4,375	350	8.0	104
Myanmar	10,067	1,100	10.9	122
Nepal	2,326	650	27.9	98
Pakistan	20,690	15,930	77.0	108
Philippines	7,920	1,500	18.9	91
Sri Lanka	1,883	600	31.9	75
Thailand	19,920	3,200	16.1	100
Vietnam	6,494	1,800	27.7	114
Totals	376,709	138,121	36.7	na

n.a. Not available.
Sources: World Resources Institute (WRI), World Resources 1990-91 (Washington, D.C.: WRI). W. P. Field 1990.

1/ Myanmar's main development has been for flood control on the Irrawaddy Delta.

The figures presented in Table 2.4 indicate the importance of irrigation to ensure food-grain and other crop production in most countries reviewed. Most irrigation systems have been developed since the mid-19th Century, and a large majority over the last 40 years. In China, the total area under irrigation has grown from about 20 M ha in 1949 to 46.6 M ha at present. Progress in India has been as impressive with the irrigated area that expanded from around 21 M ha in 1950 to 56 M ha in 1989. Moreover, it is noteworthy that almost 50 percent of the irrigation created in India is based on groundwater and that the vast majority of groundwater facilities are privately owned and managed. Other countries that have rapidly developed their irrigated area since the middle of this century include Indonesia (mainly on Java), Bangladesh, Vietnam, Sri Lanka, Thailand and the Philippines.

The indices of food production per capita shown by Table 2.4 indicate that several of the countries under review have failed to keep growth in food production in line with population over the past decade. In the case of Korea, where the index has slipped to 96 from a base of 100 between 1979 and 1981, the lower level of food production is not important as this relatively rich, industrialized country can now readily import food. Malaysia, with a present index of 104, also relies increasingly on food imports to supply its relatively affluent population, particularly as rice production becomes less attractive to its farmers. However, the remaining countries that have shown a reduction of the per capita food production index since 1979 to 1981 (Bangladesh, Nepal, the Philippines and Sri Lanka) have much less satisfactory economic situations. Bangladesh and Nepal rank among the world's poorest countries, and the Philippines and Sri Lanka face continuing economic problems. The estimate for Bangladesh, however, appears to be out of date since in the last few years record harvests have enabled the country to approach rice self-sufficiency. It should be noted that the figures indicate that India has only been able to keep the index at par despite relatively significant increases of irrigated area and total food production; but this may be somewhat misleading as the 1986 to 1988 period was one of drought.

FLOOD CONTROL AND DRAINAGE

Information on areas afforded protection by flood control and/or drainage (FCD) facilities is generally less comprehensive than for irrigated area's, with the exception of China. Table 2.5 compares cropland with areas protected by FCD facilities for 13 of the countries reviewed (information is not available for Laos and Kampuchea, but such development is believed to be small in these countries). The total area protected in the 13 countries is only about 45 M ha or about 12 percent of the total cropland. The low proportion does not necessarily relate to the need for protection, but rather to the low priority afforded to protection, particularly in the form of drainage, and to the physical difficulties of providing flood protection in some areas. Flood damage is a product of the intensity of development on the flood prone lands and can be expected to increase as population and urban and industrial activities intensify.

Table 2.5: FLOOD CONTROL AND DRAINAGE AREA

Country	Cropland area	Protected area	Protected area/cropland
	('000 ha)		(Percentage)
Bangladesh	9,154	1,700	18.6
China	97,674	17,330	17.7
India	169,000	13,000	7.6
Indonesia	21,107	450	2.1
Korea	2,143	110	5.1
Malaysia	4,375	460	10.5
Myanmar	10,067	930	9.2
Nepal	2,326	105	4.5
Pakistan	20,690	9,000	43.5
Philippines	7,920	710	9.0
Sri Lanka	1,883	60	3.2
Thailand	19,920	750	3.8
Vietnam	6,494	225	3.5
Total	372,753	44,830	12.0

Sources: World Resources Institute (WRI), World Resources 1990-91, (Washington, D.C.: WRI). Protected areas from W. P. Field, 1990, excepting Thailand, which is taken from the World Bank Thailand Irrigation Sector Review 1988.

Bangladesh is undoubtedly the most flood prone country in the world in terms of proportion of area at risk to total area, which is reflected in the high proportion of theoretically protected cropland (18.6 percent). Flooding can occur when its major rivers (Brahmaputra, Ganges and Meghna) overtop and spill; when smaller rivers escape their banks; and when local areas of constrained drainage--often caused by protection works and other man-made structures--flood after heavy rain. Flooding also occurs due to tidal surges caused by cyclones in the Bay of Bengal. But the problems of providing full protection against tidal surges and taming the major rivers are immense, and solutions to these problems are likely to remain elusive. China also, of necessity, has had to make large and continuing expenditures on flood protection in the form of embankments, notably on the Lower Yellow River and the middle and lower reaches of the Yangtze River. Large investments have been made in flood detention basins and in an intricate system of wasteway and drainage channels, which double in function as irrigation canals. Pakistan has large areas protected from flooding by primary embankments on the Indus River system, and has invested heavily in groundwater drainage to protect land against water logging and secondary soil salinization.

Other countries face major flood problems although not perhaps on the total scale of Bangladesh and China. India's relatively large area protected from floods and provided with drainage is somewhat misleading. The drains, in general, are poorly maintained and heavily encroached; flood control embankments are also often poorly maintained, usually designed to give only limited protection and rarely provided with drainage to evacuate internal rainfall surpluses. Major flood prone areas lie in the Ganges Basin and in coastal areas, which are also susceptible to cyclonic surges. Myanmar's most important agriculture-oriented development has been the flood protection embankments on the Irrawaddy Delta, which were begun during the 19th Century. Thailand began large scale development with drainage in the lower Chao Phraya Basin, and these drainage canals now double as irrigation sources. Malaysia has placed a high priority on drainage and flood protection--a federal agency is called the Drainage and Irrigation Department--because its only large areas of level land are on the coastal plains, which can be reclaimed for agriculture only by construction of coastal embankments and drainage channels. Vietnam's major areas of croplands are on the Mekong and Red River Deltas, both of which have required major flood protection and drainage works to achieve present levels of development with many additional works still required.

DOMESTIC WATER AND SANITATION SERVICES

Indicators of the availability of safe drinking water supplies and of sanitation services in urban and rural communities are shown for 14 of the 15 countries reviewed in Table 2.6 (data for Kampuchea are not available). It should be noted that definitions of "safe" drinking water differ between the countries. Many of the rural supplies are taken from groundwater and are regarded as safe, though they receive no treatment. For reticulated urban supplies, the definition of safe water is often at the treatment plant and not at the tap. Sanitation services have a variety of meanings and types, and more often than not, do not include sewage treatment. Indeed, pollution of both aquifers and streams are increasingly serious threats to both rural and urban populations. Whereas irrigation use will be limited by economic development potential, the demand for urban water and waste facilities will expand at an accumulating rate for the foreseeable future.

Table 2.6: SAFE DRINKING WATER AND SANITATION: 1985

	Population	Percentage of population with safe drinking water		Percentage of population with sanitation services	
	(Millions)	Urban	Rural	Urban	Rural
Bangladesh	115.6	25	66	20	6
China	1,135.5	50	14	x	x
India	853.4	79	60	40	4
Indonesia	180.5	41	37	32	38
Korea	43.6	90	48	100	100
Laos	4.1	>28	>20	13	4
Malaysia	17.3	100	66	100	67
Myanmar	41.7	37	27	35	26
Nepal	19.1	77	24	54	1
Pakistan	122.7	85	28	56	5
Philippines	62.4	81	68	76	66
Sri Lanka	17.2	82	35	69	41
Thailand	55.7	57	78	81	57
Vietnam	67.2	70	39	x	x

Note: Countries have different definitions of "safe" water. For instance, it seems highly unlikely that safe drinking water in rural Bangladesh is as high as 66 percent. These figures, therefore, should be viewed with reserve.

Source: World Resources Institute (WRI), World Resources 1990-91, (Washington, D.C.: WRI) except China & India, for which country records are used.

HYDROPOWER GENERATION

Table 2.7 provides information on hydropower potential and installed capacity, total energy generation versus hydel generation, and per capita energy generation from all sources and from hydel plants. China contains 55 percent of the total hydropower potential of the 15 countries reviewed and has 47 percent of the total installed capacity of those countries. Nevertheless, China has developed only about 6.4 percent of its potential hydropower. By contrast, India, with 17,000 MW of installed capacity in hydel plants (compared to 28,000 MW in China), has developed around 41 percent of its potential capacity. The figures indicate that Korea, with installed capacity in hydel plants of 2,236 MW, has fully developed its hydropower potential. Other countries with high levels of development of their hydropower potential are Thailand[1/] (2,256 MW installed or 65 percent of potential), Sri Lanka (801 MW installed or 64 percent of potential) and the Philippines (2,153 MW installed or 33 percent of potential). The remaining countries, apart from Bangladesh, which has very limited hydropower potential, have developed less than 12 percent of the potential hydropower.

1/ The potentials for Thailand, Laos, and Kampuchea appear to discount potential for shared projects on the Mekong main stem, while those for Myanmar and Thailand may discount joint projects on the Salween.

Table 2.7: HYDROPOWER CAPACITY AND ELECTRICAL ENERGY GENERATION INDICATORS

Country	Hydropower Capacity		Electric Energy Generation			Generation per capita	
	Potential	Installed	Total	Hydel	Hydel v. Total	Total	Hydel
	(MW)		(gwh/yr)		(Percentage)	(kwh/c/yr)	
Bangladesh	800	197	5,895	530	9.0	51	5
China	436,200	28,000	497,267	100,007	20.1	438	88
India	41,000	17,000	217,500	57,918	26.6	255	65
Indonesia	141,800	1,600	34,810	7,290	20.9	193	40
Kampuchea	10,000	10	na	na	na	na	na
Korea	2,000	2,236	80,250	5,344	6.7	1,841	125
Laos	28,000	200	1,100	1,050	95.5	269	256
Malaysia	11,850	1,090	17,387	4,910	28.2	1,006	285
Myanmar	32,000	258	2,279	1,121	49.2	55	27
Nepal	28,800	161	538	512	95.2	28	27
Pakistan	25,000	2,900	33,475	15,250	45.5	272	124
Philippines	6,600	2,153	23,852	5,220	21.9	382	84
Sri Lanka	1,250	801	2,707	2,177	80.4	157	127
Thailand	3,430	2,256	29,992	4,075	13.6	538	73
Vietnam	18,000	320	5,300	2,000	37.7	79	30
Totals	786,730	59,182	952,352 1/	207,409 1/	21.8 1/	347 1/	76 1/

1/ Excluding Kampuchea.

Source: World Resources Institute (WRI), World Resources 1990-91, (Washington, D.C.: WRI).

The proportions of hydropower generation in total generation vary widely between the 14 countries for which data is available. Nepal and Laos, which have very limited installed generating capacity, produce more than 95 percent of their energy in hydel plants. Sri Lanka produces about 80 percent of its total energy generation through hydropower, and Myanmar obtains almost 50 percent of total energy generation from hydel plants, and Pakistan generates 45.5 percent of total energy by hydropower. China and India, which have very large coal reserves, produce only 20.1 percent and 26.6 percent of energy generated from hydropower, respectively. Despite Korea's full development of hydropower, this source produces only 6.7 percent of energy generated in that country. Total per capita energy generation ranges from 28.2 kwh/yr in Nepal to 1,840.5 kwh/yr in Korea. Hydel generation per capita ranges from 4.6 kwh/yr in Bangladesh to 283.8 kwh/yr in Malaysia, which ranks second to Korea in per capita generation from all sources with 1,005 kwh/yr.

III. WATER QUANTITY AND QUALITY INTERACTIONS

COMPETITION FOR WATER USE BETWEEN SECTORS

Sectors in a number of the countries are increasingly competing for water. Within China, such competition is perhaps most marked on the North China Plain. Here, the surface water is essentially fully developed, except to some extent the water from the Yellow River, and the groundwater is overdeveloped in extensive areas. The water supplies for Beijing and Tientsin national municipalities, serving both domestic and industrial users, are very constrained. It is now accepted that there will have to be a reduction of water use for irrigation, at least until a south-north transfer from the Yangtze is achieved. Regional shortages of community water supply occur in India, for instance in parts of Gujarat. It seems likely that a much larger proportion than anticipated of that state's share of Narmada supplies will have to be dedicated to municipal and industrial (M&I) uses with a corresponding reduction in irrigation development. The water supply for the Hyderabad municipal area is now in direct conflict with irrigation in low flow years, and the city water supply has been given priority. Provision of a water supply for Madras City has

required a water transfer from the Krishna Basin, in which Tamil Nadu State has no riparian interest. In Indonesia, water uses for urban and industrial supplies and flushing in the Jakarta conurbation and for Surabaya, as notable examples, are now in conflict with irrigation in their subtending basin areas. In the Philippines, the water supply (and hydropower) demands of Manila are beginning to impact on irrigation in the central Luzon region in drought years.

Water must often be committed to maintaining the saline front in estuaries and delta distributaries. This necessary use comes into conflict with other actual or potential uses during low flows, for example in the Mekong Delta and the eastern part by the delta complex in Bangladesh that is fed by the Brahmaputra and Meghna Rivers. The decision of India to divert part of the Ganges low flow has already done irreversible damage to the western part of the delta, and is impacting adversely on Bangladesh. In Thailand's highly developed Chao Phraya Basin, a flow must be dedicated during the dry months to control the saline front in the delta. Such action, however, is increasingly in conflict with irrigation and urban uses in the basin. Pakistan must also dedicate an outflow to the sea from the Indus below the Kotri barrage. The need in China to devote a large part of the Yellow River's summer season flow to flushing sediment through the lower reach to the sea is an unusual but necessary use in a very water-short area. Preservation of natural fisheries and other conditions in some circumstances must be weighed against irrigation development and FCD. Good examples of this situation are found in the deltas of the Mekong and Red Rivers in Vietnam, many areas of Bangladesh and in the Irrawaddy Delta in Myanmar. Possible loss of navigation benefits must also be considered in water resources development planning. China lost a significant part of its previously navigable rivers when their natural flows were reduced by dam construction, and Bangladesh finds great difficulty in maintaining navigable stream flow in lesser rivers in the dry season. Dams and diversions for irrigation reduce to a great extent the navigation on the Chao Phraya in Thailand.

POLLUTION OF WATER RESOURCES

Pollution of water bodies by urban and industrial effluents and, sometimes less obviously, by rural domestic wastes and agricultural activities, is a growing concern. Pollution is normally most evident in the case of surface water bodies, but these can be cleaned up if actions to prevent pollution are taken. Pollution of groundwater occurs unseen and may build up slowly, as for example, by leaching fertilizers and pesticides into the watertable, or from landfills that use solid wastes. Once groundwater becomes polluted, it is very difficult to clean up. Pollution is a serious problem in a number of countries in the region. It is perhaps the most serious of all water related problems in Malaysia, where effluent from rubber and palm oil processing and tailings from mining operations have polluted many rivers. In Indonesia, many rivers in Java are seriously polluted, and the practice of flushing untreated wastes to the sea has polluted coastal waters, particularly off Jakarta and Surabaya. India has developed water pollution problems on reaches of many of its rivers due to outfalls of untreated or poorly treated sewage and industrial waste effluents, particularly heavy metals and toxic chemicals. Water pollution problems have assumed immense proportions in China, particularly on the North China Plain where most domestic and a large proportion of untreated industrial waste effluents are discharged into rivers (which often have very depleted flows) or into lakes. The coastal waters off northeastern China and northern Java have been heavily polluted. Some would include siltation as a pollutant, though it is a natural phenomenon, which may be exacerbated by catchment degradation. Its major impacts are accelerated loss of reservoir storage and loss of capacity in man-made water conveyance channels and natural stream channels.

IV. CONCLUDING REMARKS

The foregoing discussion in this chapter demonstrates that availability of water of appropriate quality at the time and in the place it is required, together with availability of land in some instances, is becoming a major constraint on further economic development in most of the 15 major countries of the Asia region that have been selected for the study. Exceptions are the very

underdeveloped countries of Kampuchea, Laos and Nepal (though development of significant additional quantities of surface water in Nepal would be expensive and could require creation of large storages); the relatively undeveloped outer islands of Indonesia; and the special case of Malaysia, which is particularly well endowed with water resources and is shifting rapidly to an industrial economy with a compensating reduction in additional demands for irrigation. The gross endowment, expressed as mean annual renewable resource, of most of the countries where water availability is becoming a constraint to development is, with the exception of Pakistan, at least several times greater than the amount of water actually diverted for use. However, the ratio of diverted water to renewable resource is a simplistic measure of water availability, particularly when applied to large countries with spatially diverse climatic conditions, and can be illusory even in a generally wet basin defined in terms of mean annual rainfall.

The predominating climatic characteristic of all the 15 countries is the monsoon (exceptions are Northwest China and Northwest Pakistan, which are areas of desert or semi-desert). Under monsoon conditions, a very high proportion of the rainfall occurs within a period covering, generally, four to six months of the year, which is followed by a marked dry season.1/ The surface water runoff regime mirrors the rainfall regime, and natural recharge to groundwater is at maximum during the rainy season, though the resource is often fairly well regulated in the groundwater reservoirs. Thus, under natural conditions, a period of marked high flows on the river coincide with the monsoon season. At this time, large water surpluses, which often occur as floods are followed by a period of marked flow recession over the ensuing dry season, when severe water shortages may occur. The seasonal variation in runoff may, in many cases, be exacerbated by relatively marked interannual variations in runoff due to the relative failure of the monsoon. The extreme disparity of the seasonal flow regimes can be corrected only by the creation of storages, which can sometimes provide interannual carry over to counteract the deficits of drought years. Indeed, a considerable number of dams to create storage have been constructed in the countries of the region, notably in China and India, and a considerable number of additional storages are technically feasible. But the topography of most basins is such that much of their area is below potential storage sites and, thus, much surplus runoff must inevitably be discharged to waste. Environmental concerns and issues of resettlement of reservoir populations will doubtless constrain the number of such structures that will actually be constructed in the future.

Meanwhile, populations continue to grow, placing ever greater demands on water resources. As noted earlier in this chapter, the 15 countries now contain a total population of about 2.7 billion (around 51 percent of the world population), and this total is forecast to grow to about 4.2 billion by 2025. As limited opportunity exists to expand cultivation on to new lands in the region and fairly limited possibilities are available for expansion into new irrigated area or for intensification of cultivation on existing cultivated area, most of the forecast growth in population will have to be absorbed into urban areas. Large amounts of industrial development will be required to sustain the growing urban populations, and ever greater proportions of the limited water supplies will have to be dedicated to urban demands and to the industries that support the urban populations. It, therefore, follows that ever greater efforts will be required to properly dispose of urban and industrial waste waters--facilities are generally inadequate at present population levels--in order to avoid exacerbating existing shortages by polluting the sources from which they are drawn.

1/ Some limited areas (for example, parts of Mindanao, parts of Malaysia and the extreme Southwest of India) have the benefit of two monsoons and experience only a short dry season, which may not be entirely without rain.

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3

INSTITUTIONAL FRAMEWORK

I. INTRODUCTION

GENERAL

The various institutional elements (customs, laws, regulations, organizations and all that is associated with them) are closely interdependent, and deficiencies frequently arise from inconsistencies between them. Thus, although institutional change may be incremental, it must be made in the context of effective arrangements for the entire water resources area. The first step is, thus, to formulate an overall framework to guide reform proposals. Since water is a substance of given physical characteristics, obtained from similar sources and applied to similar uses for the same economic and social purposes in all countries, it is expected that common principles will govern good water management wherever it is practiced, and that important lessons can be learned from countries that have successfully or unsuccessfully tackled similar problems. Annex 1 sets out such principles based on experience worldwide. Greater detail on those principles is presented in an unpublished Bank Topic Paper 7 by William Barber and Susanne Scheierling, "Water Resources Management in the Developed Countries: Selected Examples."

A generalized framework must be interpreted to reflect local conditions since institutions vary widely under different cultural norms and traditions. Moreover, differences also reflect many other factors including climate, population pressure, the rate at which problems arise, the stage of development reached, relative water scarcity, the government and the legal system. Relative water scarcity in particular has a predominant influence since arrangements can be loose under conditions of surplus but must tighten as problems of volumetric scarcity and water quality intensify. The form of government is also important, with unitary and federated countries displaying significant differences depending on the level of provincial autonomy in resource ownership and management.

This chapter evaluates performance in Asia with regard both to the common principles of good water management set out in Annex 1 and to the variety of conditions described in Chapter 2 and Annex 2. Directions for institutional reform are suggested where countries need to adapt to changing conditions. This chapter overlaps somewhat with following chapters since institutional issues are integral to all aspects of water. However, to the extent possible, the chapter is confined to the preconditions necessary for long-term planning (Chapter 4), real-time management (Chapter 5), and economic and financial policy formulation (Chapter 6), and leaves more detailed consideration of these subjects to later chapters. Given the numbers of countries, sectors and issues, the discussion is highly selective. Implications for the Bank are discussed in Chapters 8 and 9.

AREAS OF GOVERNMENT ACTION

Institutional change comes about as a result, or in default, of government action. Three primary areas of government action can be distinguished--legislation, regulation and operations:

The Legislative Area

Water legislation has two basic functions: "(i) It must confer certain necessary powers over water and land upon the Government, while preserving or granting such rights to individual users as are consistent with the ... goals of that country ...; and (ii) it must also establish a basic administrative framework and the necessary institutions to execute the various functions assigned ..." (United Nations Economic Commission for Asia and the Far East [UNECAFE] 1973). Legislation, therefore, provides the basis for government action in the regulatory and operational areas, and establishes the context for action by nongovernment entities and individuals.

International and interprovincial agreements extend this context across boundaries of legislating authorities.

The Regulatory Area

This area comprises the enforcement and monitoring of established laws, agreements, rules, regulations and standards. Among aspects typically covered are water and land-use rights; basic and real-time allocations; standards of service and charges; water quality, pollution and environmental impacts, and the configuration and safety of facilities. A wide range of other regulatory functions also impact on water as on other areas of the economy, including those pertaining to the formation of markets, finance and audit and private enterprise.

The Operational Area

This area includes data collection and planning, design, construction and operation and maintenance (O&M) of systems and facilities. In most Asian countries, sectorial integration is limited and sector-specific agencies at different levels of government dominate the operational area, at least with respect to surface water. There is, however, some movement toward both integration and decentralization of responsibilities--in particular those of O&M--to local government, autonomous public agencies, and for-profit private entities and nonprofit beneficiary entities. The private sector (primarily individual users) already dominates many aspects of groundwater development in most Asian countries.

The above areas are discussed in turn to indicate their interdependencies and to provide a framework for the discussion in the three following chapters. Water rights agreements are discussed in the context of legislation, but water and land-use rights within a country are more satisfactorily discussed in the context of their regulatory administration.

II. Legislation and Water Rights Agreements

Water Legislation

The provisions of a water code generally fall into four major categories: (i) the rights, powers and duties of individual users and government over natural waters, (ii) ancillary powers over land, (iii) registration and licensing of rights to water, and (iv) creation of the administrative structure to implement the code (UNECAFE 1973). The first three categories comprise the first basic function of legislation and the fourth category comprises a second function; regulation. The authorization of projects and the related water allocations and funding are the dominant ongoing functions in Asia countries.

Resource Ownership

Ownership of surface waters in Asia almost invariably resides with the state. In federal countries, ownership may be held by the province. In a few cases, the position is ambiguous, but in practice, amounts to the same thing. For instance, the Indonesian constitution states that: "land and water ... are gifts of almighty God, and shall be controlled by the state..." (Government of Indonesia [GOI] 1945). Customary rights assume the characteristics of ownership but individual or customary ownership is seldom recognized in constitutions or water legislations. Ownership of groundwater may be less clear cut, but in most cases it is also owned by the state (at least implicitly). This arrangement contrasts with some countries elsewhere in the world where groundwater may be legally included in land ownership. All land in China, Myanmar and Vietnam is currently state owned. In most other countries of the region, private land ownership predominates, although state lands (e.g., forests and parks) are also important, notably in Indonesia, which has 75 percent of its land surface within the Forestry Department's boundaries.

Constitutional Issues

Responsibilities for government action differ significantly between federal and unitary countries. In federal countries, they are shared between the federal and provincial governments (see Box 3.1). The constraints of a federal structure are felt most severely in India where constitutional amendments must be approved by two-thirds of the state legislatures, a virtual impossibility on a matter as sensitive as water. The Union parliament can legislate on interstate rivers within the strict limits set by the constitution, which made water a state subject. An opportunity to enhance central control over interstate rivers was missed in the 1950s and is unlikely to return. Tribunal awards may allocate water among states, but management remains predominantly a state matter, and improvements are likely to come slowly. Pakistan also inherited a system from the period of British rule under which water was a state subject, but the level of state control has never been as complete as in India and the West Pakistan Water and Power Development Authority Act of 1956 created a central entity with broad powers to plan and implement water resources development for the country as a whole. Even in China, where central government has relatively more powers, provinces are increasingly aggressive in furthering their interests.

In unitary states, the central government legislates on all water matters, although powers may be administratively delegated to local government. The extent of delegation varies greatly and in some cases (e.g., Indonesia and Sri Lanka), approaches a federal status. Indonesia makes a distinction between centralized powers (exercised by central government), decentralized powers (exercised by provincial and local governments) and deconcentrated powers (exercised by central government at the regional or local level). Under the recent constitutional changes in Sri Lanka, regional councils have assumed many responsibilities previously assigned to the national government, including management of rivers and irrigation schemes falling within a province's boundaries. In both Indonesia and Sri Lanka, powers over interprovincial rivers are retained by the center.

Water Resource Legislation

All Asian countries have accumulated a body of water resources legislation. Some have adopted comprehensive water codes among which are both federal (China) and unitary states (the Philippines and Indonesia). Others have built up legislation primarily sector by sector; for instance, the irrigation acts that apply in different parts of India (the North Indian Act, the Bengal Act, the Bombay Act, etc.) and in Pakistan (the Canal and Drainage Act, the Sindh Irrigation Act and the Punjab Minor Canals Act, etc.). In these countries in particular, there may be ambiguities in water rights, overlapping and contradictory responsibilities in administration, and failure to deal with all aspects adequately. It is of interest that, whereas China enacted a comprehensive water law in 1989, India--faced with many of the same issues--enunciated a water policy in 1988, which remains a statement of intent rather than a binding law. Several other countries (Malaysia and Sri Lanka) have proposed comprehensive legislation though these have faced major political objections, often reflecting vested interests.

Comprehensive legislation can overcome deficiencies in existing laws, further administrative efficiency and clarify basic principles. By enunciating the fundamental rights, it provides for orderly and secure development by public and private agencies and individuals. But the passage of a water code is neither strictly necessary nor, in itself, sufficient for orderly development. For instance, Korea has no comprehensive legislation, yet it has perhaps the best record in the region for rational water resource development, while the Philippines has a water code but finds difficulty in making its provisions work. Moreover, political objections grow as water shortages increase and water quality deteriorates, since those that benefit from ambiguity tend to have more to lose. Some countries, thus, are becoming less willing or able to tackle these issues. However, as Burchi (1989) states "Water resources planning is increasingly and

consistently finding formal recognition in legislation as perhaps the single most significant mechanism for sound decision-making in the management of water resources in the long run."1/

Box 3.1: PROVINCIAL/STATE RIGHTS AND APPROACHES TO WATER IN FEDERAL COUNTRIES OF ASIA (CHINA, INDIA, MALAYSIA, MYANMAR AND PAKISTAN)

In **China**, ownership is clearly vested in the nation as a whole--"water resources are owned by the state, that is, owned by the whole people"--and the Federal Government has taken a relatively active part in water resources allocation, development, utilization and management. Provincial governments play a major role, but one that is in principle subservient to federal law. Indeed, provinces do not seem to be distinguished in legal terms from other "organizational units." "The state protects the legal interests of organizational units and individuals which develop and utilize water resources according to the law". Provinces are of course powerful agents, and have become increasingly active in pressing their interests at the center of the water rights issues. They are represented on committees that allocate water both in the long term and on a real-time basis, and they participate in funding major projects. Nevertheless, the Federal Government can in law override their interests, and river basin authorities that transcend individual provinces have been established with varying powers to plan, control, coordinate and implement water resource programs for all major interprovincial rivers.

In **India**, water is primarily a state subject, included in the State List of the Constitution (Government of India [GOI] 1947, as amended). Only for interstate rivers (which, however, account for 85 percent of surface water) does the Constitution reserve rights to the central government. "Regulation and development of interstate rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest." (GOI 1947). Unfortunately, legislation to date has been weak. The River Boards Act (1955) provides for the creation of boards that are agreed to by the states concerned, but these are largely advisory in nature while the Constitution continues, "...the powers of the State Governments in relation to interstate rivers and river valleys remain unaffected". In practice, no such Board has been established. The Interstate Waters Dispute Act (1956) provides for legal tribunals to adjudicate between states in the event that one of the riparian states (the only ones with rights in the matter) "has exceeded or has plans to exceed its rights at the expense of similar rights of one or more of the riparian states" (Gulhati 1972). And a number of institutions have been established under other legislations (e.g., the Tungabhadra Board under the 1953 Andhra State Act and the Bhakra-Beas Management Board under the 1966 Punjab Reorganization Act of 1966). During the 1950s, proposals were made for the creation of river authorities with more substantial powers but these made little headway (although one authority was formed for the Damodar River in Bihar and West Bengal). Interstate river issues remain contentious and extremely difficult. Legal adjudications have been reached for three rivers (Krishna, Godavari and Narmada), and two more are under review (Ravi/Beas and Cauvery). But these and voluntary interstate agreements, which cover a number of rivers, fall well short of the ideal for integrated river basin planning and management.

In **Malaysia** Suhaimia writes that "it is fair to generalize that, with respect to matters related to environment, natural resources are normally in the state list, services are in the federal list, and matters that do not fall in either are in the concurrent list. Hence, while the federal parliament may have powers to legislate services for resource exploitation, the powers to directly exploit resources rest with the state; while the legislation in this respect is environmentally related, it may not be environmentally comprehensive" (1982). Malaysia lies, therefore, in some sense between China and India. However, it faces few water shortages or interstate disputes, and the main consequences of the constitutional division of powers are reflected in conflicting regulations and agencies concerning management and water quality control The central government is reviewing proposals for strengthening central control in water matters, though this is encountering strong resistance from the states.

In **Myanmar**, there is little water legislation, and water rights are imprecise. However, Myanmar faces few water resource shortage problems and no significant interstate water disputes. There is, thus, little pressure for institutional reform or for clarifying rights and responsibilities.

In **Pakistan**, water is a state subject under the constitution. Thus, matters such as water charges, which enables legislation to establish local water sector subdivisions of government, operation and maintenance of irrigation and drainage systems, and a provision of water related services to urban and rural populations, are provincial responsibilities. However, the West Pakistan Water and Power Development Authority Act of 1956 created the Water and Power Development Authority (WAPDA) with a mandate for Federal Government to approve a comprehensive plan for the development and utilization of the water and power resources of Pakistan, and to give the authority the power to implement the approved plan. The 1991 agreement between the chief ministers of the four provinces to share Indus waters should solve an issue that has been contentious for several decades.

1/ 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).

INTERNATIONAL WATER RIGHTS AGREEMENTS

Agreements between governments clarify rights, allocations and obligations for international waterways and water bodies. This is recognized in Bank Operational Directive (OD) No. 7.50, which sets out the Bank's policy for projects on international waterways: "The Bank ... attaches the utmost importance to riparians entering into appropriate agreements or arrangements for the efficient utilization of the entire waterway system or any part of it, and stands ready to assist in achieving this end." International law has been the subject of ongoing discussions in the context of the U.N.'s International Law Commission, and substantive agreement has been reached on most matters. The agreement refers mainly to surface waterways and water bodies, as it is based on the principles of riparian rights; avoidance of appreciable harm; and beneficial and equitable development. International law, with respect to shared groundwater aquifers, is less well developed. Although, it has recently been receiving increased attention.

Three of Asia's great river systems have involved major international riparian issues: The Indus, Ganges/Brahmaputra and Mekong. Other rivers with less critical issues include the Amur, Red and Salween. Only for the Indus has there been a final resolution of the differences between riparians. The 1960 Indus Basin Treaty, in which the Bank played a crucial role, is rightly regarded as a major achievement that clarified rights and facilitated development in both India and Pakistan. Its very simplicity has contributed importantly to its success. The allocation of the waters of three rivers to India (the Ravi, Beas and Sutlej) and three to Pakistan (the Indus, Jhelum and Chenab) is in the nature of a territorial division. Since it was made, the two parties have had no need to jointly deal with water administration other than to enforce the treaty's terms and iron out practical difficulties. Nevertheless, the division was far from an optimum economic solution. Pakistan had to invest massively in facilities that would have been largely unnecessary if the subcontinent had remained unified (the interbasin transfers to the Ravi and Sutlej). India, however, was able to make a substantial water allocation to the Rajasthan Canal project, which might otherwise have never been built (Box 1.1). Moreover, there is no clear agreement concerning the evacuation of drainage surpluses. This is being tackled separately in each country without the obvious compromise--Indian support for the Left Bank Outfall Drain in return for the right to evacuate saline effluent through this facility.

A straightforward geographical division solution is ruled out in the other basins. They typically have upstream and downstream riparians that must cooperate in the storage and allocation of variable annual flows since other solutions would be inequitable. This is well illustrated by the Mekong and Ganges-Brahmaputra, the two systems with the greatest opportunities for cooperative development, but which also have the most contentious issues. There is a history of international planning for the Mekong, and the Mekong Committee is an important instrument for coordinating development and resolving riparian issues in the lower basin (with the UN rather than the Bank playing a leading role). However, political differences have precluded signing a treaty comparable to that reached for the Indus, and riparian issues remain potentially difficult in this still largely undeveloped basin. For the Ganges-Brahmaputra not even data are shared. Each riparian has undertaken separate and partial planning activities, and development has proceeded piecemeal. The Bank has on several occasions offered to act as honest broker at the highest levels using leverage to the extent possible.[1/] An attempt to reach an accord is apparently being considered but agreement to date has been limited to specific tributaries and projects. The most important accord--a limited-term agreement of 1977 between Bangladesh and India on the Farakka barrage on the Ganges--lapsed in 1988 after several extensions, so that no major international agreement exists now. Planning studies continue but, in the absence of an agreement, it is difficult to envisage the implementation of any major projects, except those lying wholly in Indian territory.

1/ In the absence of an international agreement, a credit for the massive Sarda Sahayek project -- involving the then largest irrigation canal in India if not the world -- was aborted after appraisal. Since then, the Bank has declined to support any projects involving additional demands on the flows of the Ganges or its tributaries, though it has supported modernization (e.g., for the Upper Ganga and Chambal Projects) and groundwater projects.

Comprehensive agreements as called for by the Bank's OD 7.50, which covers both surface and groundwater systems and both water quantity and quality, could optimize the development of international basins. In principle, agreements should cover data exchange, resource allocation, resource planning and real-time operations (under normal and emergency conditions). However, such agreements will be very difficult to achieve. The Mekong involves six countries with very different characteristics (China, Myanmar, Thailand, Laos, Kampuchea and Vietnam) while the Ganges/Brahmaputra not only involves five countries (China, Nepal, Bhutan, India and Bangladesh) but also numerous Indian states and territories. Moreover, it is important to understand the interests concerned. No mainstream projects on the Mekong are likely for the near future so that--apart from data exchange and planning--the current issues relate to the impacts of tributary projects. For the Ganges/Brahmaputra, the major international concerns relate to: (i) The financing and sharing in benefits of major dams that may be built in Nepal; (ii) the dispute between India and Bangladesh over flows at Farakka; and, (iii) mutually inconsistent projects in India and Bangladesh on the Teesta, a tributary of the Brahmaputra. Provided that an agreement can be reached on storage projects, flood protection on lands along the India-Bangladesh border, and provided that flows can be assured at Farakka (from whatever source), there is no immediate necessity for cooperation on the river systems as a whole. Major projects on the Brahmaputra are unlikely for the foreseeable future, while agreement on tributaries can be reached--at least for the medium term--on a subbasin basis.

To repeat, there is always a strong *prima facie* case for comprehensive agreements, but immediate urgency varies, and realism often dictates a step-by-step approach that tackles medium-term problems while building up cooperation and trust with respect to data exchange and planning for the longer term. Similar approaches may be taken for other large rivers (e.g., between Myanmar and Thailand on the Salween, primarily with respect to power generation; between China and Vietnam on the Red, primarily with respect to reservoir operations in China, and between Russia and China on the Amur/Heliungchiang, primarily with respect to river transport), as well as for numerous smaller rivers (e.g., those between Nepal and India, India and Bangladesh, Russia and China, Myanmar and Thailand, and Thailand and Malaysia).

INTERPROVINCIAL WATER RIGHTS AGREEMENTS

The resource development and management constraints encountered on international rivers in the absence of riparian agreements arise also in federal countries on interprovincial rivers, and even in unitary countries where delegation of powers interferes with the optimum exploitation of rivers that cross administrative boundaries. These problems involve not only issues relating to water quantity but also to quality, particularly at low flow. As for international rivers, there is a strong *prima facie* case for promoting comprehensive agreements, as mentioned above, but urgency varies. In contrast to the international rivers, however, there are many examples where comprehensive agreements on interprovincial rivers are of immediate importance.

The inadequacies of interprovincial agreements is most marked in India (Box 3.1) where neither awards under the 1956 Water Disputes Act, nor those under special tribunal legislation, nor voluntary agreements are normally expressed in ways that provide for efficient management. There are various reasons for this. Most awards and agreements allocate flows to listed projects for the 75 percent probable year (i.e., flows that are exceeded three years out of four) without seriously committing states to allocating flows under actual runoff conditions during a given year. In some cases, development upstream is supposed to be limited so that, in theory, downstream riparians receive more than their allocations three years in four and less, one year in four. In practice, upstream riparians often have the capacity to divert more than their allocation, though operating rules are meant to limit diversions below physical diversion capacity. Moreover, there is usually no way of optimizing diversions in any particular year; for instance; to reallocate flows in one subbasin to another temporarily in deficit, to account for dry spells, to limit diversions early in anticipation of subsequent shortfalls, or to carry over supplies from one year to another. Given the highly variable flows in most Indian rivers, the costs of this lack of management capability are

undoubtedly very large, in particular for basins approaching full development. In addition, tribunal awards are usually specified in terms of some specific time period after which a riparian state can request a review. Not only are states encouraged to "play games" in anticipation of a possible review, but they can undermine agreement at the time of review. Thus, agreements may be readily reached when water is surplus but may collapse when it has been substantially utilized.

The classic example of failure to reach a second agreement is the Cauvery, which has the most severe deficits of any major river in India. A 1934 agreement--water disputes are nothing new!--between then Madras Presidency and then Mysore State paved the way for the Mettur and Krishnarajasagar dams, but in time came to be seen as unfair by Karnataka. The award lapsed in 1974 when a review collapsed for various reasons. Since then, Karnataka has developed projects upstream without legal constraint. Construction has been slow since the Government of India has yet to clear the projects that are being financed from the state's own resources under the non-plan budget. Nevertheless, slowly but surely deficits in Tamil Nadu have increased (aggravated by Tamil Nadu's own actions [Box 3.3]). Though a tribunal was finally appointed in 1991, Tamil Nadu's opening bid is apparently less than what Karnataka had tentatively agreed to in 1974. Problems in other river basins are generally less acute. But only in the case of the Bhakra-Beas Management Board in northwest India, the Damodar River in East India and the Periyar River in South India have genuinely satisfactory management structures been established. The Narmada agreement also provides for proper shares at times of surplus and shortage. Examples of unsatisfactory agreements include those for the Tungabhadra (an interstate Board operates the dam, but Karnataka controls the left bank offtakes); the Chambal (the agreement provides for the sharing of benefits rather than water; a pointless provision); the Sone (Bihar benefits without agreement from regulation by Rihand Dam, but Uttar Pradesh is diverting supplies out of the basin); the Jamuna (Uttar Pradesh is constructing facilities that threaten the agreement); and the Subernarekha (where Orissa has quantity rights to water in Chandil dam but no timing rights as to when it will receive the water). Perhaps the most difficult river of all is the Krishna, which is discussed in Box 3.2 to illustrate the complexities involved. In no case will the solution be easy, but, without doubt, interstate rivers provide the most troubling issues facing the Indian water sector.

Problems elsewhere in Asian countries are generally less severe. In China, river basin plans prepared by the seven basin authorities (Box 3.4) have been consolidated into a loose national water plan. The basin authorities approve all projects in accordance with the plan. Major issues no doubt arise, for instance concerning allocations between provinces, relations among and between central ministries and the provinces, the financing of major projects, and real-time operations. Provinces undoubtedly argue their case strongly. Nevertheless, these issues can, in principle, be resolved at a national level, and there is nothing comparable to the problems associated with the interstate tribunal awards and agreements in India. In Indonesia, river basin planning has been patchy, basin management has in some cases been uncoordinated, and experience with basin agencies has been mixed. For instance, in the greater Jakarta region, various water projects have been constructed by the national power agency, the autonomous Jatilihur authority, West Java Province and the Jakarta municipality. The government, however, is increasingly recognizing the costs incurred by uncoordinated action and *inter alia* is reviewing coordinating mechanisms. The central government retains powers over rivers that cross provincial boundaries, and indeed over other major (Class A) rivers, and can, therefore, legislate if it proves desirable. More generally, managing rivers that cross administrative boundaries is of major concern throughout Asia and needs to be tackled as a matter of high priority.

Box 3.2: INTERSTATE ISSUES IN THE KRISHNA BASIN OF SOUTH INDIA

The Krishna Basin has been extensively developed by Andhra Pradesh, Karnataka and Maharashtra for irrigation, power and water supply. Transfers out of the basin are made across the Western Ghats to generate power at the Koyna hydro plant and to the deficit Pennar Basin primarily for irrigation. A delivery system is under construction to take water across the Pennar Basin to supply Madras in neighboring Tamil Nadu. Supplies could potentially be transferred into the basin from the Godavari River (which is surplus in its lower reaches), a river system shared by Madhya Pradesh and Orissa in addition to the three Krishna riparians. Andhra Pradesh is considering the transfer of water from the proposed Polaram barrage on the Godavari to serve the Krishna Delta.

The 1973 Krishna Tribunal Award provided for the development of irrigation and other uses based on what are widely believed to be conservative estimates of availability (including return flows) for 75 percent of the year. (Andhra Pradesh argued for a low estimate since this limits development upstream.) Andhra Pradesh has a right to utilize surpluses reaching its borders and has used this right to justify construction of additional schemes beyond those listed in the agreement. One of these (Sri Sailem Right Bank) was for tortuous political reasons cleared by the Government of India, but others (Telugu Ganga, Sri Sailem Left Bank) are being financed from Andhra's own resources and are disputed by the other states. These projects are important to Andhra Pradesh, lying as they do in drought-affected Rayalseema, which lost an earlier battle with coastal Andhra Pradesh for the first major project (which became Nagarjunasagar). Telegu Ganga is complicated by the fact that each riparian subsequent to the award agreed to allocate 5 TMC (15 TMC in total) to the water-short city of Madras. Though Madras could theoretically be supplied partly through natural channels (the Kundu/Pennar), and should perhaps have been supplied by pipeline, Andhra Pradesh took the opportunity -- and the finance provided by Tamil Nadu -- to construct a surface system that will also serve Telegu Ganga.

Maharashtra is meanwhile well on the way to fully utilizing its allocation. Indeed, despite the low returns from much past irrigation, it is building costly schemes involving substantial lifts apparently just to use its share. Massive additional diversion capacity is also provided at Koyna for peaking (diversions at Koyna, which are lost to purposes downstream, are in principle limited under the award). In contrast, Karnataka is way behind in exploiting its allocation, in particular due to delays in constructing the massive Upper Krishna project. In certain subbasins, however, for instance the Vedavathy and Tungabhadra, Karnataka is closer to full development and appears to divert more than its allocation for many schemes.

Apart from the flawed operation of the Tungabhadra scheme, as discussed earlier, there is no joint interstate management capability in the basin. Moreover, management capability even within a state can be very deficient as illustrated by Andhra's failure to optimize joint operation of the Sri Sailem and Nagarjunasagar Dams. Andhra essentially responds to water coming down from Maharashtra and Karnataka (and Madras, in turn, will depend on Andhra providing what is due). On average, Andhra receives more than its long-term allocation, but in a drought can receive much less, and all states are positioning themselves for the year 2000 when the award can be reviewed. Data are kept secret since one of the main issues for discussion will be the revision of the water availability assumptions. Much will depend on whether water is diverted from the Godavari to the Krishna Delta (and perhaps other schemes), and at whose cost, since this would permit a large volume to be reallocated upstream or to the Pennar Basin. Andhra's construction of Telegu Ganga, Maharashtra's construction of diversion capacity at Koyna and Karnataka's desperate attempts to complete the problematic Upper Krishna scheme, are all part of this interstate maneuvering that is undertaken in the absence of joint master planning or significant management cooperation, and which is complicated by the ever changing political scene within states, between states and between the states and the Union government.

III. RIGHTS AND REGULATORY POWERS

THE ADMINISTRATION OF WATER AND LAND-USE RIGHTS

Water-Use Rights

Countries in Asia--with the notable exception of the Philippines -- generally do not have comprehensive water-use rights systems of the kind found in developed countries.1/ Water rights are, therefore, often not established or ambiguous. In principle, existing users are protected by investment sanctioning procedures and in operating rules. Water for human and animal use may be legally unrestricted. Customary use (e.g., village irrigation) is recognized without necessarily being given a legal character, at least in quantitative terms. Countries with strong administrations may establish allocation priorities in considerable detail, even if these have no firm legal protection. For instance, irrigation schemes in the lower Yellow River Basin in China fall into no fewer than seven classes depending on their infrastructural characteristics and priority for water. Elsewhere, rights may be specified more vaguely. Existing users may seek redress in the courts, especially in South Asia. But this often achieves little if the resource is overdeveloped, particularly, as is usually the case, if the overdevelopment results from government programs and projects.

Ambiguities in water rights are more than a question of licensing. They often reflect weaknesses in planning, management and administration. Box 3.3 provides examples from South India to illustrate the variety of issues involved. Even if implicit or explicit rights are in principle protected by limiting investment or in operating rules, these may be negated by inaccurate assumptions due to data inadequacies, unrealizable efficiency expectations, or a failure to anticipate management constraints. If there is a basic inconsistency between the intentions of planners and the physical and managerial capability provided, then something has to give. If special interest pressures are added to this situation, it is not surprising that allocations are often arbitrary. Under such circumstances, an inadequately defined licensing system has limited value or may even be counterproductive. For instance, attempts to licence wells or pumps to manage an aquifer or to protect small farmers can create opportunities for rent-seeking and abuse, besides failing to achieve their stated objectives (e.g., in Bangladesh, Box 1.1). The Philippines has a comprehensive licensing system, yet control over water abstractions appears little better than in comparable countries without such a system. However, the ineffectiveness in both these examples is due to improper administrations, and this does not invalidate the concept.

1/ Licensing systems for surface water are almost universal in developed countries, being based in a variety of traditional legal conventions including riparian rights (as in Europe and the eastern United States), "first-in-time and first-in-use" (as in the western United States), and legal authorization for beneficial purposes (as in most countries). Permits or licences can be permanent, limited duration, annual or revocable. They may stipulate the following: Category of use (agricultural, urban, industrial, environmental, etc.); class of use (consumptive, non-consumptive, polluting); quantity and quality restrictions; time and duration of use; and priority under conditions of scarcity. In addition to defining the source of water and nature of return flows, there may be geographical restrictions (including linkages to land use) and rules governing transfers by the holder. Licensing systems for groundwater are of more recent origin, although, they are becoming widespread. See Topic Paper 3, "Water Allocation Methods and Water Rights in the Western States of the USA"; Topic Paper 8, "Water Allocation Methods and Water Rights in Japan"; and the unpublished Topic Paper 4, "Integrating Agricultural and Environmental Policies in Relation to Water Quality: European Community Example."

Box 3.3: AMBIGUITIES IN WATER RIGHTS: EXPERIENCES FROM SOUTH INDIA

Tambaraparani Basin, Tamil Nadu

The Tambaraparani has been developed primarily for paddy irrigation. Storage dams have been constructed in the head reaches to regulate river flows, double cropping is achieved over most of the area, and surpluses flow to the sea. In contrast, the Chittar, a major tributary, is very water short. Barrages in the past diverted flood flows to village tanks, which also collect local runoff. But a storage dam now regulates flows so that the top barrage on most occasions can divert the whole flow. A proposed transfer from the Tambaraparani to the Chittar has been blocked in the courts, because it would "deprive" traditional users, even though there are surpluses (the Tambaraparani farmers are politically powerful). Meanwhile, the lower Chittar commands have no recourse to assure their traditional supplies.

Ponniar Basin, Tamil Nadu

As on the Chittar, construction of the Sathanur Dam regulated flood flows. The rights of the lower commands are recognized in the operating rules. But the head barrages can now divert essentially all the regulated flow, and losses in the wide, sandy river bed have also increased. No surface water has reached the sea, or even the lower intakes, for more than twenty years. The farmers in the lower delta have asked to be reclassified as rainfed for land-tax purposes. Meanwhile, overdevelopment has occurred at Sathanur through the construction of the right-bank command. But further development upstream, in turn, has deprived Sathanur of the full supplies that were used to justify construction of the right-bank command in the first place.

Ameravathy Basin, Tamil Nadu

The Ameravathy Dam provided justification for extension of the irrigation area. The old areas are recognized in the operating rules; but release of regulated flows has encouraged installation of numerous private pumps along the channel, which deprives the lowest areas of virtually all their share. Efforts to ban these pumps have been reversed. Though no further power connections have been authorized, illegal connections cannot be controlled, and there is no restriction on diesel pumps. Meanwhile, construction of tanks and diversions in the Kerala catchment proceeds unconstrained; further dams are being constructed on tributaries; little water reaches the lowest areas; and no water reaches the Cauvery. Without an interstate agreement for the Cauvery, Karnataka continues major projects upstream, as discussed earlier in this chapter. Tamil Nadu complains that this affects the historic rights of the delta, but its own actions in the Ameravathy Basin have deprived the delta of supplies from one of the Cauvery's major tributaries.

Rajolibanda Diversion Scheme, Karnataka and Andhra Pradesh

The main canal passes through Karnataka, where oversized outlets provide unlimited supplies to about 2,000 ha. Inequities also occur in the larger Andhra command, with areas authorized for paddy in the head reaches--and some areas not so authorized--which take more than their fair share. A program to consolidate paddy areas and reallocate water more equitably has been blocked in the courts on the grounds that farmers localized for paddy have developed a right to sufficient water to complete their crop. This is so, even though tailenders are deprived and even though the assumptions on which the original project was based (a specified flow from Karnataka and low transmission losses) have proven incorrect.

Practical considerations do not negate the justification for a licensing system that can provide a rational basis for: (i) Allocating and controlling water use and quality, (ii) charging for water services (depending on the level of service, priority at times of shortage, level of pollution allowed, etc.); (iii) protecting investments and other user interests; and (iv) transfering rights through legal mechanisms. Nor do they detract from the need to clarify rights and obligations. But such considerations have important implications for the system to be adopted and the priority and phasing of associated actions. Ambiguity is most damaging at the level of international and interprovincial rivers. If rights at this level cannot be assured, they have little meaning at lower levels. Rights and obligations at the rivercourse level are also a priority since basin, reservoir and scheme operating rules can provide greater assurance and clarity to users (e.g., the specification of category, class and priority in the event of shortage). Contractual arrangements are also a way of strengthening assurances whether or not they are legally binding. Licensing, or its equivalent, at

the level of the individual provides for both assurance and control within a surface water system or groundwater basin.

Land-Use Rights

Legal restrictions on land use vary. In China, Myanmar and Vietnam, land is nationalized and all land use is subject to conditions. In other countries, controls on private land use may be imposed by local, provincial or national governments (e.g., for land zoning purposes in major urban areas or to meet environmental objectives). There are in particular wide-spread restrictions on settlement in floodplains and other vulnerable areas. This has perhaps gone furthest in China where it complements flood control, detention basin and flood proofing facilities. Restrictions to control pollution (e.g., in the siting of industries), or to secure water at times of shortage (e.g., by precluding high water users) are little legislated except in Korea. Acquisition of key sites for water resource development in advance of requirements, rather than when the project is cleared for construction, is a particular case that can help control economic activity and reduce the subsequent costs of resettlement. However, as for water rights, practical constraints may limit the effectiveness of land-use regulations, and encroachment on reserved floodplains is widespread and would often be difficult to prevent on acquired sites. Particular solutions will, thus, vary depending on the strength of a country's regulatory administration and other factors.

WATER ALLOCATION

Allocation Objectives

If, all externalities could be internalized and the mechanisms for a fully functioning market could be established, then water allocation objectives could, in principle, be rationally expressed in terms of economic efficiency and achieved through the hidden hand of market forces. In practice, though, this is not possible, as discussed in Chapter 1. Objectives must, therefore, be established by a government with project authorization, regulatory controls and incentives as the primary mechanisms for allocating water in accordance with these objectives. In practice, usually, the balance is partly established *ex ante* as an explicit consequence of social consensus and/or political judgment, and partly reflected *ex post* as an implicit consequence of development and the operation of the water-rights system. The stronger the administration, the more likely explicit objectives will be established and achieved; the weaker the administration, the more likely allocations will be an incidental and, perhaps, arbitrary result of development.

Objectives vary widely and the weights to be attached to different objectives change over time. Allocation mechanisms should, therefore, in principle be flexible and adaptable. At early stages of development, objectives in different sectors (regional development, agricultural intensification, expansion of urban infrastructure, power generation, maintenance of instream flows, etc.) can often be pursued independently. As demands increase, trade-offs occur between different objectives, and prioritization is required between categories of use. First priority is universally given to domestic use. Industrial and agricultural use usually follow in that order,1/ subject to limits imposed for instream flows (e.g., for navigation, fisheries or environmental protection). Priorities in long-term allocations, however, often differ from those in real time. For instance, though agriculture may have to give way to other users in the longer term, a permanent crop typically receives high priority at times of shortage. In the final analysis, allocation is a political decision. Nevertheless, decisionmakers can be guided as to the efficiency, equity and environmental consequences of their decisions, utilizing techniques for evaluating alternatives in a systematic manner (Chapters 4 and 5).

1/ India's National Water Policy of 1988 gives second priority to agriculture with the proviso that this may, in some circumstances, be overridden by the demands of industry.

Allocation Mechanisms

Most of the diverted water used in Asia has been appropriated by governments in the course of program and project implementation. Prior and concurrent communal development and private investment are also generally recognized. Allocation objectives and allocations are, thus, both largely integral to the act of development, with public investment supported by legislation related to project authorization and funding. Real-time operations are reflected in operating rules and regulatory powers, which are specified with varying levels of precision. If a licence is issued, then a user receives a legal right. If no legal title is given, or if legal title in practice has little meaning, then protection of an allocation depends primarily on public controls. Perversely, therefore, lack of precision in rights allows for greater flexibility than if rights were defined. If government control is weak, however, flexibility can be at high cost in terms of arbitrary action and uncertainty, with conflicting demands resolved as a compromise between political and private interests, redress in the courts and *force majeure* (Box 3.3). The stronger the process of planning and management, the more likely allocations will be controlled in line with stated objectives; the weaker this process, the more likely decisions will be arbitrary.

Overwhelmingly, therefore, it is the strength and purpose of a country's administration that determines whether clear allocation objectives are established and whether water is allocated in accordance with these objectives. In other words, regulatory mechanisms, and hence government, largely determine success. Market mechanisms for the exchange and sale of water rights, such as those evolving in some developed countries, imply not only a price that is far above the usual charge for publicly supplied water, but also a rights system of a type not found in Asia. There is evidence that markets play an important role locally in reallocating water among neighbors. The best examples lie in groundwater and low-lift pump areas where water is appropriated through the private construction of a tubewell facility or purchase of a pump is also sold to neighbors. Though this may also be viewed as a situation similar to where water users distribute a bulk allotment at a price to cover costs. Sale of irrigation turns can also be significant if they are secure (as under "warabandi" in Northwest India and Pakistan [Box 5.4]). But these are usually short-term exchanges. Such markets are often surprisingly versatile and competitive, and have important efficiency benefits. Facilitating such mechanisms, and ensuring that prices as far as possible reflect efficiency levels, presents an important, though difficult, challenge.

Standards of Service

The quality of water service greatly influences the value of water to the user. Standards for municipal and industrial services are in principle straightforward, although in practice they may be difficult to achieve and, where water shortages are encountered, rationing may be severe. For instance, in Madras in South India, urban water is seldom supplied for more than an hour a day even in the monsoon season. Standards for irrigation delivery are even more problematic, being peculiar to the scheme concerned. Operational plans, implementation rules and monitoring of the outcome are all often neither in sufficient detail nor transparent enough to ensure realization. Moreover, standards intended by designers are often difficult to attain under prevailing conditions, with success in irrigation a reflection of external conditions as much as of the regulations proposed (Chapter 5).

In general, China and Korea are more successful in assuring standards of irrigation service (and other water services) than other Asian countries. In part, this success reflects cultural factors and, perhaps, a more favorable environment. But organizational structures also help explain relative performance since they largely determine whether incentives support regulatory action. The most obvious advantage of the East Asian structures is that water charges can be levied in ways that influence those responsible for water allocation. Though charges are usually well below the real cost of providing the water--let alone its value to end-users--the retailing entity has an interest both in minimizing the amount it pays and collecting from farmers since these impact directly on the funds at its disposal for O&M. In contrast, irrigation charges in South and Southeast Asia, if levied at all, generally return to the government and the irrigation agency has a

very limited interest in collection. Regular bureaucratic incentives and penalties in principle ensure that O&M is in accordance with stated objectives, but in practice these are widely ineffective. If incentives are inconsistent with regulatory aims, then water delivery cannot be expected to accord with stated objectives.

Allocations Governing Extreme Events

An area of weakness in many Asian countries are regulations governing response to droughts and floods. Even if there are few problems under normal conditions, those responsible for management come under enormous pressure in emergencies. Operational plans to meet allocations are typically based on fairly normal supply conditions, and generally function fairly well in these circumstances. However, advance plans and prior allocation decisions are rarely made to deal with the situations that can be imposed, for example, by extreme droughts. Without adequate advance planning, and in the absence of detailed and transparent regulations to guide action, response will be *ad hoc*, resulting in potentially huge unnecessary damage or loss. Topic Paper 1, "Planning for Droughts: An Essential Action," outlines the factors to be considered and the content of a drought plan.

Changing Allocations Over Time

If most water is appropriated in the course of development, then allocations can be changed over time through development. While the results may be arbitrary, governments can, thus, shift water to areas of higher priority as objectives change. An extreme example is the *de facto* reassignment of many previous irrigation supplies in Saurashtra (Gujarat) entirely to water supply. Moreover, whereas 90 percent of Gujarat's water under the Narmada program was initially destined for irrigation, the latest estimate is 75 percent, and this will no doubt decline further (Box 1.1). However, the political and third party consequences of altering established uses and investments make this option fraught with serious obstacles. Reallocation can involve major social and economic costs, and mechanisms for compensating those affected need to be given attention. It is ironic, for instance, that while major emphasis is given to compensating oustees from reservoirs, no attention is paid to those who loose their livelihood if water is not provided because it has been reallocated. Few countries have laid down detailed procedures for changing allocations over time (Korea is an exception), and, as long as rights are ambiguous, compensation will remain a very difficult issue.

STANDARDS, REGULATIONS AND ADMINISTRATIVE RULES

A wide range of regulatory mechanisms impact on water resource development and management. They range from regulations governing water rights and allocations, through environmental standards and water quality controls, to more general administrative and financial regulations. Their formulation entails a range of actions from clarifying legislation to preparing manuals. A crucial requirement is to detail specific responsibilities and powers. Effective enforcement is often difficult and appropriate signals, incentives and penalties are needed to encourage adherence. In many cases, interim rules and regulations may be effective in addressing immediate problems, allowing time for the refinement of details for broader application. Market mechanisms are often impractical, but it is possible that practices evolving elsewhere in the world (e.g., markets for pollution permits) may become feasible in Asian countries with strong administrations.

Water Rights and Allocations

As discussed earlier in this chapter, few Asian countries have detailed rights legislation, although those that have a licensing system invariably promulgate related regulations that are implemented with varying success. Allocation is primarily a government responsibility, and the civil administration in most Asian countries has traditionally played the dominant role in the oversight and regulation of water matters. Where these concern uses wholly or predominantly

within jurisdictional boundaries of the level of government concerned, and are on a local scale, there may be little ambiguity. Although, the detail with which allocations are administered is highly variable. For instance, decisions on seasonal water allocations at a local or regional level are often taken in committees chaired by the local district official or governor, comprising representatives from different departments and, perhaps, the beneficiaries or their representatives. Examples include the provincial, district and subdistrict water resource committees in Indonesia; the district irrigation committees in many states in India; and the scheme-level cultivation committees in Sri Lanka. Though orientated to irrigation, such bodies make decisions on allocations for other uses where these are significant. Problems arise where hydrological boundaries cross administrative boundaries, and the imprecise regulation and control of rivers that cross administrative boundaries then represents, possibly, the most intractable issue facing water allocation in the region.

Environment and Water Quality

Water quality and pollution problems are increasing and increasingly recognized worldwide. Most countries in Asia have created environmental control agencies, and project clearance procedures have been greatly strengthened in an attempt *inter alia* to limit adverse water quality impacts before they emerge. Formal environmental impact studies are now a requirement in many countries, and the Bank and other donor agencies have been actively assisting in developing appropriate procedures. Essentially all countries have also adopted water quality standards, often based on World Health Organization recommendations, to meet health objectives in domestic supply. Standards for instream flows, effluent control and groundwater contamination are less widely established and few countries have yet to tackle in any substantive way issues related to the use of fertilizers, pesticides and other nonpoint sources of pollution.1/ Together, domestic waste water from urban areas and industrial effluents form the most important sources of surface water pollution in most Asian countries.

As in most other areas, the main issues relate to enforcement rather than standards *per se*. Countries with strong administrations, often those facing immediate industrial pollution problems (e.g., Korea and Malaysia), have generally adopted the principle that the polluter pays while providing tax and subsidy incentives to control point-source pollution. Other countries have similar, if less well developed, mechanisms. The responsibility system in China provides an interesting example, whereby not only are incentives provided to encourage local government, line agencies and autonomous enterprises to meet environmental targets, but the limits governing their independence and freedom from administrative control are also in part a consequence of performance in this area.

An issue in many countries is the lack of integration and complementarity between water quantity and water quality regulation and incentives. Water quantity allocations are overwhelmingly administered by sector agencies. In the Philippines, they are based on the formal issuance of legal licences. Quality standards are usually set, monitored and enforced by environmental agencies, which may also be responsible for administrating subsidy and similar programs. As a consequence, interactions between quantity and quality may go by default. In particular, there are few incentives to limit extractions--whether obtained officially or unofficially--to recycle water or to limit return flows as a pollution control device. With some exceptions (e.g., Korea), there has also been very limited control of land-use rights for purposes of water resource quality management.

1/ The severe problems that can be encountered, and possible approaches to resolving them, are illustrated by the review of European Economic Community countries in the unpublished Topic Paper 4, "Integrating Agricultural and Environmental Policies in Relation to Water Quality: The European Community Example."

Dam Safety and the Configuration of Facilities

Dam safety assurance is of continuing concern because loss of life or property would be threatened by failure. More generally, the configuration of all physical facilities, including flood protection embankments, bridges and buildings, raise safety concerns. All countries have laws, regulations and organizational arrangements related to dam safety and, to a lesser extent, safety of other facilities. With regard to large storage structures, most have adopted the general approach developed by the International Commission on Large Dams. Standards, regulations and rules normally cover technical aspects in considerable detail. As in other areas, however, there are often weaknesses in administering these standards, both in terms of defining conditions of acceptability and in terms of reporting, monitoring and enforcement. India has recently adopted a program to strengthen its dam safety arrangements with Bank assistance, and discussions have been initiated on similar programs in several other countries.

General Administrative and Financial Regulations

The general rules governing civil service administration and finance, as well as those governing autonomous public agencies, user-owned entities, cooperatives, private companies and individuals, strongly affect the development and management of land and water resources. In developed countries, there is a public utilities commission or similar agency responsible for overseeing nongovernment entities in water and other service sectors. If the government is directly involved in financing or supporting nongovernment entities, then some governmental oversight agency must be responsible for reviewing the level of charges, cost-recovery mechanisms and fiscal operations in general. In Asian countries, this agency is normally a regular government department (for instance, a ministry of finance or home affairs), and decisions on the level of charges may be taken at the highest level of government. These issues are beyond the scope of this review. Nevertheless, in any particular context, if the general administrative, financial or judicial procedures are deficient in any respect, this can preclude the success of regulations for land and water.

IV. Agency Functions and Organization

Introduction

Participants in Water Resources Management

Three main types of agents participate in water resources management: government agencies, nongovernment entities and individuals. Government agencies guide exploitation and management for the benefit of society, implement programs and projects, and provide services to the private sector and individuals. Nongovernment entities (beneficiary-owned or for-profit) implement projects in the operational area for the benefit of their members or customers within bounds established by government. Individuals act for their own benefit. Advocacy organizations (professional societies, customer protection bodies, environmental groups) are well established in developed countries and are becoming more important elsewhere.

Government plays the predominant role in water resources development and management in Asia. There is, however, a long tradition of communal irrigation and community water supply (village tank and diversion systems); nongovernment industrial entities often develop captive sources in response to uncertain public supplies; and individuals and cooperatives (in China) predominate in groundwater development. Moreover, the balance between the various agents is changing. This is seen notably in the turnover of small irrigation schemes, and even subunits of larger schemes, to user groups. Public tubewell irrigation systems are also passed to user groups, and privatization of some other water supply functions has been proposed. Clarifying the role of government, especially in O&M, and promoting appropriate communal and private participation is a major need in most countries.

Functional Linkages

The characteristics of water (Chapter 1) logically require linkage in agency responsibilities between: (i) Water and land use, (ii) surface and subsurface water and (iii) water quantity and quality. Separated responsibilities for water and land use can lead to failures in planning to account for water and land-use interactions, in regulations to ensure that water and land uses conform with planning objectives, and in operations (public or private) to ensure compliance with regulations. Separated responsibilities for surface and subsurface water can result in overly optimistic resource projections, conflicting and inefficient programs and projects, and ineffective management of groundwater and return flows. Finally, separated responsibilities for quantity and quality can lead to inefficiencies in management and to failures in exploiting trade-offs between pollution control and waste treatment in the same watershed.

Few countries in Asia have adequately established appropriate functional linkages in agency assignments. Exploitation of surface water itself may be divided among sectorial ministries, let alone having adequate linkage with land, groundwater or water quality. Land-use planning and control is normally the responsibility of local government. Groundwater planning and regulation is often assigned to a separate agency from surface water, such as a ministry of mines or a groundwater board. Water quality may be the concern of a ministry of health or environment. If establishing linkages encounters bureaucratic resistance, it may be adequate, as an interim measure, to strengthen formal coordination and improve review/approval procedures among existing single-focus entities. In the longer term, however, as pressures increase, more radical adjustment in agency responsibilities will usually be justified.

Area Jurisdictions

Inconsistencies between administrative and hydrological boundaries present major difficulties. These are compounded by decentralization policies that promote accountability and local participation, but tend to subdivide hydrologically-determined regions. "The central problem has been how to reconcile regionalization--particularly that of general government--along administrative lines with the hydrological imperatives of basin management, and at which point to strike the right balance between the water administrations at central and at regional levels of government" (Burchi 1989).

Many countries in Asia have adopted explicit decentralization policies. Such policies are usually general in scope, but they often have important implications for water. Examples include Indonesia, where river basin and irrigation matters are increasingly decentralized to the provinces and districts; Sri Lanka, where similar responsibilities have been assigned to the recently created provincial councils; and the Philippines, where important decentralization measures are expected to strengthen regional and provincial organizations. A crucial enabling element is the decentralization of budgetary authority, because without control over finance, the powers of local administrations can be bypassed or made ineffective. An interesting example is provided by China where decentralization of financial responsibility has been of central concern. Under the slogan "let water support water," units of the provincial Water Resources Bureau (WRB) at each level (village, prefecture, county and province) are in principle required to finance O&M, as well as make a contribution to construction of their respective components of water facilities. Arrangements vary, for instance, with respect to collection of water charges, payment to the water supplier, mobilization of labor and seasonal operating decisions. Responsibilities are often shared with the corresponding level of the civil administration, to which the WRB unit is accountable and with which it maintains a close relationship. Thus, while there is a strong push for local self-sufficiency, and there can be functional integration in the water sector even at a low level, there may be little separation of regulatory functions from those of operations.

In a few cases, basin entities have been established with quasigovernmental powers. The Damodar Valley Corporation in East India (modelled on the Tennessee Valley Authority in the

United States) was intended to function in this way and the Mahaweli Authority in Sri Lanka also has characteristics of this type. However, powerful authorities that are independent of the civil administration usually encounter strong resistance. Hence, commissions, boards or committees that coordinate planning, operating and regulatory activities while giving full recognition to political jurisdictions, are often a more practical solution. The powers of basin agencies vary considerably (Box 3.4), and experience in Asia has been mixed. They range from agencies that control individual multipurpose or single purpose projects to those that have broader controlling or coordinating functions for the basin or subbasin as a whole. In the absence of a single operating agency, coordinating mechanisms are required irrespective of the size of the basin, and the weakness of coordination in many Asian countries has a major negative influence on management efficiency.

Much depends on the functions to be assigned. Inconsistencies between hydrological and political boundaries have few disadvantages for broad data collection, planning and regulatory activities, provided a basin agency or coordinating mechanism is created to recognize the hydrological dimensions of the resource. As long as political jurisdictions are recognized and procedures for consultation and implementation are clearly defined, these functions can be assigned within a variety of different organizational arrangements. On the other hand, sound O&M at the level of service (water supply, water distribution, waste collection, drainage and flood protection) requires that agencies reflect hydrological boundaries and that beneficiaries of a given system are covered by the responsible entity. Where the operating entity falls within the bounds of a political jurisdiction (district, county, municipality and village) there is no problem. Then public works departments and local government utilities can readily satisfy the hydrological principle with larger schemes subdivided into hydrological subunits, and with communal and private customers served on a wholesale basis. Where the service area extends across political boundaries, then two or more jurisdictions must join in forming service entities. Where possible, hydrological subunits should again be designed to fall within a political jurisdiction, as in China where the county water conservancy bureau accepts delivery of and pays for water at its boundaries. Where possible, local planning and regulation of water and land use should also conform with hydrological boundaries, although these are frequently assigned to politically determined agencies. It is noteworthy that New Zealand has recently relocated its administrative boundaries to fit with hydrological units in order to permit more rational management of its land and water resources in a decentralized manner. (See Topic Paper 7, "Water Resources Management in Development Countries".)

ASSIGNMENT OF FUNCTIONS

Public and Private Agents

Broad data collection, planning, regulation and oversight are necessarily government functions, although private participation in oversight bodies is desirable. Activities in other operational areas (detailed data collection, project planning, design, construction and O&M) may be undertaken either by government or nongovernment entities or individuals. The relative importance of public and private agents varies between countries depending on policy, the scale of activity, the stage of development and other factors. In general, private involvement increases as resources are developed and as activities move toward O&M.

Box 3.4 EXPERIENCE WITH RIVER BASIN ENTITIES IN SELECTED ASIAN COUNTRIES

China. Seven commissions cover the six major interprovincial river basins and one lake basin. They are central agencies under the Ministry of Water and have important planning and regulatory functions. The Yellow River Conservancy Commission is undoubtedly the strongest since, in addition to the planning and clearance functions common to all commissions, it has specific responsibility for flood management in the lower Yellow River and for the operation of San Men Xia and other reservoirs. It undertakes major flood protection works and will construct and operate the Xiao Langdi Dam proposed for Bank assistance. It has considerable financial strength and autonomy as a consequence of water and power receipts from the operation of San Men Xia and other facilities. The other commissions are financially less strong and: "... do not have the powers and capabilities to exercise coordinated management of the development of local water resources, to protect water quality, to mediate in disputes arising locally in their regions, and to ensure the successful implementation of multipurpose river development plans." (GOC, 1990). These weaknesses reflect problems of coordination with provincial governments and central agencies; lack of assigned powers and detailed implementing rules; and inadequate revenues and financial autonomy. Their powers appear in some respects to be ambiguous. They have encountered resistance from the provinces and other ministries, and their future role remains uncertain. Nevertheless, they are undoubtedly important institutions that provide a crucial dimension to the proper development of water resources.

India. The Damodar Valley Corporation (DVC) was established in 1948. It was envisaged as the first of a series but, as in the case of the Tennessee Valley Authority, has proved one-of-a-kind. It retains authority to develop water and other infrastructural facilities within its jurisdiction (powers normally exercised by state governments) but the funds available have been inadequate for its ambitious initial proposals. It continues to manage its various facilities for flood protection, irrigation and power. But the DVC's impact on thinking in India has been minimal, beyond antipathy to such agencies. Several river boards have been established under other legislation, although not under the River Boards Act. A notably successful example is the Bhakra-Beas Management Board, which manages Bhakra and Pong dams and associated facilities in Northwest India. Other agencies have been generally less significant, but include the Narmada Control Authority, the Ganga Flood Control Commission, the Brahmaputra Board (also concerned with flood control), the Mahi Control Board and the Tungabhadra Board. However, these agencies perform only to the extent that the concerned states readily cooperate. In many basins with major disputes (e.g., the Jamuna/Ganges, Cauvery, Krishna/Pennar), there are essentially no effective institutional mechanisms for basin management. Since 85 percent of all surface runoff is accounted for by interstate rivers, some of which also cross international boundaries, this is a matter for serious concern. Coordination through the Command Area Development Authorities (CAD) at a state and scheme levels takes on the characteristics of subbasin management where individual facilities are dominant. The CAD has taken different forms in different states, although its the primary aims have been to coordinate development and management in major irrigation schemes and to undertake completion works, notably tertiary canal and land development. Combining these two functions on specific large irrigation schemes has had mixed results.

Indonesia. Indonesia has created several basin agencies with powers that variously include planning, regulatory activities, and management of major facilities. The Jatilihur Authority manages the dam and major irrigation facilities, and supplies power and municipal water to other agencies. But two upstream dams are operated separately for power, and there are limited mechanisms for coordinating activities throughout the interconnected basins of the greater Jakarta region. The Brantas Authority has even fewer powers, although it has implemented some physical structures besides having planning and related functions. The agency for the Solo River, which crosses the boundaries of Jogjakarta, Central Java and East Java, has had even less impact, as it is confined primarily to some desultory planning.

Sri Lanka. The Mahaweli Authority has been a powerful agent for both development and management. It develops and manages major storage and irrigation facilities through its respective executing arms and provide the secretariat for seasonal planning and other water management activities. It thus combines the characteristics of both an area-based and a river-based authority, which, given the scale of its operations, has had a major impact on Sri Lanka's development process. In theory, its area management role was supposed to be temporary, with its quasi-government responsibilities for civil administration and economic services returning in due course to the respective regular agencies. However, there is little sign of this happening, although it did occur in respect of the earlier, but substantially less powerful, Gal Oya River Board.

Malaysia. Malaysia has created area-based authorities for the Muda and Kemubu irrigation projects, which are responsible for both irrigation and agricultural development. Given the size of these schemes relative to the basin concerned, they essentially act as basin coordination authorities. Similar examples can be drawn from other countries, for example the Upper Pampanga and Magat schemes in the Philippines.

Basic Principles

Two basic principles should normally govern the assignment of functions: (i) Separation of regulatory and operational functions in government and (ii) separation of different operational functions, whether in the public or private sectors. The separation of regulatory and operational functions in government follows from the need to ensure that those who administer, monitor and enforce standards and regulations remain independent and unbiased. However, regulation and operations are often combined in Asia, most obviously and most detrimentally in water allocation. If water allocation is integral to the act of development, then there is an inevitable tendency to overcommitment and overdevelopment. This is particularly the case if several departments are involved and if private agents are largely unregulated. Inconsistency also arises where water supply agencies enforce quality standards; if industrial promotion ministries regulate land use and factory siting; where owner agencies are responsible for dam safety; and where operational agencies enforce environmental standards. This last is complicated by indiscriminate application of the term "environment" to a wide range of activities (watershed management, groundwater control, waste treatment and land drainage) better called by their traditional names. The resulting confusion means that new environmental agencies may be required not only to enforce regulations but also to implement programs better left to established (specialized) agencies that work, if necessary, toward improved standards.

The second basic principle, separation of operational functions, arises from differing jurisdictional coverage, as well as the need to develop specialized knowledge, skills and practices. Thus, data collection requires comprehensive procedures and coverage; planning requires inter-disciplinary teamwork and the understanding of national and sector policies and programs; design requires advanced technical knowledge; construction must oversee field activities and assure quality; and O&M requires the expertise and discipline of sustaining a service to end-users. Moreover, quality assurance requires a clear separation of work so that units can be held accountable for performance. This is most evident in the design, construction and O&M phases of a project. For example, transfer of responsibility from construction to O&M should require a warranty to ensure that construction deficiencies are not passed on to the O&M agency. Quality assurance of course also requires that activities in any one functional area respond to experience and requirements in other areas. For instance, planning must reflect relative economic returns from past programs and projects; design must respond to what can be managed under prevailing conditions; and construction must ensure that facilities can be maintained at affordable cost.

Changes over Time

A flexible response to changing conditions is clearly desirable. Government agencies tend to be inflexible reflecting bureaucratic inertia, poor remuneration, and resistance to staff adjustments and/or downsizing. Private agencies are more flexible both in personnel matters and with respect to technical changes and management practices. Thus, there are strong arguments to encourage private involvement and to promote practices in government that imitate those in the private sector. For instance, future workload is often inadequately addressed in public agencies. Project planning, design and construction invariably decline. Operation and maintenance invariably becomes the predominant activity. Policy, oversight, regulation, data collection and general planning persist, though their character may change. Mechanisms for adaptation to changing workload, which are common in the private sector include: Natural attrition, which can often result in rapid adjustment especially if supported by early retirement incentives; subcontracting; employment of consultants for peak loads or specialized tasks; and limited-term appointments.

DATA COLLECTION AND DISSEMINATION

The general inadequacy of information on water and land resources in many Asian countries stems in part from dispersed responsibilities among many agencies and entities of government. Systematic data collection in many areas is a poor relation of construction and is

often limited to that needed for project formulation. Not only are there inadequacies in the availability and accuracy of data (notably in relation to groundwater and water quality) but processing and dissemination also leave much to be desired. A particular problem, encountered most notably in India, is the restriction of access to data for political reasons. This applies not only to international rivers (for instance key streamflow data on the Ganges system are not provided to other riparians or assistance agencies) but also to interstate rivers where state governments similarly restrict access to information. Without open access to reliable data, neither proper resource development planning nor proper real-time management of water resources are possible.

Most countries have a well established central meteorological agency, and the rainfall and other climate data they produce are generally satisfactory. Climate data collected by other agencies are, however, seldom properly reviewed nor are they consolidated within a permanent record. Moreover, few countries employ modern techniques of weather forecasting, which seriously affects their ability to respond to real-time emergencies. In contrast to climate data, hydrology networks are often incomplete and poorly administered. River gauging stations are often technically inadequate, too few in number and distributed among several agencies. Groundwater data collection is often an area of particular weakness, and is frequently the responsibility of an agency different to that responsible for surface water records. Studies of the two parts of water resources are seldom integrated except perhaps in project preparation. Data on land use and land capability are generally unsatisfactory and are rarely combined with those on water. Geographic information systems are being slowly introduced, but the potential of this technique is far from fully exploited.

Few countries, therefore, have a strong data collection, processing and dissemination system. Since such a system is fundamental to all aspects of water resources, creation of an institutional framework is a first requirement. Experience elsewhere in the world suggests that this is a specialized field that justifies a separate entity, possibly attached to a central policy and oversight agency. Such a unit would establish conventional and remote sensing programs; set data collection standards for, and review collection procedures of, other agencies; monitor and integrate data from all sources; and submit regular and intermittent data compilation reports and studies. In federal systems, the unit would collect data of national and interprovincial interest and supplement weak provincial agencies, with the provinces primarily responsible for developing programs for their own requirements. A crucial function of such a unit would be to make information available equally to all concerned government agencies and also to the private sector and other interested parties. A decision would be required as to how the costs incurred by the unit would be met and whether a fee should be charged to users of the service.

POLICY, PLANNING AND OVERSIGHT

Water Policies

Many countries in Asia have mechanisms for advising government at the highest levels on water matters. These are supported to varying extents by permanent bodies which may be independent and above the implementing ministries and sectorial departments. In China, the State Council is advised by the Water Resources Coordination Steering Group comprised of members drawn from all relevant ministries and agencies, but which has only limited secretarial support. In India, direction at a political level is given by the National Water Resources Council, which is chaired by the prime minister and includes state chief ministers. This council also has little permanent presence. In Thailand, a permanent National Water Resources Board (NWRB) was created in 1983 under the national planning agency. It has an advisory role that has proven somewhat ineffective. In contrast, the Philippines' NWRB not only advises Government on water matters but is a permanent organization with broad powers for coordinating and integrating water resources development; administering rights; formulating and promulgating criteria, rules and regulations; undertaking river basin planning and other surveys and studies; and reviewing and approving water resource projects within the context of overall national, regional and river basin plans. On paper, therefore, its powers are very considerable, although its performance in practice

has been less impressive, and it has had some difficulty in ensuring that other agencies abide by its instructions.

In addition to any interministerial advisory or control body, most countries assign leadership in water matters to one ministry. In China: "The Department of Water Administration (the Ministry of Water Resources) under the State Council shall be in charge of the unified administration of water resources throughout the country." (Government of China 1988). In India, the Ministry of Water Resources is responsible for: "overall planning, policy formulation, coordination and guidance in respect of the water resources sector as a whole" (Government of India 1989). In Indonesia, the Directorate-General of Water Resource Development in the Ministry of Public Works is charged with the overall planning, development and management of surface water resources. However, evaluation of groundwater rests with the Ministry of Mines and Energy, and licensing with the provincial governments.

The activities of the lead ministry are, in many Asian countries, constrained by competing powers of other national and provincial agencies. In India, the Ministry of Water Resources is essentially the old Ministry of Irrigation (previously the Ministry of Irrigation and Power), which was renamed in 1985. It is responsible for international relations and for the central government's role in interstate rivers. But its origins are reflected in its preoccupation with irrigation and flood protection, and it has no direct authority over other important ministries. Even its authority over the Central Water Commission (CWC) is ambiguous since the CWC Chairman has the rank of secretary and acts in his own right as technical adviser to the planning commission. In China, the Ministry of Water Resources has greater powers but also has an irrigation and flood control focus and experiences some difficulty in managing relationships with the provinces (e.g., the river basin commissions [Box 3.4]) and other central ministries. This is hinted at in the 1988 Water Law, which states that "other relevant departments under the State Council shall be in charge of corresponding administration of water resources in conformity with the respective responsibility assigned to them by the State Council and in coordination with the Department of Water Administration under the State Council" (Government of China 1988). Only in the State Council, the highest authority in the land, can disputes be resolved.

The sectorial orientation of agencies in Thailand is perhaps an extreme case. According to evidence, there were no fewer than 31 agencies and 17 committees under eight ministries responsible for water resources development in 1982, and until the relatively weak NWRB was established, no particular agency was entrusted with overall direction. Irrigation is easily the largest water user but it comes under the Ministry of Agriculture and Cooperatives and has no particular responsibility for nonagricultural uses. As in India, a water policy statement has been adopted at a political level. But the need for rationalization is reflected in active discussions on a water code, which could lead to a strengthened NWRB. In Indonesia, water resources under Directorate General (DG), Water Resources Development and urban development under DG Cipta Karya both come under the Ministry of Public Works. This Ministry in principle facilitates coordination in areas where water conflicts are emerging due to rapid urbanization. In contrast, in Sri Lanka, irrigation and land are combined under the Ministry of Lands, Irrigation and Mahaweli Development, in this case facilitating integration of catchment land and water management.

The degree and type of sectorial integration, thus, varies depending on local circumstances and requirements. Nevertheless, the sectorial orientation of so many agencies and the inefficiencies and inconsistencies to which these variations gives rise, argue for a strong water advisory body. This advisory group should preferably be outside the line agency structure (for instance, in the office of the president or under the national planning commission or finance ministry). There can be no standard recipe for location of the advisory body in government,[1] nor for its powers relative to those of the line agencies and provincial/ local governments. It would normally be a highly qualified, relatively small body, with direct access to the highest political level. It would logically be responsible for national framework planning and, perhaps, data collection through an attached specialized entity.

Water Resources Planning

Assigning responsibility for planning must reflect its purpose and the decisions to be taken (Chapter 4). At the broadest level, national planning agencies integrate water resources along with other sectors in national plans. Water and land-use framework planning is necessarily conducted at levels where resource ownership resides and allocations are made, whether at the national, provincial or river basin level. The detail and characteristics of such planning vary greatly. In China, systematic river basin plans have been consolidated in a national water plan. In Korea and the Philippines, river basin plans provide the basis for approvals and licensing of water use. In Bangladesh, national master planning has been supported by the United Nations Development Programme and the Bank for many years. Elsewhere, master planning is less well developed and river basin plans are prepared *ad hoc*, ranging from the more comprehensive basin plans (e.g., for the Mekong, Mahaweli, etc.) to little more than a basic interstate allocation for 75 percent of the year (as under most Tribunal Awards in India). National planning is logically assigned to a central unit to: (i) Maintain and update the framework plan, and (ii) advise policymakers on the consequences of alternative actions. River basin plans should be fully reflected in framework plans, although, logically, basin planning would be done by the jurisdiction responsible for the basin. Local planning naturally falls to the respective local government entities, depending on the control exercised not only over water utilization but also land use, waste treatment and disposal and other activities. Project planning is undertaken by the implementing entity, which may be a line department or autonomous body; in principle, in line with national, river basin and local plans.

Regulation and Oversight

Separation of regulatory and operational functions is seldom clearly established in Asian countries. Thus, many operational and implementation agencies are to all intents and purposes self-regulated. This has adverse consequences for operational efficiency and the fair exercise of regulatory powers. Regulatory and line responsibilities, thus, should be separately assigned. Monitoring and enforcement of water quantity allocations, water quality standards and environmental regulations logically takes place at the level of resource ownership, although some powers may be properly delegated to lower levels of government. Land-use matters naturally reside at the level of corresponding water and land-use planning functions. Administrative and financial regulation of service entities also resides at the level of government responsible for their registration. Delegation of powers may be constrained if provinces and local governments do not

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1/ The problems this can involve are well illustrated by Bangladesh. The Master Planning Organization (MPO) has been temporarily located in the Ministry of Irrigation, Water Development and Flood Control (MIWDFC). The draft, *Water Resources Planning Organization Order*. The Government of Bangladesh MPO proposed in 1991 to establish it on a permanent basis, but it fails to identify where in the bureaucracy the organization would be located. This reflects contentious rivalries between the Ministry, the Bangladesh Water Development Board (BWDB) (administratively under the Ministry but powerful in its own right) and other agencies. In the past, it has variously been suggested that MPO might come under one or the other of MIWDFC, BWDB, the Office of the President or the Planning Commission.

have the necessary capabilities and may be undesirable if national objectives dictate uniform application of standards. In these cases, central government may need to retain certain powers.

Environmental and water quality standards are often set by an environmental ministry or similar organization, with powers to regulate the activities of a wide range of private and public entities. In China, the National Environmental Protection Agency functions at the provincial and local levels through units integrated within the Ministry of Water Resources and other resource ministries. This facilitates integration of water quantity and quality regulation while helping ensure that the regular implementing agencies retain responsibility for compliance in their respective areas. In contrast, in India, the Ministry of Environment and Forests implements pollution control standards and other environmental measures separately from, and in parallel with, the Ministry of Water Resources and other sectorial agencies. This not only raises problems of enforcement and compliance, but it encourages a tendency for special "environmental" programs to be developed in parallel with those of traditional agencies. This negates the principle of separation of regulation and operations, and possibly leads to waste, duplication and ambiguity in the operational area itself.

PROVISION OF WATER SERVICES

Water Services as Utilities

Experience worldwide has shown that measurable economic services (operation of multipurpose facilities, water supply and sewage, irrigation, power, telecommunications, posts, transport, etc.) are best provided by autonomous entities organized as utilities with the entity providing a readily defined service to its customers.[1/] The entity owns assets, procures new facilities and equipment, finances capital improvements, conducts O&M, and charges for the service. It can be a national agency, local government unit, user association or private company. Where it is a public entity, budgeting and accounting are separated from the parent organization. By isolating the service function from other influences and activities, the utility form encourages operational efficiency, service accountability and sound financial management. It allows clarification of any taxes levied or any subsidies provided, and creates the basis for public scrutiny and transparency of operations. Whether subsidized or not, the utility form establishes the necessary preconditions for the effective use of financial incentives rather than administrative regulation to encourage efficiency. The alternative is a public line department (national, provincial or local) financed from taxes, fees (including service charges) and other sources of government revenue. Such an arrangement is commonly adopted with respect to services that are difficult to measure in terms of benefits to individuals (roads, large flood protection, river training, etc.).

Multipurpose facilities in Asia are sometimes constructed and operated by an independent agency (Box 3.4), though these are not always financially autonomous. More typically, such facilities are operated by the predominant user (hydroelectric, irrigation or water supply), which allocates water to other users in line with government decision. Hydropower facilities are universally operated by power utilities. Most urban water services are also organized according to the utility principle, usually at the level of local government. Practice in rural water supply varies, but when government is involved, it is usually through a line department. Communal irrigation throughout the region and some public irrigation in East Asia are organized as utilities. In contrast, public irrigation in South and Southeast Asia is predominantly provided by line departments. Domestic supply in rural areas and in poor urban neighborhoods (via standpipes) are usually a direct government service, as are drainage, flood protection and river training. As in other parts of the world, many countries are seeking to extend the application of the utility principle as a means of decentralizing responsibilities, improving accountability and efficiency, and reducing burdens on the public budget. This can include promotion of communal participation and/or privatization. Given its importance in total water use and present

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1/ The utility form for provisions of water services is discussed in Annex 1 and Topic Paper 5, "Water Resources Institutions: Some Principles and Practices."

organizational patterns, perhaps highest priority should be given to the irrigation sector. Indeed, one of the major challenges facing the region is the promotion of the utility concept in major irrigation systems in South and Southeast Asia.

Multipurpose Facilities

In a few instances, multipurpose facilities in the region are operated as financially autonomous entities that supply water (and energy) for a fee to users. The Yellow River Conservancy Commission (YRCC) in China, for instance, operates San Men Xia and other facilities primarily for flood control, but wholesales water and energy to other users at a charge that depends on service and use. (Water charges to municipal and industrial facilities [M&I] for instance, are well above those for irrigation). The revenues generated are far from sufficient to finance its flood control and river training costs, which are subsidized by the national and provincial governments. But the YRCC has a basic interest in maximizing its revenues, and financial autonomy provides it with a strength and purpose lacking in many other multipurpose entities. Faced with provincial and agency resistance, the Ministry of Water Resources (the parent organization of the basin commissions) has had less success in promoting this approach in basins without an operating requirement comparable to flood management in the Yellow River. Even in the case of the Yellow River, the YRCC's operating powers are limited to the lower basin. The cascade of dams in the upper reaches is operated by a power utility that releases water in line with government allocations without receiving any financial payments from benefitting downstream users. Most other multipurpose entities in Asia operate in a similar manner. For instance, the Mahaweli Authority in Sri Lanka releases water for irrigation and power generation in accordance with government priorities. The Authority seeks to recover water charges from farmers within its own irrigation schemes, but neither the power utility, which operates the generating plant nor the Irrigation Department, which manages non-Mahaweli schemes, pays for the regulated water supply as such. In both cases, however, they incur all costs downstream of the point at which they receive water, and in turn seek to recover charges from the end-user.

Water Conveyance Facilities

The utility principle can be extended to water conveyance. Again, China provides an exception in that it applies this principle fairly widely. For instance, in the case of the lower Yellow River, the provincial water conveyance agency pays the YRCC for delivery of water at the river offtake, and in turn wholesales water to the county water conservancy units for a fee. More generally, provincial rivercourse entities similarly provide water to county units on a wholesale basis. In a sense, much major irrigation in South and Southeast Asia operates in a comparable way where the Irrigation Department delivers water to a government outlet below which a group of farmers is responsible for O&M. In most cases, however, the individual farmer rather than the group pays the water charge. But in the Philippines, and in Indonesia under a pilot program, group payment is encouraged, which could provide the basis for extending the wholesale principle more widely.

Municipal and Industrial Supply

Even though organized on a utility basis, many M&I utilities face severe administrative and financial problems due to: (i) Inappropriate coverage relative to administrative and/or hydrological boundaries (e.g., where allocations in a shared basin are arbitrary, where regulation and provision of service are inconsistently organized, or where agencies are remote from their customers); (ii) inadequate separation from other government activities; (iii) inadequate powers (notably over personnel matters, setting water charges, etc.); (iv) inadequate discipline or powers of enforcement (e.g., with respect to metering and billing, staff abuse, illegal abstractions, etc.); (v) inadequate maintenance of facilities (leading to high physical losses, deterioration of facilities, etc); and (vi) financial deficiencies and losses. Thus, while the utility form is normally a necessary condition for employing financial incentives and autonomy to encourage efficient operations, it is far from being a sufficient condition unless it is applied in every respect. Moreover, as indicated

above, the failure by primary water suppliers to charge M&I users provides little incentive at the wholesale level for minimizing water demands. Where the M&I user develops the primary source, of course, it incurs the costs of development and subsequent conveyance to its customers subject to any government subsidies.

Sewage and waste disposal services are relatively ill developed in Asia and have received much lower priority than the provision of the water supply service. As in other parts of the world, where they exist, they are usually provided by the water supply utility in return for a surcharge on the water fee since measuring waste disposal on an individual basis is difficult if not impossible. Standards of effluent disposal into common watercourses may be set by national, provincial or local regulators. In the case of local government utilities, costs of treatment are therefore included along with other costs. In principle, this encourages efficiency in water use both by the utility and by the customer where he is charged on a volumetric basis. Where standards are enforced, the impact on industrial entities is generally more pronounced and, in some cases, recycling can provide a financially attractive alternative to meeting effluent standards. However, virtually no standards are enforced in Asian countries, apart from Korea, with regard to domestic waste water discharges from urban areas.

Privatization of water supply activities is pursued to a limited extent in some developed countries where experience has shown that services classically provided by public agencies may be better handled by nongovernment entities. In Asia, however, there is little experience in privatizing such facilities, and they appear likely to remain structured as public corporations or utilities. Private development of captive sources, rather than being an objective to be desired is usually a response to a poor public service. Where such development is unregulated, this can have undesirable effects, for instance overdrawal of groundwater leading to land subsidence and/or saline intrusion (e.g., in Bangkok and other cities). Rather than the promotion of such forms of privatization, major emphasis must be placed on regulation and the provision of an improved and reliable public service.

Public Irrigation

Irrigation is both the dominant water user in Asia (Table 2.3) and the sector with the most varied agency structures. In South Asia and much of Southeast Asia, irrigation departments are among the largest and most powerful government bureaucracies. In India, the state irrigation departments are funded through the regular state budgets (funds for capital investment normally provided under the plan budget and recurrent funds under the non-plan budget) and are subject to normal civil service regulations and controls. In some states, the departments are responsible for both assessment and collection of water charges (collection, perhaps, by seconded revenue officers); in others they are responsible only for assessment; and in yet others they have no role in fee collection (e.g., in Tamil Nadu where charges for irrigation are reflected in a land tax). In all cases, however, receipts return to the state treasury and the allocations made to irrigation through the budget are only very indirectly related to the amount collected. A similar approach prevails in Bangladesh and Nepal. In Sri Lanka and most Southeast Asian countries (Indonesia, Myanmar, and Thailand), not even this level of fee collection has traditionally been attempted, although numerous pilot approaches are now underway, as in Sri Lanka and Indonesia. Land tax may reflect irrigation status, as in Indonesia, and rice export duties have been a quasi-cost-recovery mechanism, as in Myanmar and Thailand. Irrigation in these countries, therefore, has been seen as a free service to farmers and a vehicle for meeting national food security, income generation and income distribution objectives.

Where the external environment (physical and social) is favorable and irrigation management practices can be sustained, the line department approach can still perform well. An important example is Northwest India where system design is well adapted to the external environment and irrigation supports one of the most productive systems of agriculture in the

region.[1] But where external conditions are more difficult, the erosion of the discipline associated with simpler times and more autocratic government suggests that the line department mode is becoming increasingly untenable. Numerous reforms have been implemented or proposed, many with Bank support. For example, a comprehensive reform of the irrigation department in Orissa in eastern India was proposed in 1986, which would have streamlined the agency, created functional specialization, clarified public sector and farmer responsibilities, and introduced supporting reform measures. Although this proposal was suspended, elements of such an approach have been implemented in other states (e.g., Punjab). Elsewhere, emphasis has often been on specific elements: for instance, integration of water and nonwater activities, as under the Command Area Development Authorities program in India, decentralization of O&M functions, as in Indonesia, clarification of scheme-level operating rules and service functions, as under the National Water Management Project in India; transfer of responsibilities to farmer groups and their integration within management, as in Sri Lanka, Thailand and Nepal; and capacity building through training, improved procedures and other activities, as in all countries.

These reforms have had important benefits, although few have been entirely successful.[2] Reasons are many and varied but usually come down to the inherent difficulty of reforming massive government line agencies that are largely self-regulated, yet neither financially nor administratively accountable for delivering a defined service. This is illustrated by a recent comparative review of California, North China and Maharashtra (Pandya 1990), which concluded with respect to Maharashtra that: "while [the Irrigation Department] exerts monopoly control over water from 'production' to 'consumption', unlike a corporation it is not accountable or responsible for its outputs, revenues or costs and there is no distinction between governance and operations. Since operating budgets depend not on performance but on 'irrigation potential' created by new projects, the Irrigation Department consistently over designs projects and stretches water resources to the limit. Consequently, the system is ineffective and performance is poor." Though the conclusion on extensive irrigation is debatable, the paper makes a strong case for separation of regulation (governance) and operations, and for a corporate structure for the latter, an argument that can equally be applied to much other Asian irrigation. In contrast in China, Pandya concluded that: "...operating units have clearly marked and specified tasks and are accountable for their performance ...at the lower end of the system farmers control operations and the center is strong enough to exert discipline and create goal congruence."[3] Each operating unit is required to cover its O&M costs, including an allowance for depreciation and payment to the water supplier at a higher level. Thus, although units at different levels remain in the public or cooperative sectors they are financially and administratively autonomous and the system "resembles an administered Vertical Marketing System," in other words, a utility form.

1/ In Pakistan, despite an equally favorable physical environment and a similar approach to the design and operations to that in Northwest India, management of irrigation systems is reported to be deteriorating (International Irrigation Management Institute 1990) due to a breakdown in law and order. Without basic discipline, even the simplest and most robust system of irrigation management will ultimately fail.

2/ Programs that confuse the responsibilities of the irrigation agency with those of other departments, as has occurred in many cases under the Command Area Development Authorities program in India, have probably been counterproductive.

3/ With respect to the Californian system, Pandya concludes that it is: "organized as a commodity distribution system with suppliers, wholesalers, retailers and farmers...with a separation of governance (i.e., regulation) within an institution at each level of distribution; and there is separation of tasks among institutions which depend on market borrowings for financing projects. These structural elements make the entire system hierarchically accountable. A whole system of water rights, backed by enforceable laws, guarantees an equitable distribution of water, resulting in higher system performance." In other words, the system is fully structured on utility principles, with regulatory and service activities separated, and rights and implementing rules governing both public and private activities clearly established and promulgated. See Topic Paper 5, "Water Resources Institutions: Some Principles and Practices"; Topic Paper 7, "Water Resources Management in the Developed Countries"; and Topic Paper 8, "Water Allocation Methods and Water Rights in Japan" for more comprehensive discussions.

Fundamental reform of irrigation line departments, including their transformation into a utility form, will not come easily. However, developments in China over the last two decades, though building on a long history of local initiative, is one example that shows it can be done. The Philippines provides another example where a traditional line department was converted in the 1960s into an autonomous corporation, the National Irrigation Administration (NIA). As in the case of a line department, NIA has a monopoly from "production to consumption" and is subject to political control in setting its fee rates and employment policies. However, it retains the fees collected for its own use, is financially autonomous, and has created decentralized profit centers and incentive systems to encourage financial selfsufficiency. The NIA still faces formidable problems, and irrigation performance is not noticeably better than in countries with similar external conditions (e.g., Indonesia, Malaysia and Thailand). Even so, NIA has responded to financial pressure through cost savings, staff reductions and staff reassignments in a way unusual in the region. It has pioneered promotion of farmer groups to manage water at lower levels and in developing contractual arrangements with these groups for undertaking a variety of O&M activities. It has also demonstrated the advantages of a utility form in other ways. While the pace and nature of reform will vary between countries, transforming public line departments in South and Southeast Asia into utilities undoubtedly represents one of the major challenges in the region.

Communal Irrigation

Throughout the region there is a long and successful history of small-scale irrigation developed and operated by farmers. Notable examples include river diversion systems in the Himalayan foothills and piedmont zone of North India and Nepal; the tank systems of south India and Sri Lanka; the complex and interconnected diversion systems in the Indonesian islands of Java and Bali (most famously the subaks of Bali) and the Philippines (most famously the Banawe terraces). More substantial examples of private development are typified by the zinjara schemes of northern Luzon, which were developed in the last century by registered societies but are now operated by NIA, and the irrigation societies dominant in Japan, Korea and Taiwan. While the water conservancy bureaus at county level in China are in the public sector, they function much like farmer-run systems, both in smaller schemes and at lower levels in larger schemes. Farmer operated systems can be as large as 2,000 to 4,000 ha (e.g., in Nepal and the Philippines), and interconnected schemes covering much larger areas function well if water is abundant. In a few cases, farmer institutions have evolved to control water distribution between schemes (notably the subaks of Bali). More typically, cooperation beyond the scheme level breaks down at times of stress, requiring public intervention at the basin level if real-time management is to be implemented in an equitable manner. Such intervention takes on the characteristics of "wholesaling" and is comparable to the distribution of water in major irrigation schemes to the outlet.[1/]

The question arises whether the role of beneficiary organizations in irrigation can be increased through turnover of smaller public schemes and augmented responsibility in larger schemes. As indicated above, such organizations are already dominant in Korea and effectively so in China. Many other countries are implementing pilot programs (notably, the Philippines, Indonesia, Nepal and Sri Lanka) including: Formalization of water-user associations in village irrigation; turnover of smaller schemes to farmer management; and transfer of responsibility of aspects of O&M in the lower levels of major schemes. Bangladesh is promoting group ownership of groundwater irrigation facilities and is attempting to dispose of its entire inventory of publicly owned facilities, even at "firesale" prices. India is a partial exception, although statements of intent have been enunciated. In a few contexts (e.g., Kerala), CAD organizations approach farmer-managed entities. In others (e.g., in Maharashtra and as proposed under Gujarat's Narmada program), farmer control at a low level is to be institutionalized; in the case of Narmada, within the

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1/ Exceptions include systems in Northwest India and Pakistan, where the "warabandi" schedule below the outlet can be made legally binding at the request of the farmers, and those of western India, where under the "shejpali" rotation the public agency in theory controls supply to the farmer. In the majority of cases, however, distribution at the lowest levels is left to the farmers, most obviously in the field-to-field irrigation that characterizes paddy.

proposed service area of about 500 ha. India, however, has a long way to go before it approaches successful East Asian practice. Indeed, it is arguable that farmer associations at the retail level are unlikely to perform satisfactorily until the main distribution system can be effectively managed and until facilities that are handed over can be maintained. Nevertheless, in principle, there are still strong arguments for separating the primary conveyance function from that of retail distribution; establishing the former as a government utility; and transferring full responsibility of the latter to farmer groups operating as a farmer owned utility in the interests of their members. As envisaged under the Narmada program, contracts between the user group and the wholesaling entity could define the level of service to be provided, and the charge to be made.

Individual Irrigation

Ownership and operation by private individuals of surface systems will remain exceptional in Asia apart from small pump lift schemes. Individually owned ground-water facilities, however, have been a dominant regional characteristic. Again, in China, while not strictly private, local autonomy and farmer involvement mean that cooperative groundwater pumping installations in effect operate as nongovernment entities, especially on the North China Plain. A notable example of success in promoting the private sector is Bangladesh, where an enormous acceleration in investment in shallow wells and low lift pumps was associated with market liberalization and the abolition of distorting regulatory controls, a development in which the Bank had a positive role. Private groundwater development has had similar success in India. The decision at an early stage to rely on the private sector with supporting public power infrastructure and credit contributed to the successful conjunctive-use systems of Northwest India. Elsewhere in alluvial areas, government programs have contributed to the rapid spread of private shallow tubewells, greatly overtaking previous public tubewell development. In hard rock areas, dugwells with pumpsets are typically much more expensive to develop and operate than shallow tubewells, but are entirely a private sector activity and have expanded rapidly. Private sector investment is essentially unregulated. Where overdrawals do not lead to irreversible environmental effects, and input prices reflect real resource costs, unregulated market pressures can regulate groundwater exploitation. However, where overdraft is possible, licensing is the only effective management mechanism.

Drainage, Flood Control and River Training

Few developing countries have successfully charged individuals for regional drainage, flood control or river training services. These services in Asia are generally provided by national, provincial or local government line departments with few effective mechanisms for cost recovery. Within the clearly defined jurisdiction of an irrigation scheme, drainage and flood control works can be provided as an integral part of development and costs could be recovered as a surcharge on the irrigation fee or a property betterment tax. Stand-alone drainage projects can also be established under the same principles. Fees or betterment taxes could be levied on a more general basis for flood control or drainage works. This has been long practiced for flood control in China. Also in China, the tradition of local labor contribution for the construction and repair of flood control works goes back millennia. Consideration is being given to formalizing this in terms of a levy or tax in areas protected by major works, although it is unlikely that this can be properly organized fully on a utility basis in the foreseeable future.

Other Economic Services

A final mention can be made of other economic sectors, including river transport and similar services, which are often provided by autonomous public agencies though they may be prime candidates for privatization; aquaculture, normally private sector or communal activities; noncaptive fisheries, a predominantly private activity that may require public support to preserve the water body; and recreational and environmental activities, normally provided as a public service, though relatively rarely in Asia. Apart from formal aquaculture, these activities are predominantly instream uses that require flow regulation and the maintenance of water quality

standards. Some incremental consumptive use and deterioration of water quality may be involved and, if the utility principle is adopted, users would be expected to pay an appropriate charge with respect to the class and type of service provided by the wholesale supply entity. However, in the case of many miscellaneous instream users, there are few mechanisms for levying charges, although access may be regulated (e.g., relating to fishing or recreation) and other charges and taxes may be applicable (e.g., lock charges with respect to river transport or environmental levies of various kinds).

V. CONCLUDING REMARKS

Institutional reform is at once the central requirement in the water sector in most countries and the most difficult to institute. No standard solutions are possible and in all cases reforms must reflect the particular country context. As noted by Rogers (1990): "Water use in all countries has become embedded in complex legal and institutional settings. While it is evident that many of these institutional complexities can hinder economically efficient use of water it should be remembered that they arose in the first place because of the genuine problems that water raises for any politico-economic system." It is less evident that Rogers is correct when he goes on to say: "As the costs of ignoring the unitary nature of the resource rise one would expect to see the gradual ease of institutional constraints on development in the direction of more rational integrated use of the resource." There is little evidence from Asian countries that these reforms occur as a matter of course. Indeed, there is much to suggest, at least in the highly politicized countries of South Asia, that the necessary reforms become more difficult as the pressures on the water resource increase. Effective management of water resources requires the imposition of controls that are often difficult to enforce, for instance with respect to water quality standards, water rights systems, and water and land-use allocations. Even so, the failure of governments to tackle these crucial issues results in rising costs to the countries concerned.

This chapter has emphasized that: (i) Comprehensive water and related land legislation--clarifying water and land rights and establishing an administrative framework for government intervention--is a necessary if not a sufficient requirement for orderly development of the water resource; (ii) regulation must reflect the unitary nature of the resource while realistic as to what is attempted; (iii) management of domestic waste water, especially in urban areas, and of industrial effluents is a matter of growing concern that is often inadequately covered by legislation and for which any existing regulations are rarely enforced; (iv) data collection, processing and dissemination are the first requirements; (v) policy and oversight functions should be clearly separated from service functions; (vi) administration should be integrated and appropriately decentralized; (vii) water supply service agencies and service operations in many other related sectors are best organized as utilities that are transparently accountable, financially autonomous and provide a service for a fee; and (viii) many service functions in the water sector are best handled by nongovernment entities (beneficiary-owned or private). The promotion of these themes requires both realism and persistence. In many contexts, the Bank could be more forceful, and suggestions as to how this might be done are discussed further in Chapter 9.

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WATER RESOURCES PLANNING AND LONG-TERM MANAGEMENT

I. INTRODUCTION

Planning is taken in various contexts to mean different things. In this study, a broad definition is used to cover everything from national level planning and interactions with the macroeconomy to long-term management at regional and basin levels and to project and program planning. Program planning encompasses issues related to the creation of the incentive framework. As defined, planning is a large subject, about which much has been written. This chapter highlights some major themes with illustrations of the Asian experience and emphasizes that sound planning is an essential tool for long-term management of water resources.

PLANNING GOALS, OBJECTIVES AND POLICIES

A country's goals describe its broad aspirations (e.g., national security and social well-being); its objectives define what should be accomplished in measurable terms; and its policies express the decisions that guide appropriate action. They can be stated in political, economic, social and environmental terms. If all objectives could be valued using common, presumably economic, terms, then planning at each level could seek to maximize net benefits. However, despite heroic efforts to assign weights to social objectives and to internalize externalities, objectives remain disparate. Multiobjective planning is one technique for integrating them within a single framework. According to Peter Rogers it is: "based upon the concept of constrained optimization. The planner optimizes one objective, for instance national economic growth, while setting other objectives, such as environmental quality, as constraints upon the system" (1990). Though the planner can help clarify the goals and objectives, the government must put them into effect on behalf of its people through the political process. The planner's role is to evaluate their implications in terms of economic, social, environmental and other consequences, and to suggest the policies and actions that can best achieve the objectives desired.

Water development objectives are stated according to the needs of each sector, in particular, whether the sector represents a consumptive or instream use of water. Thus, in domestic water supply they are typically expressed in terms of target populations and quality standards; in irrigation, in terms of food security, regional development and economic welfare; in hydropower and navigation, in terms of least cost investments to meet the power and transport needs associated with projected economic activity; and in environment, in terms of a variety of physical standards and aesthetic perceptions. Multipurpose planning takes into account such differences in ways that recognize the particular characteristics of water. An important concern is to ensure all sectors are equitably treated and to avoid biases that can arise when planning is assigned to a sector-specific lead agency.

PLANNING SCOPE

The geographical limits and time horizon of a planning activity, and the level at which the activity is undertaken, all vary depending on the planning purpose and decisions necessary to take. The area covered is normally defined by administrative and/or hydrological boundaries. The time horizon is dictated by the period over which decisions have a foreseeable effect. Given the scale and gestation period of many water programs, and their impact on the distribution of population and economic activity, a long time horizon is usually appropriate. Indeed, failure to anticipate the long-term consequences of major decisions is a prime weakness in many Asian countries. Four types of plans are discussed: National, regional, basin water and plans for projects and programs.

1. **National Water Resources Plans** document the goals, objectives and current policies to guide water and related land-use development and management. They document the surface and groundwater resources including transbasin diversions. They describe the existing and projected future situation and the projects and programs to meet the agreed objectives over a time horizon of 50 years. Greater detail is usually provided at intermittent periods of 5,10 and 25 years. These plans are usually built upon basin plans and are updated at five-year intervals. Water resources development plans to guide expenditures are usually a component of the national economic/development plans and schedule water sector investments over time periods dictated by the specific investment and funding allocation. The development plans directly reflect legislative authorization and budgeting.

2. **Regional Plans** are framed in terms of resource development; the consequent distribution of population and economic activity; the required infrastructural support; and the measures to balance public and private activity, to provide an appropriate environmental setting and to achieve other objectives. They typically focus on rapidly developing regions (urban conurbations, development zones and settlement schemes). Time horizons are similar to those for national water plans with investment phased in line with short-term development plans.

3. **Basin Water Resources Plans** have a content similar to national plans with less backup discussion of goals, objectives and policies but more detail on projects and programs. Their preparation allow greater participation by the local entities and citizenry. The time horizon and updating criteria parallel the national plan. Typically, the general provisions of a real-time operation plan are included, though the detailed real-time operation plan is kept current by the responsible operating and oversight entities.

4. **Project and Program Plans** are set within national, regional and basin plans. They have variable time horizons, depending on the facilities provided and the nature of the programs supported. Project feasibility studies review alternatives in the light of capital and operation and maintenance (O&M) costs, project benefits and environmental considerations, and are converted to final design plans for implementation. Program plans reflect the regulatory and incentive structures that must be established.

All Asian countries have variations of national plans. These range from detailed and powerful control mechanisms to little more than rolling five-year investment programs. Feasibility studies or project plans are also essentially universal though their quality varies greatly. The main deficiencies are found in regional and basin planning, and in their aggregation into national water plans, for use in controlling and guiding the formulation of projects and programs.

ISSUES IN WATER PLANNING

Data Requirements

Sound planning and management are impossible without good data. Much information, especially at aggregated levels, should be available from regular public sources. Other information is collected during the course of the planning exercise itself. A widespread weakness in much Asian planning is, however, overdependence on one-off data collection exercises (notably during project preparation) rather than establishing permanent and systematic data collection and dissemination programs. A further weakness is the failure to integrate data on water and land, surface and subsurface water, and water quantity and quality.

Planning for O&M

All planning and design assumes that facilities will be operated and maintained to provide defined services over time. In practice, services may differ from those intended and projected benefits may not be achieved. Reasons vary greatly but very often they reflect a failure in planning to account for the impact of the external environment on system and project performance.

For instance, overreliance on a statistical measure such as the 75 percent probable rainfall or runoff year rather than a full assessment of the variable and stochastic nature of water resources provides a poor guide for management, and hence for planning or design, even when based on an adequate record. Operational procedures and water control must reflect the real variability even if the project is cleared on the basis of some statistical measure. More generally, inadequate attention to O&M during planning and design results in plans of operation and maintenance that are neither sufficiently realistic to be manageable in practice nor sufficiently detailed to provide adequate guidance. No doubt there are often opportunities for strengthening O&M at subsequent stages, but many of the most intractable problems date from the initial planning and the subsequent design and construction of the facilities.

Efficiency Assumptions

Water-use efficiency is best expressed in economic terms based on a full accounting of the physical resource. With respect to physical accounting, the only important issue is whether water is lost to the system; that is, whether it flows to the sea or a sump, or becomes so degraded as to be unusable. If return flows to rivers or groundwater systems can be exploited, then real losses may be negligible. Thus, endeavors to improve the physical efficiency of a facility may be inappropriate and indeed may deprive downstream users of customary supplies. Impacts on drainage, treatment and pumping costs, and on the timing and manageability of supplies, must of course be assessed in each context, and the sizing of facilities must reflect diversions irrespective of losses. But with respect to water availability to the basin, it is basin efficiency rather than project efficiency that is relevant. Efficiency in many Asian basins is essentially 100 percent during the dry season, and can approach such levels year round if sufficient storage is developed. Under these conditions, such measures as canal lining will do nothing to produce more water except at the individual project level and may aggravate lower basin shortages if the "saved" water is then consumed within the project (see Topic Paper 2, "Water-Use Efficiency and Effectiveness").1/

Planning Alternatives

Planning combines the skills of many disciplines. It involves specification of alternatives (technical, institutional and phasing) by different specialists, and their integrated evaluation at every level. This is done through comprehensive multipurpose planning, with alternatives conceived in the broadest sense to reflect not only intersectorial issues but also resource interactions (land and water, conjunctive use of surface and groundwater, and water quality and quantity), and varying approaches to resolving problems (structural versus nonstructural solutions in flood protection, and large-scale surface irrigation versus groundwater development, etc.). Alternatives must allow for reallocation over time, in particular as the resource becomes more fully exploited, since near-term commitments can impose serious rigidity and longer-term inefficiencies. Planning can be overdone. It needs to focus on real issues and questions. But failure to consider the broader picture, and a full range of possible alternatives, lies behind much inefficient and wasted investment.

Planning Methodologies

Options can be brought within a consistent framework using standard cost-benefit techniques, a set of procedures that can account for externalities and public goods in ways that are consistent with resource-use efficiency. According to Rogers,"the literature provides robust methods for planning water resources at a river basin level and at the level of individual projects," but tends to break down in "(i) Establishing and using the concept of opportunity cost of water in

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1/ Examples exist where channel lining has been shown to improve the operational characteristics of irrigation facilities in addition to the water-use efficiency, as, for example, the canal and water course lining programs in Northwest India.

different sectors of water use, and (ii) incorporating social and environmental concerns directly into planning" (1990). Cost-benefit analysis can readily account for opportunity cost so that the first inadequacy reflects a widespread failure to apply known techniques rather than methodological deficiencies as such. Cost-benefit analysis may be less suited to the incorporation of social, environmental and intergenerational concerns, which may have to be evaluated as constraints on efficiency using multiobjective planning. Cost-benefit techniques are also generally inadequate for relating water plans to overall macroeconomic and regional development. Given the scale of water resources programs in Asia, this methodological weakness is of particular concern.

Even if projects are properly selected taking into full account multipurpose use, opportunity cost and environmental impact, subsequent operation may be inconsistent with planning intentions. For instance, preference may be given to a single use, or the water charge may be set well below its shadow price, or there may be a failure to penalize environmental damage. These issues relating to real-time management and financial incentives are discussed in following chapters.

Mathematical Models

Numerous modelling techniques are available to help in program and project analysis. Notable are simulation models that represent the physical or socioeconomic system, and programing models to optimize development subject to specified objectives and constraints. Simulation models in particular are indispensable for assessing hydrology and water operations, for undertaking sensitivity and risk analysis, and for providing the basis for evaluating alternative program and project configurations. It must be recognized that modelling can produce misleading results if inadequate data are available (the most common cause of poor decisions), and that the power and flexibility of modelling techniques can be abused if objectives are not clearly established and if planning exercises are not focussed on real problems. However, the failure to apply well established modelling techniques is a weakness in many Asian contexts and results in suboptimal solutions for many problems.

II. National and Provincial Planning

National Development Planning

Development planning in Asia is typically undertaken through five-year plans. Such plans respond to shorter-term resource and other constraints while promoting longer-term strategies and policies. They are sometimes--as in Malaysia--supplemented by formal long-term perspective plans. In communist countries (China and Vietnam) five-year plans are intended as powerful instruments for command and control. In other countries (India and Indonesia) they can be important statements of government intentions. In yet others (the Philippines and Sri Lanka), they are little more than public investment programs, perhaps revised on an annual basis. In federal countries (China and India) provincial plans are essentially replicas of, and integrated within, the national plan. A five-year time horizon is far too short to achieve most water-resource objectives, which must be framed in decades rather than years. Nevertheless, short-term funding constraints are real and development planning in poor countries (Bangladesh, Nepal, Laos, Myanmar and Vietnam) is inevitably dominated by the availability of external finance. Foreign aid can be an important determinant even in somewhat richer countries (the Philippines and Indonesia) and, in all countries, financial constraints must be reflected in plans for achieving longer-term objectives in the water sector.

Water resources development in Asian countries typically account for 20 to 25 percent of total public investment, with ripple and linkage effects that can be extensive. Irrigation projects in particular have often been the motor that has driven regional development and, in a few cases, national development. An extreme example is the failure to anticipate the macroeconomic consequences of the Accelerated Mahaweli Development Program (AMDP) in Sri Lanka (Box

4.1). Many of its negative effects were due to the scale of expenditure rather than to the particular characteristics of water. However, the size of water resource programs, and their linkages throughout the economy, make them particularly liable to such consequences. Irrigation, for instance, is frequently linked to national objectives of food self-sufficiency without adequate attention to their real resource costs and macroeconomic impacts. Indeed, the AMDP itself was envisaged as a means of achieving rice self-sufficiency despite little evidence that Sri Lanka had a comparative advantage at the margin in rice production. On the other hand, Rogers (1990) quotes an attempt to construct an economywide model for Bangladesh, incorporating a detailed water sector and its macroeconomic linkages. The results suggested that an export crop strategy was inferior to a food crop strategy in view of their relative foreign exchange effects, and the consequent impacts on raw material and intermediate goods imports to sustain nonagricultural sectors. Whether this implied more than that Bangladesh has a strong comparative advantage in rice production is uncertain, but clearly "The development of a reliable planning methodology linking water sector plans to the overall macro development of a country is a generic problem that is of major significance to guiding investments and other ...water activities" (Rogers 1990).

NATIONAL WATER POLICIES AND PLANNING

Water Policies

Several governments in Asia have published statements of national water policy. For example, India published a National Water Policy in 1988 that represented a consensus at the highest political level of goals, objectives and policies for water. Thailand has set out a similar document. Other countries embed water policies in legal codes, for example in China, the Philippines and Indonesia. Environmental policy is also typically expressed in legislation.

Box 4.1: MACROECONOMIC IMPACTS OF THE MAHAWELI DEVELOPMENT PROGRAM

A recent study entitled, "Macroeconomic Policies, Crises and Growth in Sri Lanka, 1960-90" (Athukorala and Jayasuriya 1991) places the impact of the Accelerated Mahaweli Development Program (AMDP) within the broader macroeconomic setting. At its peak, the AMDP absorbed 6 percent of GDP, 17 percent of total public expenditure and 44 percent of public investment expenditure. In the short-term, it had strongly positive effects on growth, creating "boom conditions" and attracting support both at home and abroad. However, it also came to be seen as the indicator of the success or failure of the regime, crowding out other priority public investments, and reducing the government's capacity to adjust expenditures in response to external developments. Moreover the inflow of foreign savings supported an overvalued exchange rate, put extraordinary pressures on real wages and prices of intermediate goods, and absorbed large domestic resources in the form of counterpart funding. It thus counteracted the structural adjustment goals of the concurrent trade and exchange rate liberalization -- in itself an important justification for donor support! -- and adversely affected private industrial investment and trade. Once the initial investment boom faltered, the country was faced by renewed balance of payments and debt problems without having created the conditions for sustained growth. "No other country in recent history has raised its public sector spending so massively in such a short period of time ... perhaps the worst aspect [being that it] permitted the postponement of required adjustments and policy changes" (Athukorala and Jayasuriya 1991).

It is true that new land and power supplies were developed. However, the costs of land development, excluding headworks, rose to US$12,000 to $15,000 per ha at 1987 prices, compared to $3000 to $5000 per ha typical in other Asian countries. Even with double cropped paddy, Operations Evaluation Department (OED) had found the economic returns from earlier, and cheaper, projects to be low or negative. Meanwhile the hydroelectric components were included in least cost power investment programs only on the assumption that 55 percent of the headworks costs could be attributed to agriculture. Conventional arguments based on sunk costs, generous aid terms, and lack of aid fungibility failed to account for the adverse macroeconomic impacts, and the productive impact was in any case limited. Since not even operation and maintenance costs could be recovered, new settlers benefited from massive subsidies and their spatial distribution, if anything, aggravated social tensions. Indeed, it can be argued that a long history of high cost settlement schemes in Sri Lanka has aggravated communal problems without creating a contented settler community. A one hectare paddy farm is inadequate to generate incomes much above the national average and, within a generation, leads to renewed land subdivision and unsustainable population pressures.

Water Planning

The extent to which national water planning is implemented through policy statements and legislation varies. Perhaps the most systematic approach has been taken in China where basin plans have been consolidated into a national water plan that in principle controls all water resource developments and allocations. Basin Commissions rather than provincial agencies are responsible for clearance so that development can be managed on the basis of hydrological considerations. Basin plans are also used to control development in Korea and the Philippines, although these have yet to be consolidated in national plans. However, the Philippines is currently reviewing a proposal (drafted with assistance from the Economic and Social Commission for Asia and the Pacific) to update and supplement existing basin framework plans and consolidate these in a National Water Resources Master Plan. As in China, the aim would be a legal framework on a national scale for project clearance and approval but, in contrast to China, control would be exercised by a central government agency (the National Water Resources Board) rather than basin commissions. A similar approach was envisaged in Indonesia under Regulation No. 22 on Water Management (1982). But, although plans have been prepared several years ago for twelve major basins, they are rarely used to guide development and have yet to be consolidated in a national plan as envisaged under the 1982 legislation. Bangladesh has also made concerted attempts to prepare a national plan (Box 4.2). The plan has a strong data collection and analytical base, and could contribute to future institutional and policy reform. However, as it currently stands, and in contrast to the national water plan in China, it is a document with limited strategy recommendations rather than an enforceable master plan, and in this sense, is best regarded as a follow up to the influential 1972 Land and Water Resources Study.

National water planning elsewhere in Asia has typically been less formalized. Essentially all countries have undertaken strategy reviews and studies, which, to a greater or lesser extent review the water sector as a whole. For example Myanmar, then Burma, undertook a major land and water resource study in the 1950s with U.S. assistance, which was influential in setting directions for development (Knappen, Tibbetts, Abbett (KTA) Engineering Co. 1953). In Malaysia, a National Water Resources Study was completed in 1983 with Japanese assistance, which recommended the formulation of a national water policy to be followed by the preparation of national and regional level master plans. The national water policy remains a matter for contentious debate. In many other instances, strategic planning has been predominantly undertaken on a sectorial basis. For instance, in India, the Report of the 1972 Irrigation Commission had a major influence, although it only partially responded to overall water resources issues. Similarly, most countries have prepared energy master plans *inter alia* to guide investments in hydroelectric facilities, and to varying extents, have undertaken master planning in other water-using sectors. While these normally have important benefits, countries in the region increasingly recognize the need to prepare formal policy statements for the water sector as a whole, to be followed by the adoption of national framework plans to control development.

Box 4.2: BANGLADESH NATIONAL WATER PLAN

The 1972 Land and Water Resources Study was influential in the 1970s in guiding the Government of Bangladesh and donor actions in the water sector. By the early 1980s, it was felt that a further initiative was required to update the earlier study, broaden its analyses and prepare a framework for long-term water resources development. The Master Planning Organization (MPO) was established in the Ministry of Irrigation, Water Development and Flood Control, and the National Water Plan Project (NWPP) was started in late 1983. The Phase I Report was submitted by the consultants in December 1986 and, under a separate contract and after some delays, the Phase II Report was received in June 1991.

The NWPP assembled a substantial amount of information, including much based on primary survey and research; developed a range of planning models and analytical tools; and recommended strategies, programs and projects, many of which have been adopted by the government and donors. In particular, groundwater resource studies indicated substantial remaining potential, and the NWPP advocated approaches that have been progressively adopted to abolish regulatory controls, liberalize and privatize sales of pumps and other equipment, and promote rapid development of shallow groundwater and local water markets. These approaches built on earlier policies that had been moving in the same direction and together helped support a rapid increase in agricultural output based primarily on dry season irrigation. The MPO and the NWPP also prepared a draft water code and made other proposals to institutionalize the process of water planning and long-term management in Bangladesh.

Despite these achievements, the Phase II Report falls short of a true national water plan. First, its perspective was only to 2010, which is inadequate for evaluating large-scale programs, impacts and requirements. Second, it failed to integrate or evaluate properly a number of major projects and programs, even those falling within the purview of its parent ministry (barrages, irrigation schemes and flood control facilities). Third, programs in other ministries were inadequately integrated, with their assumed requirements taken as constraints rather than evaluated systematically within a common framework. Fourth, in response to the Terms of Reference and in the absence of agreements on international rivers, the plan deals only tangentially with major aspects of water resource availability. Finally, despite MPO's efforts, it remains unclear to what extent the agency has been institutionalized and, if so, where it will be located in government. Other planning exercises continue in parallel to those of MPO (on international waters, flood control, programs in other ministries), and there is a danger that the substantial data gathering and analytical achievements of the NWPP will be at least partly lost if they are not followed up and supported on a permanent basis.

III. REGIONAL PLANNING

Regional planning is undertaken to a greater or lesser extent in all Asian countries. Coverage and content vary greatly. Plans range from regional strategy documents such as those prepared in the 1970s for North, Northeast and South Thailand, to detailed land-use plans for settlement schemes, urban conurbations and regions selected for intensive industrial development. Such planning typically relates water issues to the region's physical characteristics. This is most clearly illustrated by land settlement plans and land-use plans for urban/industrial areas. Environmental studies also often have a regional dimension, although they fall outside the usual scope of regional planning. Environmental studies in Asia with a major water focus have included those for Songhkla Lake in Thailand and Laguna de Bay in the Philippines.

RURAL DEVELOPMENT

New Land Settlement

Settlement plans typically establish, in an integrated manner and in a green field setting, the pattern of agricultural activity, the location of new population centers, and the design of infrastructural and service facilities, including those for water. Examples where irrigation has provided the main motor for such programs include the Rajasthan Canal scheme in Northwest India,[1/] dry zone settlement schemes in Sri Lanka (culminating in the AMDP), projects in

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1/ Settlement schemes in the Indus Basin date back to the "Canal Colonies" associated with the first stages of irrigation development during the last century, in Punjab in India and in what is now Pakistan.

Indonesia's outer islands, and some developments on Mindanao in the Philippines. Successful programs based on rainfed agriculture include those undertaken in Malaysia by the Federal Land Development Authority (in the Jengka Triangle, South Johore, Pahang, etc.). Transmigration schemes in Indonesia and settlements implemented by the Department of Public Welfare in Thailand have proved more problematic. Among the most difficult have been swamp reclamation programs in Indonesia. However, similar swamp reclamation and settlement schemes have been implemented successfully in the coastal zone of Malaysia, many of them prior to independence. Flood protection and land reclamation programs in the Irrawaddy Delta in Myanmar date back to the last century and, by all accounts, have been highly successful over the long term. Similar schemes have been implemented on the Mekong and Red River deltas in Vietnam.

Existing Settled Areas

Regional planning approaches are less widely applied in support of infrastructural investment in already populated areas, presumably because land ownership and settlement patterns may initially be somewhat unaffected. Nevertheless, irrigation in particular can transform population patterns and economic activity especially in arid regions.

Gujarat's ongoing Narmada development was planned primarily as an irrigation and power project, largely by an irrigation agency, even though it is best regarded as a regional planning program impacting broadly on much of the state. Indeed evaluation of the program in regional planning terms might have modified its rationale. The issue is not just the direct benefits of new irrigation, substantial though these may be, but also the impact on existing activity in its widest sense. For instance, lacking additional Narmada supplies, water will have to be increasingly diverted from present irrigation to community and industrial supplies, with consequent impacts on incomes, rural-urban migration, and the need for urban infrastructure. The comparison of the "with" and "without" cases, and the proper accounting for opportunity costs and externalities, is thus very much more complex than if the scheme is regarded as an irrigation and power project only. Given that the program has already been justified in terms of its direct power and irrigation benefits,[1/] and that existing facilities in benefiting areas represent sunk costs, there is a strong *prima facie* case that economic returns would be substantially increased if expressed in regional development terms.

In general it seems likely that bringing additional water supplies into a water short, but existing settled area, will always tend to have relatively high returns. Other examples might include the south-north transfer scheme in China and interbasin transfers from Kerala to Tamil Nadu in South India. In contrast, new settlement requires a full range of infrastructural investment and will invariably be relatively high cost. It is true that new settlement relieves pressures elsewhere--a major rationale for the transmigration program in Indonesia--and that this can also have important externality benefits. Nevertheless, where new settlement includes the high costs of irrigation, road communications, power and other infrastructure, programs are only likely to be justified if they support high return agriculture. This is not the case for the two examples mentioned. In contrast, settlement schemes in support of rainfed agriculture often create a high return activity at relatively low cost, as illustrated by oil palm and rubber schemes in Malaysia.

There is a clear need for a better understanding of the regional impacts of major water development schemes in Asia, comparable to the need relating to macroeconomic linkages. A study of the Muda irrigation scheme in Malaysia was one important attempt that documented the importance of multiplier effects (Bell, Hazell and Slade 1982). In the event, however, Malaysia's rapid development has led to movement off the land to high paying urban jobs rather than to squatter colonies in overburdened cities. (This of course does not negate the benefits obtained at

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1/ Direct irrigation benefits may of course be overstated to the extent that less water will be available for new irrigation. But the delay of Narmada Sagar Dam has also caused substantial foregone power benefits from the Sardar Sarovar Dam.

an earlier stage of development). Lasting impacts have been achieved in some other areas of relatively high rainfall (e.g., Magat in the Philippines), although they are much less obvious where irrigation provides low returns and proves difficult to manage (e.g., in East India, Box 1.1). On the other hand, in more arid areas, even if irrigation performance leaves much to be desired (e.g., Nagarjunasagar, Upper Krishna and other projects in South India) the impact on regional economic activity can be striking, and, in many cases, there is perhaps no other comparable mechanism available to governments for promoting and achieving balanced regional development.

URBAN AND INDUSTRIAL DEVELOPMENT

The distinction between new development and planning for existing settled areas in the cases of urban and industrial planning is less clear cut. Planning for new development typically focuses on areas identified for rapid industrial development. The objectives may be to relieve pressures on existing urban areas or to create conditions for rapid industrial expansion. Thailand's Eastern Seaboard Development Plan covered all aspects of regional planning in the context of relieving pressures on Bangkok, and including the development of deep sea port facilities and the promotion of industrial and tourism development. Malaysia's Klang Valley planning exercise had similar objectives for the Kuala Lumpur/Port Klang region. China's Special Economic Development Zones along its eastern and southern seaboard have also been major enterprises that have accommodated massive population growth and industrial development.

Planning in respect of some existing major urban conurbations (e.g., Calcutta, New Delhi and Rangoon) also dates from their founding. In most cases, however, it came later in an effort to manage and control rapid urban development. Almost all major cities and towns now carry out such exercises, although the quality of planning and the degree to which it is formalized varies enormously. Even in small towns and villages, local government attempts to exercise some control over land use and other economic activities. Typically, urban development plans focus on land use, the location of economic and social activity, and the development of transport, communication and other infrastructure. Water supply, drainage, flood control, waste water disposal and other water-related services are invariably crucial components, and in some cases can be of dominating concern. In the cases of Beijing and Tientsin in North China, water shortages are an overriding concern and the urban limits include large agricultural areas partly to facilitate reallocation of water at times of shortage. In Madras in South India, water is supplied no more than one hour each day even in good years. In Calcutta, storm water drainage is a major concern. In the Jabotabek (Jakarta) region in Indonesia, there are important regional issues relating to the provision of community and industrial supply, its competition with irrigation and other uses, and the need for flushing water during the dry season and for pollution control. In Bangkok, major issues relate to overpumping of groundwater, the consequent aggravation of seasonal flooding due to land subsidence, and the need to plan for the future water supply and drainage needs of the city within the framework of the overall Chao Phraya Basin.

IV. BASIN PLANNING

INTERNATIONAL BASINS

Extensive studies were undertaken in the 1950s by India and Pakistan, together with the World Bank and others, while seeking agreement on the division of the **Indus** waters. These studies focused on river flows and prior rights, and were highly contentious until the compromise was reached that resulted in the 1960 Indus Basin Treaty (Chapter 3). Thereafter, each riparian has planned its activities separately. Unfortunately, this applies also to drainage planning, which more logically should have been a joint exercise. Formal planning, much of it with World Bank support, has been particularly extensive in Pakistan, dating back to the Lieftinck Report and the major detailed planning studies of the 1960s. These were followed by the United Nations Development Programme (UNDP) financed "Revised Action Program for Irrigated Agriculture" in 1979 and, more recently, by the 1990 "Water Sector Investment Planning Study." A notable

development, to which the latter study contributed in important ways, was the 1991 agreement on the allocation of Indus waters--including Tarbela--among the four provinces. In contrast, final allocation of Indus waters in India is still awaiting legal adjudication, and the Rao Commission report remains in draft.

Lack of cooperation has characterized planning for the **Ganges-Brahmaputra** Basin. Both India and Bangladesh have undertaken perspective planning studies variously proposing major storages on the river systems and transfers from the Brahmaputra to the lower Ganges. The Indian proposals envisage a massive canal beginning and ending in Indian territory and crossing Bangladesh. This has formidable technical and economic problems and would create massive social disruption and resettlement requirements, especially in Bangladesh. For these and other reasons, it has been unacceptable to Bangladesh, which has emphasized storages in Nepal to augment dry season Ganges flows. Bangladesh has also undertaken major water planning studies within its borders (Box 4.2) and is currently engaged, with international support, in major flood protection studies. Planning in India has typically focused on legal requirements for the development of tributary systems. In Nepal, apart from limited agreements with India on specific tributaries, planning has been independent and confined to major projects. Indeed, Nepal's consultants for the proposed Chisipani multipurpose project on the Ghagara/ Karnali River could not even visit irrigation schemes in India despite the major benefits attributed to Indian irrigation. The level of cooperation is even lower in the case of the proposed Pancheswar Dam on the Sarda/Mahakali River. This affects even site investigations since the river marks the India/Nepal frontier. Preliminary discussions have recently been initiated between the three main riparians--China and Bhutan have yet to be involved--and it is possible that these could lead to international cooperation of some kind.

Only in the case of the **Mekong** has joint international planning been seriously attempted. The Mekong Basin involves six riparian countries with divergent interests. Over a considerable reach the main stem marks the border between Laos and Thailand where main stream projects would require international agreement. Joint planning has been confined to the lower basin and dates from the 1950s when the lower riparians (Thailand, Laos, Kampuchea and South Vietnam) had similar political regimes. At their request, the United Nations in 1957 established the "Committee for Coordination of Investigation of the Lower Mekong Basin" (the Mekong Committee), which by 1970 had produced an indicative (lower) basin plan. Both the short range (1971-80) and long range (1981-2000) plans focused investment on hydropower, but with major irrigation and flood control benefits. The core of the long-term plan envisaged a cascade of seven dams on the main stem (the largest is Pa Mong) with a total net storage of about 142 BCM, installed generating capacity of 23,3000 MW and an irrigated area of 4.3 M ha. The 1970 Indicative Basin Plan has been subject to subsequent modifications. However, the committee's "Perspectives for Mekong Development" (1988) retains the main stem cascade as central to long-term development planning though with combined storage reduced to 77 BCM to ameliorate resettlement problems. Development of the cascade will be a very long process. Agreement has yet to be reached on the first project and, with growing environmental concerns and escalating resettlement problems, the cascade may never be implemented in its entirety.

The Mekong Committee has been forced to focus on data collection, planning and smaller tributary projects. Only one hydropower dam has been constructed under its sponsorship--Nam Ngum in Laos with 150 MW of installed capacity from which about two thirds of the energy is exported to Thailand. However, Thailand has financed four dams on tributaries within its territory from its own resources. The possibility that China and Myanmar might join the Committee is in principle to be welcomed but might do little to improve this situation. Each country continues to undertake planning on its own behalf (e.g., under the Bank-administered Mekong Delta Planning study in Vietnam and studies in Thailand, which envisage the possible transfers of water from the Mekong to the Chao Phraya Basin).

DOMESTIC BASINS

Several countries have made the river basin the basic planning unit for water resource development. **China's** 1988 water law requires that basin plans should serve as the basis for water development, utilization and prevention of damage, and these have now been consolidated in a national plan. Ancillary regulations are adequate to ensure that the provisions of the water law are reasonably effective. However,"In approving certain engineering projects, some departments and regions (provinces) have violated the principles and aims of river basin planning ... (and) ... have sometimes failed to base their decisions on long-term plans for the river basin" (Ministry of Water Resources, 1990). In addition to implementation issues, there is no doubt also room for strengthening the technical and economic bases for planning in China. Major ongoing planning exercises include those related to flood control and other problems in the Yangtze Basin (notably related to the proposed Three Gorges Project); flood protection, siltation management and other issues in the Yellow Basin (notably related to the Xiao Langdi project); and water shortages and groundwater overdraft on the North China Plain (notably related to the south-north water transfer of Yangtze water). These projects are among the largest in the world, and provide a formidable challenge in the coming decades. Lesser, but still very substantial, programs and projects are envisaged in other Chinese basins. China's basin approach is illustrated for the Yellow River in Box 4.3. The basin unit is also used for planning of water resources in **Korea**. The legal powers of government are such that allocations can be changed in accordance with changing priorities and shifting demands. Moreover, the government can and does relocate industry to maintain water quality standards in critical parts of the catchments in conformity with overall basin development plans and objectives. The only planning problem of significance concerns the North Han River Basin, the upper part of which extends into North Korea. No riparian agreement is likely between the two countries in the foreseeable future given the political issues concerned.

Basin level planning is in principle required for all uses of water in **Indonesia**, although in contrast to China, the provisions of the 1982 law have had little practical impact. Draft legislation on the regulation of rivers, classified into 90 basins or composite basins, was prepared by the Ministry of Public Works in 1984, followed in 1989 by a Draft Ministerial Regulation, which, if adopted, would firm up planning requirements. The **Philippines** has also accepted the concept of planned development of its water resources on the basis of basins or composite basin units. Between 1979 and 1983, 35 major basin and composite basin reports were prepared covering the entire country apart from the Central Luzon region, which was the subject of an earlier study assisted by the U.S. Agency for International Development. The reports follow a standard format and are in considerable detail. They cover the physical setting, water and land resources, socioeconomic situation and population, and environmental considerations. They make sectorial recommendations regarding water supply and sewage, irrigation, flood control and drainage, land-use management, power and fisheries. They need updating to reflect changes over the last decade and shifts in policy, but are used by the National Water Resources Board for licensing and project clearance and are useful reference documents. Even so, the Philippines still experiences problems in pursuing rational development and management of its water resources, reflecting weaknesses in administration rather than its basic planning approach.

Other countries have generally followed a less systematic approach to basin planning, adopting it to prioritize projects rather than to control development. In **Bangladesh**, it is true, the nationwide water resource evaluations and allocations under the National Water Plan Project (Box 4.2) were based on an aggregation of estimates for naturally defined hydrological units (essentially subbasins), but these have yet to be implemented to control development in any meaningful way. **Thailand, Myanmar, Sri Lanka** and **Indonesia** are countries that have prepared numerous individual basins plans, usually with the assistance of consultants. These have influenced project selection but have seldom been institutionalized or systematically updated. Mahaweli development in Sri Lanka illustrates this experience. The original master plan was completed with assistance

Box 4.3: PLANNING IN THE YELLOW RIVER BASIN

The first multipurpose planning report for the Yellow River was prepared in 1955. It identified 44 projects for the main river downstream of Long Yang Xia. Since then, detailed planning and design has revised these proposals, and 29 main stream dams are now envisaged, seven of which are identified as "key" projects: three in the upper reach (Long Yang Xia, built; Liu Jia Xia, almost completed; and Hei Shan Xia, planned), and four in the middle reach (San Men Xia, built; Xiao Langdi, in advanced planning; and Jikou and Long Men, planned). Planning is based on allocations among 11 provinces/special areas after allowing for downstream releases for sediment control. These allocations are notionally for the year 2000 with stated reliability for irrigation and municipal and industrial use. All projects must be cleared by the Yellow River Conservancy Commission (YRCC) for consistency with the basin plan and approved allocations. Real time decisions based on detailed simulation/water balance studies, and reflecting the approved allocations, are taken at regular meetings of an interprovincial committee chaired by the central government. Dams in the upper reach are operated by a power authority primarily for hydrogeneration, subject to specified releases for irrigation and other purposes. The considerable reregulating capacity allows for fairly sophisticated power operations. Dams in the middle reach are, or will be, operated by the YRCC primarily for flood protection and sediment management. Xiao Langdi, Jikou and Long Men are scheduled for construction over the next 50 years or so with a view to controlling downstream sediment deposition, reducing flood protection investments and improving security against floods. Income from power and water sales are retained by YRCC, which is responsible not only for the middle reach dams but also for river training, dikes, flood detention and other services for which it receives no income. Financing is a contentious issue between the provinces, central government, YRCC and the power authorities.

Divided responsibilities between the power authorities and YRCC could in theory lead to operational inconsistencies, and the YRCC has sought responsibility for Long Yang Xia, which represents the main potential for interannual storage in the system. However, these inconsistencies are in practice limited, given the great distance between the upper and lower dams, and the predominant influence on flow variations of run-off and sediment from the middle reach. The basic simulation model is being refined and developed with Bank assistance, *inter alia* to account for flow time. It is possible that improved operating rules will result, in particular to integrate operations of the upper and lower dams. The revised model, in association with optimization and regional planning techniques, is also being used to evaluate alternative scheduling of water-use projects to help maximize economic returns consistent with the basic provincial allocations. Implementation and financial constraints have led to construction delays so that the YRCC now assumes that the approved allocations will not be fully utilized before 2010. Provided Xiao Langdi and some tributary projects are constructed, then assuming an average (50 percent) flow in the year 2010 "12 BCM (could be discharged) into the sea (for sediment control) ... the river channel in the lower river might be kept from aggregation over a period of 20 years or so by retaining sediment by Xiao Langdi reservoir ... (and) ... planned water supply could meet demands" (YRCC 1988). Beyond 2010, additional demands in the region of the North China Plain, including the Yellow River Basin, would have to be met from the south-north transfer from the Yangtze, while Jikou and Long Men would need to be scheduled as appropriate for sediment management and flood control.

from the United National Development Programme (UNDP) and the Food and Agricultural Organization of the United Nations (FAO) in 1968. Under this plan, it was envisaged that the full development of the water resources of the river system and neighboring basins would be completed in three phases over a 30-year period. The first projects generally followed the master plan. However, dissatisfied with the pace of development, a new government adopted the AMDP, which greatly accelerated implementation. For various reasons (including changing power costs, feasibility investigations and communal politics), the AMDP substantially revised the earlier master plan's proposals, but without the benefit of detailed planning. It initially envisaged construction of five dams and 135,000 ha of irrigation over a six-year period. It was modified following completion in 1979 of the "Mahaweli Implementation Strategy Study", but proposals for basin transfers to the north central province as envisaged under the UNDP master plan were suspended and, following a further planning study, essentially dropped. Implementation has been plagued by cost over runs, delays and political disputes, and it is unclear where it will go from now. Thus, although real-time management of the Mahaweli system represents one of the most successful approaches in the region (Box 5.3), development has been far less satisfactory.

Basin planning in **India** has been very limited. Indeed, it is arguable that only two serious attempts have been made to plan and actually implement the development of the water resources of a total basin -- that for the Damodar Valley (Box 3.4) and the Narmada Valley. This

is not to say that basin concepts are completely neglected. Tribunal awards and state agreements require that allocations be based on some assessment of river basin development. Moreover, most states have some institutional capacity for river basin planning. Tamil Nadu implemented a UNDP-supported planning study for three basins (Ponniar, Tambaraparani and Vaigai); Karnataka had for many years a master planning commission; Madhya Pradesh established the Narmada Valley Development Authority in 1982 to plan development of its share of Narmada water; and comparable activities have been undertaken in a variety of different contexts in all other states. The Union Government itself undertakes a variety of planning activities, notably through the Water Planning Wing of the Central Water Commission; in the context of individual river agencies (e.g., the Brahmaputra Board, the Ganga Flood Control Commission, and the Sone River Commission); and by the National Water Development Agency, which is preparing a perspective plan that envisages massive interbasin transfers within two regional systems (the Himalayan Rivers and the Peninsular Rivers). Finally, there have been numerous academic and independent studies (Chaturvedi and Rogers 1985). Even so, basin planning in its true sense has been noticeable by its absence, and, of all the major countries in the region, India has possibly done least to ensure that water resources are allocated consistently and efficiently within the framework of the hydrological system.

V. PROJECT AND PROGRAM PLANNING

GENERAL

Feasibility studies of some sort are required in all countries for project clearance as well as invariably being a condition for external funding. Study guidelines are typically provided by national planning agencies and are available from international agencies (e.g., the UN and the FAO/ International Bank for Reconstruction and Development Cooperative Program). Design and final facilities plans are required to varying extents for release of funds and are essential for implementation. Many countries depend on consultants for project preparation. Indonesia is perhaps an extreme example, but consultants have also been extensively employed in most other countries in the region. The most striking exception is India, which has strongly resisted use of foreign consultants, particularly in irrigation. It has depended very largely on state departments to prepare projects, supplemented by central government agencies (e.g., the Central Water Commission) and indigenous public and private companies. China is an intermediate case. Basic feasibility and project planning activities are undertaken primarily by domestic agencies, but these have been supplemented by specialist inputs from abroad and, with respect to major projects (e.g., Three Gorges and Xiao Langdi), the Government of China has both commissioned and readily acceded to studies by foreign consultancy firms to supplement those undertaken domestically. Planning for more diffuse programs (land reclamation, groundwater and pollution control) is typically less formalized in all countries. Planning of this type often requires a combination of agency actions, regulatory powers and incentives that is difficult to coordinate at the planning stage, and even more difficult during implementation.

As would be expected, the quality of project and program planning varies greatly. A main source of weakness has been suggested in previous sections--the failure in many cases to plan projects and programs systematically within the framework of regional and basin plans. This has the result that there can be inconsistent demands on the basic water resource. Other weaknesses are more directly related to the project area or program itself. In this context, it is possible to no more than highlight a few examples drawn predominantly from the irrigation sector to illustrate some of the most frequently encountered problems. Projects and programs are discussed separately in this section, although there is considerable overlap and this distinction is in some ways arbitrary. Additional evidence relating to project planning issues is provided in Chapter 8 in relation to Bank-supported projects for which data are, in general, more readily available than in the case of locally-funded activities.

PROJECT PLANNING

Financial Planning

Incomplete surface irrigation projects, due in part to poor capital programming and budgeting, are commonly found in the region. In China, numerous projects were started in the context of erratic past political campaigns. Completion is coordinated in a basin framework and accounts for much of the Bank's irrigation program. Such projects are often viable only by treating existing assets as sunk costs. India also has consistently had a large backlog of incomplete projects, also. Projects are initiated in excess of financial and technical implementation capacity, often for political reasons, with costs understated in the absence of adequate data or to facilitate clearance. A five-year planning horizon is grossly inadequate (some projects have extended over seven plan periods or more) and irrigation departments must passively accept continuing budgetary constraints. After 30 years under construction, the Rajasthan Canal serves less less than one third of its originally planned command area. Major projects on the central and eastern Gangetic Plain (Sarda Sahayek, Gandak and Kosi) and in South India (Nagarjunasagar and Tungabhadra) are other examples where the implementation program appears almost indefinite. For political reasons, the Gandak project was declared "complete" but was immediately followed by Gandak Stage 2 and by a large drainage program! Smaller projects (e.g., in Madhya Pradesh and Orissa) have also been excessively drawn out. Completion of headworks followed by delayed construction of irrigation networks, particularly minor networks, is a common feature in many countries, which seriously reduces economic returns.

Technical Planning

Implementation of projects without adequate hydrological and land capability data has already been mentioned. An example is the largest multipurpose project in the Philippines (the Upper Pampanga project), which has had significantly less water than originally envisaged (due to inadequate hydrology and, perhaps, a change of hydrograph as a result of catchment degradation). Similar afflictions plague many of the Philippines' run-of-the river schemes that seldom reach the design expectation of 100 percent cover in the wet season, in part due to inadequate hydrology and in part to overestimation of the area that can be served. A particularly striking example of an inadequate technical basis for a project is presented by the Teesta project in Bangladesh, which has been under construction with internal financing for almost twenty years. A recent reevaluation show that (i) Peak water requirements in the key month (October) are around 539 m^3/s rather than 285.5 m^3/s as previously estimated; (ii) the 75 percent dependable flow in October is only 198.4 m^3/s; (iii) the project will take 13,500 ha out of production through infrastructure etc.; (iv) 34 percent of the proposed command area is already served by tubewells; and (v) 88 percent of the area could be served by shallow tubewells or low lift pumps. Moreover, India continues to construct its Teesta barrage upstream with a guarantee that it will further reduce dry season supplies to Bangladesh. There is something extremely wrong with any planning and selection process that could select this project for implementation. Similar problems, if less extreme, are found in most other countries.

Overoptimistic assumptions related to project water-use efficiency can result in over-extension of irrigation command areas and undersizing of canals and other facilities (see Topic Paper 2, "Water-Use Efficiency and Effectiveness"). Losses have been much higher than conventionally assumed in India, Pakistan and elsewhere, notably during the 1970s (work in Pakistan by Colorado State University is frequently quoted). Examples where this contributed to overextension of the irrigation area are particularly notable in South India. The Radhapuram Canal constructed in the Kodayar System was partially utilized only twice in its first ten years. The extension to the Periyar Vaigai command area received no supplies in its first four years, in part because tanks on drainage ways in the command can reregulate all return flows, and when these

were reduced by canal lining the tanks had to be filled directly from the canal system.1/ Nagarjunasagar is an example where overoptimistic efficiency assumptions led to undersizing of canals contributing to severe tail-end problems, over loading of canals and the need for subsequent remodelling (including lining of the left bank main canal).

The formulation of realistic POMs is often lacking at the project level, which subsequently results in some of the most intractable O&M problems. Plans for O&M of all types of facilities in principle should be incorporated into project configuration planning studies at an early stage and be developed in great detail during final design. These issues are discussed at greater length in the following chapter.

Program Coordination

Poorly coordinated construction programs are common. Head-works are completed far in advance of the conveyance systems, minor distribution networks are delayed or left incomplete, and drainage is ignored. When several agencies are involved in implementation, coordination failures can be even more marked. Notable examples occur in Indonesia on the outer islands where irrigation projects typically involve land clearance and the settlement of at least some of the beneficiaries, many of whom have no farming background. Such projects require extremely careful planning of all components by several agencies in addition to the physical works and their management. Coordination of the inputs from the concerned agencies has seldom been satisfactory. Swamp reclamation programs in Indonesia, involving resettlement and physical works in difficult areas, have also encountered severe problems. Resettlement has on occasion lagged well behind reclamation, and settlers have been placed in very marginal situations. Responsibility is divided between the Ministry of Transmigration for planning the movement of settlers and land development, and the Directorate of Swamps in Ministry of Public Works (MPW) for planning, design and construction of the infrastructure. No agency fulfills the responsibility for O&M. With such a loose assignment of responsibility and lack of coordination, there is little wonder that overall planning is poor.

Planning of construction contributes in important respects to the quality of works. In some major projects financed from external sources (for instance major dams) procurement may be single source under international competitive bidding. In others, however, numerous small contracts can result in serious problems during implementation and contribute to subsequent O&M difficulties. A notable Indian example has been the Upper Krishna project in Karnataka where the isolated location, rapid staff turnover and poor management control has been compounded by the problems associated with managing innumerable contracts even with respect to the main canals.

Environmental Assessment

Many projects have failed to provide adequately for the environmental impacts of development -- sometimes by a lack of facilities, other times by subsequent failure to finance. Notable problems include failure to deal adequately with siltation or to take timely action to resolve drainage problems, leading to waterlogging and secondary salinity in surface water irrigated areas. Examples in China include inadequate planning of a number of irrigation projects in the closed basins of the arid northwest. For example, the diversion of the Tarim River for irrigation led to waterlogging of the irrigated lands, reduced flow below the diversion so that no water reached Titema Lake, and desert encroachment into the corridor of vegetation, which had been maintained by shallow groundwater recharged from the river. The Bank's Tarim basin project will attempt to reverse some of the negative impacts caused by this and other projects in the basin. Examples in

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1/ Even if tank capacity is exceeded, return flows to the river can be fully diverted and stored lower in the system, and essentially no water escapes to the sea other than from local storms in the delta. The delta has no formal rights to water diverted across the Ghats from the Periyar, but in real terms, all return flows were effectively utilized.

India include: (i) The developing waterlogging and secondary salinization problem in Northwest India; (ii) the extraordinarily difficult conditions encountered in the Rajasthan Canal project with windblown sand clogging the canal system and inclusion of poor desert soils; (iii) severe siltation of the canal systems and drainage congestion in the Gandak and Kosi projects in Bihar; and (iv) the construction, drainage and management problems associated with black soils in Tungabhadra and other schemes of the Deccan Plateau.

PROGRAM PLANNING

Program planning as here defined covers relatively diffuse activities ranging from soil conservation and catchment management, through groundwater development and small scale irrigation, to pollution control and water conservation programs. These programs are implemented by widely varying agencies that include not only those responsible for direct construction but also those involved in financial intermediation and other support programs. For its success, program planning, therefore, often requires a careful balance between construction by the agencies concerned, incentives governing private action, and regulation. It thus overlaps not only with project planning but also with other institutional and policy issues discussed elsewhere in this report.

Given the above characteristics, program planning is less easy to categorize than project feasibility work, although examples of program planning problems can be seen throughout the region. Even in Korea, during the 1960s, when priority was given to expanding and intensifying agriculture to increase food production, mistakes were made in the large land leveling programs undertaken along with land consolidation to develop irrigation. The leveling left some farmers with allocated lands of near barren subsoils. Large scale soil improvement programs had to be promoted through the extension service to increase soil fertility. These included promotion through subsidy of tiled roofs to replace thatch and funding alternatives to rice straw for cooking so that these residues could be returned to the land to improve soil structure. More recently, Korea's development of industry through private sector endeavor has left a legacy of water pollution, which is proving difficult to rectify.

Perhaps the most striking example in China of inadequate planning coupled with inadequate regulation relates to the groundwater development programs for irrigation and other purposes on the North China Plain. These have resulted in overdraft in extensive areas of the plain--the groundwater level is now below sea level in an area of 14,000 km^2 around Cangzhou, and there are groundwater depression zones totalling 8,800 km^2 in the Henan province and additional zones in the Shandong province. The dangers of the situation are self-evident: Induced land subsidence and the possibility of water quality deterioration in some areas, as well as the limitations imposed and increased costs implicit in mining a finite resource. In contrast, China has implemented extensive and systematically planned land reclamation programs that have in some areas rectified past degradation and been highly profitable. However, effective solutions to control erosion on the Loess Plateau of northern China have proved to be difficult.

In India, as in China and other countries, water pollution problems from both urban centers and industry (a significant part of which is scattered in the countryside) are of huge magnitude and growing concern. Overdraft of groundwater, developed mainly by the private sector with support from government subsidy programs, has occurred in some areas in India, notably in the Northwest, in parts of Gujarat, and in the Coimbatore area of Tamil Nadu. The subsidy programs to supply electrical energy for groundwater pumping have impacted negatively on the power supply system in most states. Experience in Northwest India is in some respects exceptional. Initial public sector groundwater development acted as a catalyst for the rapid spread of private groundwater facilities, which was justified by the extensive nature of surface water irrigation design and subsequently supported by intensive and well planned rural infrastructural development (roads, electrification and rural markets). However, as noted, some of the programs have failed to cope with overdevelopment of groundwater. Elsewhere, approaches were less well conceived. For instance, overemphasis on surface irrigation and the development of public

tubewell irrigation systems has characterized developments on the central and eastern Gangetic Plain (Box 1.1).

VI. Concluding Remarks

Institutional reform in its widest sense (Chapter 3) is a necessary precondition for effective planning since no amount of comprehensive integrated planning will have much impact until rights and allocations are clarified and responsibilities for planning, regulation and provision of service are logically assigned. Again, until the incentives facing the various agencies and those who control them--in particular the irrigation agencies--are changed, pressures for irrational action and investment will continue. Conflict may be subsequently resolved through a combination of *force majeure* and objective decision, but no one will be held accountable for the waste incurred.

This said, with notable exceptions and with due regard to deficiencies in project and program planning, the weakest links in planning in many Asian countries lie at the level of basin and regional planning. The dominant role of public development activities in the allocation of water resources means that the failure to verify compatibility of programs and projects within the full hydrological system has led to much inefficient and wasted investment, especially in irrigation infrastructure. Similar waste arises from the failure to integrate water resource infrastructural development within systematic regional land-use plans, most notably in urban conurbations. As pressures on the resource mount, the potential for wasted investment increases. Financial incentives and regulatory powers can all play an increasingly important role in balancing supply and demand for water, and in maintaining quality standards. However, it is government planning in its widest sense that will play the predominant role in determining how efficiently water resources are developed and managed to meet a country's goals and objectives.

With respect to project and program planning, the variety of activities in the different sectors, and the enormous range of conditions encountered, suggests that the litany of problems and deficiencies set out above can only be indicative. Nor should it be taken to imply that there have been no good projects or programs in the region. An unflattering emphasis is perhaps inevitable in a brief review of this kind. Nevertheless, it is clear that in almost all countries, deficiencies in planning at the project and program level have also led to waste and inefficiency and thus warrant substantial attention and improvement. Further discussion of these issues is provided in Chapter 8 in the context of a review of the performance of Bank-supported projects.

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5

REAL-TIME MANAGEMENT OF WATER RESOURCES

I. INTRODUCTION

CONSTRAINTS ON REAL-TIME MANAGEMENT

All planning and design is predicated on the assumption that appropriate resources management actions will be taken and facilities will be operated and maintained to provide defined services over time. These services are reflected in benefits (crop output, power production, water supplies and environmental standards) that are typically projected to rise to some level that can be sustained over the life of the project. Sensitivity analyses show how facilities might perform under differing outcomes to assess risk and guide operations for varying conditions. Design flexibility provides capability for subsequent response to change.

In practice, services often differ from those intended, and projected benefits are not always achieved. Reasons vary greatly and include factors associated with each stage and aspect of project implementation. Planning and design may fail to account sufficiently for the impact of external factors on subsequent water operations. Poor construction can lead to insupportable maintenance requirements and to the need for subsequent rehabilitation. Operations may respond inadequately to stochastic water supplies and issues of water control. Maintenance may be unsystematic and be given limited attention. Operation and maintenance (O&M) funding may be inadequate to sustain performance. Regulatory controls and administrative procedures may be absent or weakly enforced. Incentives for sound financial management and agency performance may be limited or contradictory. Water pricing and other signals may distort the response of the private sector. More generally, problems arise from a failure during planning, design and construction to give sufficient attention to operation and maintenance, and in implementation to ensure that the necessary administrative support, funding, regulatory enforcement and financial signals are in place.

The above deficiencies are primarily institutional. (Institutions are discussed in Chapter 3 in relation to the three main areas of government action: legislative, regulatory and operational.) While issues of real-time management are integral to the operational area, they are also placed within a legislative and regulatory framework. If this framework is inadequate, it can be detrimental to sound performance. Moreover, the planning for sound O&M needs to reflect the practical aspects as funding, equipment, regulations, administrative procedures, and incentives to ensure proper delivery of service. The utility form provides an effective basis for achieving this balance in the operational area while demand management techniques can in principle be used to complement supply operations.

PLANS FOR OPERATION AND MAINTENANCE

Plans of Operation and Maintenance (POMs) for water systems can be considered at two levels: the basin and the project. Intermediate configurations (subbasins, conveyance systems and interdependent projects) can be adequately dealt with under this classification. Basin operations are normally a key to effective project operations, and in many instances must have first priority. Interactions beyond the basin (the regional economy, power system operations and environmental regulation) must also be accounted for within the framework of the hydrological system. The POMs at all levels must respond to the legislative framework and be consistent with established policies, rules and regulations (water rights, environmental standards, safety requirements, administrative and financial rules, etc.).

Basin POMs

So long as water is abundant within a basin, projects can be operated independently. As development intensifies, projects increasingly interact. Many basins in Asia are now developed to levels that make formal basin operating plans of critical importance, and the failure of management capability to keep pace with development has undoubtedly been costly. Basin POMs are normally expressed in terms of operating rules and regulations that give expression to any international and interstate agreements and to rights and use allocations established by government (Chapter 3). Rules are needed for response to normal and abnormal conditions, and failure to anticipate extreme events, such as floods and droughts, can be particularly damaging.1/ Water quality is integral to real-time management, and rules may be required to deal with emergency conditions imposed, for instance, by toxic spills. Interactions between surface water and groundwater must be reflected together with opportunities for conjunctive use. Plans at the level of the basin typically focus on water operations. However, maintenance of basin management support systems must also receive attention.

Scheme POMs

POMs for all types of facility (multipurpose and single-use reservoirs, irrigation and drainage projects, urban water supply and waste treatment facilities, and flood protection levees, etc.) should be incorporated into project configuration studies at an early stage and be developed in great detail during final design. A clear description of operational concepts and the resulting O&M program as part of project planning would avoid many design inadequacies and service shortcomings. The POMs cover as appropriate: Operating objectives for the facility; rules and/or criteria relating to water quantity and water quality, conservation and/or reuse of water, and conjunctive use of surface and groundwater; maintenance methods and practices (force account, petty contract and service contract); maintenance equipment and buildings including their location; staffing and its posting; and beneficiary responsibilities. Job descriptions are defined for key staff, and service charges or other sources of funding are set out. Detailed operating rules are required for extreme conditions as droughts and floods, as well as normal conditions.

ISSUES IN REAL-TIME MANAGEMENT

Data Support

Real-time management, no less than planning and long-term management, requires reliable and timely data. Data systems in Asia are, however, frequently inadequate with respect to both basin operations and scheme-level O&M. A basin hydromet system with flow measurement at key points is basic to any data collection system. This should be supported by appropriate communications and other facilities. Measurements should be fully integrated with the system of monitoring water services, and where possible, associated with the administration of water charges. Given the complexity of many basins and projects, computer applications are of increasing importance and can have continuing performance benefits.

Regulatory Functions

Effective administration of regulatory functions is a necessary complement to ensure that actions are carried out properly so that real-time water operations and physical maintenance of facilities can be most effective for meeting their objectives. If water rights administration, allocation practices or other regulatory aspects are deficient, then this will impact in turn on the effectiveness of O&M planning and implementation at the service level. Weaknesses in the implementation of regulatory functions in many Asian countries account for many of the deficiencies in O&M performance.

1/ See Topic Paper 1, "Planning for Droughts: An Essential Action."

Agency Accountability

Clear assignment of responsibilities is critical to effective O&M. This applies whether the function is regulatory or service, and whether it is in government or the private sector. Administration of regulatory functions should be isolated from operating entities (Chapter 3). With respect to operating agencies, the utility form is preferred when possible. The POMs should cover the field of responsibility of the agency concerned and include procedures for meeting regulatory requirements and standards.

A particular need is to clarify responsibilities for completeness of facilities and quality of works at the time of transfer to O&M status. This is particularly true for irrigation and drainage works, which are widely dispersed and often in remote areas. Large structures such as dams rarely encounter problems, perhaps because the costs of failure are so high and works are concentrated and easy to supervise. But irrigation distribution projects can linger under a construction unit's jurisdiction for years without proper O&M arrangements, while other projects are transferred from construction to operations before works are complete. Formal transfer procedures incorporating clear assignment of responsibilities could overcome much of this problem, with the construction unit held accountable for quality and completeness, and with deficiencies corrected from capital funds within a warranted period.

Programming, Budgeting and Scheduling

Programming, budgeting and scheduling are basic to efficient and cost-effective government and private operations. Failure to undertake these activities on a timely basis is the cause of many inadequacies. Government personnel policies can also be a major constraint on the implementation of effective water management. Staffing and organization should reflect the need for functional specialization and staff continuity. Inadequate staff skills, frequent transfers, and unfocused training programs are all commonly encountered, especially in line departments. Sound financial and staffing practices are encouraged by the utility form.

Demand Management

Real-time water management in Asia is predominantly concerned with managing supplies at the basin or scheme level to meet allocation objectives. Integral to such activities are issues related to water conservation, rationing at times of scarcity and other techniques to ensure that water demands are moderated to correspond in a logical manner to water availability. These issues are covered in this chapter in the context of basin and scheme-level O&M. In addition, however, there are a number of more general aspects of demand management that are receiving increasing attention worldwide [1/] and that can complement actions at the basin and scheme level.

PUBLIC AWARENESS AND PARTICIPATION

Some countries have developed mechanisms for involving local officials and beneficiaries in real-time decision making. Examples in the region occur under the Command Area Development (CAD) program in India, at the traditional cultivation meetings in Sri Lanka, and in the context of organized user group participation in the Philippines (e.g., in the Magat scheme). Examples are generally lacking in the urban services area. In most cases the public is only peripherally involved, or involved in the guise of special interests and pressure groups. Implementing agencies are neither accountable to their beneficiaries nor to the public at large, leading to inefficiencies and rent seeking practices. Public awareness and participation are critical to establishing accountability and to ensuring acceptance and support for difficult decisions.

1/ See, for instance: United Nations, "Legislative and Economic Approaches to Water Demand Management: A Strategy for the Implementation of the Mar del Plata Action Plan for the 1990s." (1991).

II. BASIN OPERATIONS

INTERNATIONAL RIVERS

Requirements for real-time operations in the three most critical international basins of Asia (the Indus, the Ganges-Brahmaputra and the Mekong) are implied by the discussion in Chapter 4. The **Indus** Basin Treaty minimizes the need for real time cooperation between the two riparians. The solution is not perfect. Residual flows that cannot be regulated on India's allocated rivers must still pass into Pakistan, and operational agreements for management of water quality and floods are still lacking. More over, India must forego a gravity outfall solution for disposal of saline groundwater drainage effluent (a problem of growing concern) for want of agreement with its downstream riparian. Even so, reasonably effective operational capabilities have evolved within India for managing its share of Indus waters, even if modern water management techniques have yet to be adopted and fully integrated operation of all facilities awaits a comprehensive interstate agreement or award. The costs of inadequate management have been higher in Pakistan, but the recent interprovincial agreement provides hope that this will be rectified (Box 5.1).

The only international accord for the mainstream **Ganges** was the 1977 interim Farakka Agreement between India and Bangladesh (Box 5.2). However, the last extension expired in 1988, and it is now virtually impossible for Bangladesh to plan for real-time management during the low flow season. Agreements between India and Nepal for the Sarda, Gandak and Kosi ignore Bangladesh and are in themselves so simple as to obviate any need for additional operational plans. The Sarda agreement specifies flows to be made available to Nepal from the barrage during fixed periods in any year and India has met its commitments for more than 60 years. The 1959 Gandak agreement similarly provides for agreed deliveries to Nepal directly from the right bank of the barrage and indirectly from the left bank through India's Don Branch. It must be admitted that India's performance in meeting its commitment through the Don Branch has been poor, mainly because it is vulnerable to flood damage. Further operational agreements would be pointless unless India also made large investments in flood protection. The 1954 Kosi agreement (revised in 1966) is also straightforward, again primarily because Nepal's requirements are small and can be readily met. The situation would radically change if dams on any of the major tributaries were constructed (Box 5.2). Moreover, it is doubtful whether the external finance, which ventures of this type would entail would, or should, be made available unless the rights of Bangladesh were properly secured. In such a situation, internationally agreed real-time operational plans would be more complicated and assume basinwide implications.

Box 5.1: REAL-TIME MANAGEMENT ON THE INDUS

India and Pakistan have established comparable mechanisms for real-time management in their respective parts of the Indus Basin. In both cases, they represent a pragmatic and reasonably effective adjustment to political realities, providing a basis for systematic review and decision. However, in neither case do they yet take full advantage of the potential for optimizing benefits from water operations using modern water management techniques.

India

In India, the Bhakra-Beas Management Board (BBMB), a central government agency, was established under the Punjab Reorganization Act to manage water and power operations at the Bhakra Dam on the Sutlej, including diversion from the Beas into Bhakra reservoir. Its role with respect to existing or potential dams on the Beas and Ravi has yet to be clarified, and a fully integrated operation is unlikely until the Rao Commission report has been acted upon. Even more problematic is the integrated operation of the interconnected Jamuna/Indus systems, though Haryana will have improved capacity for offsetting low Jamuna flows if the Sutlej-Jamuna link is completed. For each water year, the BBMB draws up an operating plan, which reflects state allocations under the Punjab Act, for the filling (June 1 to September 20) and depletion (September 21 to May 30) periods. Representatives from the concerned states, the Union Territory of Delhi, and the central government, meet monthly at senior level, and more frequently at a technical level, to evaluate operations and take real-time decisions. On September 21, for instance, a decision is taken governing the depletion period, implying choices on the proportion of irrigation demands to be met, the level of firm power, and carryover storage. The BBMB utilizes straightforward water and power balance techniques, to which the state delegates respond. Studies suggest that there is potential for improved joint power and irrigation operations through, for example, response to rainfall, use of river and canal flows (reregulation and dynamic programming techniques), and conjunctive use of surface and groundwater. Proposals have been made (by Rao and Ramaseshan 1985) for multiobjective planning, whereby some physical or economic quantity would be optimized subject to set constraints. A particularly interesting suggestion (Narayanamurthy 1987) would provide all participants with the capacity for competent analysis using common simulation and optimization models. Each state could evaluate its real-time options on a common basis (at present, even irrigation and power agencies even from the same state can be in conflict), and BBMB would increasingly adjust actual operations to reflect varying but consistent state requirements. Action on these suggestions, however, is complicated by political turmoil and failure to act on the Rao Commission report.

Pakistan

In Pakistan, operating practices are very similar, with the Water and Power Development Authority performing the role of the BBMB. The real costs of failing to optimize operations have, however, undoubtedly been greater than in India. Until the 1991 interprovincial agreement, allocations were made from storage (notably from Tarbela) on an interim "continuing" basis, reflecting previous provincial shares and practices. Provinces had an incentive to maximize demands early in the season so as to establish "rights." Pernicious effects included excess diversions during the early depletion period, aggravating waterlogging in some commands and failing to exploit conjunctive opportunities in others, and reduced carryover for an early and guaranteed main season crop. Analyses under the United Nations Development Programme supported "Water Sector Investment Planning Study" demonstrated to provincial planners the large economic costs being incurred, and these, in turn, played an important role in persuading political leaders to end the self-induced damage resulting from previous uncertainty, and reach agreement on water allocations.

Interstate agreements for the Ganges within India are piecemeal in nature and would not, in their present form, permit formulation of a real-time operations plan for the basin as a whole. Most are for shared irrigation facilities and in sufficient detail to satisfy water rights as specified. A notable exception is the Chambal Agreement between Madhya Pradesh and Rajasthan, which avoids specifying water shares in terms of quantity or time. With storages and power generating capacity in Madhya Pradesh, and a diversion structure in Rajasthan to serve both Rajasthan and Madhya Pradesh, the project has proved difficult to manage efficiently, mainly because water rights are not clearly quantified. Difficulties have emerged with respect to shared facilities elsewhere, for instance between Haryana and Uttar Pradesh on the Jamuna, and between Uttar Pradesh and Bihar on the Gandak right bank canal. Problems can also occur if riparians develop projects separately without the need for joint construction. The Sone is a good example. Power releases from Rihand benefit Bihar but Uttar Pradesh is increasingly diverting water outside the basin and, with no agreement, Bihar has no recourse but to construct its own storages. There is, thus, often the need to improve real-time operations within subbasins. In principle, there is also a need for basinwide arrangements. But the only mainstream facility below Narora barrage in western Uttar Pradesh is Farakka barrage (immediately above the bifurcation on to the delta), so that the primary need is with respect to an international agreement (Box 5.2).

Box 5.2: INTERNATIONAL REAL-TIME MANAGEMENT ON THE GANGES

The Farakka barrage was built by India to supplement low season flows on the Bhagerathi to the Hooghly for Calcutta port and city water supply. The Bhagerathi was once the major Ganges distributary but in recent centuries has been overtaken by the Padma, so that in a sense India sought to reverse geomorphological history. An initial 1977 five-year agreement shared Farakka flows during the critical dry months (January through May) subject to specified minimum flows to Bangladesh. Bangladesh could thus plan use of its facilities for irrigation, navigation, water supply and fisheries with a reasonable level of security. However, no comparable guarantee could be given to Calcutta and the minimum flow clause was dropped under two subsequent three-year memoranda of understanding. In principle, Bangladesh continued to have a share in a diminishing asset but the last extension expired in 1988, and not even this degree of security is now available. Within India, interstate agreements on the upper Ganges and major tributaries are piecemeal.

Several states in India continue to develop surface irrigation in the Ganges and its tributary basins while rapid groundwater development also tends to reduce river discharges. Bangladesh has minimal recourse and for the time being may simply have to adjust to declining dry season flows. Calcutta can be protected to some extent, but India is under moral pressure to supply something to Bangladesh, and may ultimately find it difficult even to supply Calcutta. The Government of India could in principle bring pressure on upstream riparians and, indeed, it may be that releases are already made at some of the major barrages to support Farakka flows in the dry season. However, upstream riparians would undoubtedly resist any formal commitments and, as irrigation and other uses expand, even current releases may become increasingly untenable. Despite the high costs and low returns of surface irrigation (Box 1.1), upstream states are unlikely to forgo these possibilities while relocating Calcutta Port has been rejected over the years as being disruptive and of high cost. Transbasin diversions from the Brahmaputra also appear ruled out so that the only practical solution in the foreseeable future is construction of storages on basin tributaries. Major development has already occurred on the southern tributaries, primarily for subbasin purposes (although power releases from Rihand dam on the Sone in particular add to dry season flows at Farakka), so that the major remaining potential is in the Himalayas. Releases from the controversial Teri Dam, if it is completed, would be absorbed by the water short commands on the Upper Ganges and Jamuna in Uttar Pradesh so that the most promising options lie in Nepal on the Sarda, Ghagara (Karnali), Gandak and Kosi, of which planning for Chisapani Dam on the Karnali is most advanced.

If Chisapani or some other dam were to be constructed, an international agreement would clearly be required. Most costs would be incurred in Nepal but most benefits would accrue to India, if Bangladesh has no role in its development. Any storage would tend to have a favorable impact on Bangladesh. But pressures due to dry season water shortages in India would be reduced, and a major project would provide an obvious opportunity for resurrecting something comparable to the 1977 Farakka agreement. Whether to confine this just to reservoir operations would need to be assessed. There are no conceivable diversion projects on the Ganges below Allahabad, and in principle releases from any combination of the barrages would be equally acceptable to Bangladesh (and Calcutta!) provided flows at Farakka were assured. Storage release would almost certainly be the primary source of dry season flows but joint operation of all facilities would in theory allow full optimization.

Brahmaputra Basin

In the Brahmaputra Basin, the only significant immediate real-time operations issue relates to the Teesta; tributary to the Brahmaputra on which both India and Bangladesh are constructing barrages and irrigation projects without benefit of a water-sharing agreement. The Indian facility will be able to divert the entire flow at critical times so that Bangladesh cannot begin to develop a rational plan for dry season operations. There are some issues with respect to the Meghna River system, in particular relating to flood management, and India and Bangladesh cooperate in the context of a joint commission for the smaller rivers. India has also cooperated with Bhutan in flood forecasting and construction of run-of-the-river power facilities. If India constructs any of the large storages for which there is potential on the Upper Brahmaputra and its tributaries, possibly even in association with China, a need could arise for Bangladesh to assert its riparian claims on the waters. Except in the case of the Teesta, however, the projects would be primarily for power and would automatically benefit Bangladesh from the point of view of flood control and dry season flows. It is very doubtful that Bangladesh will ever agree to the proposal for a canal to transfer Brahmaputra water to the Ganges.

The Mekong and Other International Rivers

Proposed main stem projects on the Mekong would require international agreement for their construction and subsequent operation, but none have yet proceeded beyond the early stages of planning. At the present stage of development, there is little need for an international agreement on real-time operations except perhaps with regard to flood protection and management of low flows between the two delta riparians. Other international rivers of note in Asia include the Red River (Vietnam and China), the Golak river (Malaysia and Thailand), the Salween (Myanmar, Thailand and China) and the North Han (Korea and North Korea). Vietnam contains only 43 percent of the Red River catchment but accounts for almost all development since China has only limited potential for consumptive use in its part of the basin. There is no immediate need for real-time operations agreement between the two riparians except perhaps in relation to quality considerations (e.g., toxic spills). Regarding the Golak and Salween River systems, there are at present no water resource developments of consequence on either system that necessitate internationally agreed operating rules, with the possible exception of flood control embankments and quality aspects along the Golak where it marks the border between Malaysia and Thailand. The North Han River has been a matter for contention between the two Koreas but, at present, all major facilities on the river are in the south, and there is little need for cooperation, even if it were politically possible.

INTERPROVINCIAL RIVERS

Real time management issues on interprovincial rivers are most pressing in **India**. In addition to the Indus and Ganges, notable examples include the Subernarekha, Godavari, Krishna and Cauvery. Even where there is an agreement (Subernarekha), or a tribunal award (Krishna and Godavari), these are inadequate to control real-time operations. Management of the Cauvery has reached the stage of almost perpetual crisis. According to newspaper reports, Karnataka makes *ad hoc* releases only after agitation by delta farmers has led the Tamil Nadu Chief Minister to phone his opposite number! An exception is perhaps the 1979 tribunal award allocating Narmada waters between Madhya Pradesh, Gujarat, Maharashtra and Rajasthan, which is clearly-enough defined to form the basis for real-time interstate operations when any or all planned facilities are completed. However, the Narmada is relatively straightforward, dominated as it will be by two large inter-dependant storages (Narmada Sagar and Sardar Sarovar) with interlocking financing and ownership. Other basins can be enormously complicated (Box 3.3). While this creates great difficulties, it also suggests that modern water management techniques could have substantial benefits.

Other federal countries face fewer problems. The central government in **China** retains a high level of control over water through the constitution and its water law. Nevertheless, real-time management to meet resource allocations on rivers where several provinces have made investments can create both conflicts and economic inefficiencies. The Yellow River presents a particularly difficult situation by virtue of its varying hydrology and mixed reservoir configurations. In such cases, real-time operational agreements between provinces may be warranted that go beyond the decision-making arrangements currently in place. **Myanmar** has weak institutions and ill-defined water rights but few real-time management problems. **Malaysia** is thus the only other country in the Asia region, apart from India, with a federal form of government where the states have strong rights and controls over their water resources. The main need is for interstate cooperation in the control of pollution--a function of regulation rather than real-time operations--although real-time agreements are needed where toxic spills are possible. Establishment of a comprehensive water code in Malaysia has been stalled for almost a decade (Box 3.1).

BASIN WATER OPERATIONS

Several countries in Asia have adopted real-time management plans and procedures that go beyond straightforward water balance studies. It might be expected that these same countries would establish effective institutional arrangements (Chapter 3) and adopt systematic long-term planning (Chapter 4). Interestingly, however, though effective approaches in different areas are

often correlated, this is not always so. In part this reflects physical conditions. Divided management of the Yellow River in China (Box 4.4), for instance, responds to the different objectives for upstream (power) and downstream (flood protection) facilities. In part, it reflects political factors. For instance, despite several long-term plans, political factors have driven **Sri Lanka's** Mahaweli development without precluding adoption of one of the most objective real-time operations in the region (Box 5.3). Management of the Chao Phraya in **Thailand** is also relatively systematic, yet there are institutional weaknesses and a failure to prevent overdevelopment in the basin as a whole and to control adverse long-term trends in the Bangkok area (Box 5.3).

Korea

Korea is preeminent in implementing real-time management at the basin level as an operating principle throughout the country. The five main catchments are managed as total water operations to serve users of all classes, and allocations are met meticulously. It is noteworthy that Korea has created a high level of surface regulation through cascades of storages on its rivers, as well as facilities in the estuaries to control saline water ingress and loss of freshwater to the sea. Moreover there is a high proportion of water use instream for power generation. In this situation, a high level of reuse is possible, and there is operational flexibility to divert water to high priority uses during times of shortage. Korea has achieved these standards without the benefit of comprehensive legislation and without establishing unified basin management entities.

China

In contrast, basin agencies in China have been created for all major rivers primarily for long-term planning (Chapter 4). With some exceptions, they are not responsible for real-time operations and major basins are not managed by a single agency, perhaps due to their size and complexity. Other arrangements (e.g., interprovincial committees) give effect to central government allocations and provide a context for resolving interprovincial disputes. Moreover, lack of unified control does not preclude relatively sophisticated operations by predominantly single purpose agencies (e.g., the management of the cascade of power dams on the upper Yellow River, see Box 4.4). Real-time management of floods and the facilities to manage such events are also advanced wherever floods present a major hazard, which is the case in many parts of China.

India and Bangladesh

In India, it may be questioned whether the Damodar Valley Corporation fulfills its real-time management functions adequately (Box 3.4). With the exception of the Bhakra-Beas Management Board (Box 5.2), no other significant case exists in India where real-time basin operations are managed by a single operating agency, although in some cases a single agency provides guidance and direction (e.g., the the Narmada Control Authority). In Bangladesh, the major real-time management concerns are associated with flooding. The massive scale of flood emergencies and the speed with which they can develop make coordinated response very difficult. Flood forecasting and flood preparedness measures are inadequate to meet the problems encountered. It seems improbable that it will ever be possible to control flooding effectively in large parts of the country. As large populations must continue to occupy extremely vulnerable areas, flood warning systems coupled with highly planned and executed measures to evacuate people to places of safety become the only practical solutions. Management of low flows to meet the multiple and conflicting objectives of irrigation, fisheries, navigation and salinity ingress to the delta is also in its infancy.

Box 5.3: SYSTEMS ANALYSIS IN SUPPORT OF REAL-TIME OPERATIONS
(The Mahaweli and the Chao Phraya)

The Mahaweli Authority of Sri Lanka (MASL) is both a development and a management agency. Real-time management is accomplished through a high level Water Management Panel (WMP) which, in turn, is serviced by the Water Management Secretariat (WMS). Using a comprehensive systems model, the WMS presents alternative policy options to the WMP reflecting initial and projected conditions; prepares seasonal operating plans to implement the WMP's decisions; monitors actual operations; and recommends adjustments to the seasonal plan in the light of evolving circumstances. Besides representing the physical system in considerable detail, including the power system (both hydro and thermal) beyond the Mahaweli Basin, the systems model evaluates the benefits of alternative lines of action so that the WMP is informed of the efficiency (opportunity) costs of its decisions. The Central Electricity Board, the Irrigation Department and other concerned water-use agencies are represented on the WMP and meet regularly at the working level under the auspices of WMS. Given the complex characteristics of the physical system, there can be major conflicts between power and irrigation and between different irrigation schemes, especially at times of shortage. In particular, diversions at Polgolla to the Ambon Ganga and Kala Ganga basins -- the location of much irrigation -- deprives the power generating facilities at the main stem dams (Victoria, Randenegala and Rantembe). Sociopolitical objectives, in particular the imperatives of a standing paddy crop, can override any economic considerations and, at least in theory, the MASL could give priority to its own irrigation schemes over those managed by the Irrigation Department. Nevertheless, the technical basis for taking decisions is well developed, and decisions can in principle reflect objective trade-offs between different purposes.

The Chao Phraya Basin in Thailand is managed as a whole to allocate dry season supplies, and to ensure that flows do not fall below a specified minimum at the head of the delta so as to control saline water ingress into the delta distributaries. The Royal Irrigation Department (RID) has operated a real-time water management system for the basin since 1980 in close coordination with the Electricity Generating Authority of Thailand (EGAT). RID uses a simulation model, first developed in 1977, that includes the hydro and thermal power system beyond the basin. The 1977 study demonstrated that the water resources of the basin were fully committed and that major benefits could be obtained from a systematic approach to real-time management. The two main dams (Bumiphol on the Ping and Sirikit on the Nan) are operated by EGAT in accordance with a weekly demand schedule prepared by RID. Local supplies upstream of the Chao Phraya (Chainat) diversion dam and rainfall over the area are taken into consideration, and the demands accounted for include those for power, irrigation, water supply, saline water control and navigation. Shortfalls in any week are made up during the following period. Before each dry season, a dry season cropping plan is approved by an interdepartmental committee, chaired by the Minister of Agriculture. The plan gives priority to areas that could not be cultivated or were damaged in the prior wet season. In principle, the remaining dry season supplies are rotated from year-to-year equitably among different areas, subject to the requirements of other users. Overcommitment of the basin resources, however, means that it is not possible to meet all demands. For instance, releases for navigation have been consistently below the levels required to utilize facilities constructed, and water supplies to the Bangkok area have fallen well short of those required to control serious subsidence problems (although, this is also a consequence of inadequate municipal facilities). Inevitably, as nonagricultural demands increase, and if no additional water becomes available, supplies for dry season cropping will tend to decline. It is unclear whether the present institutional arrangements will readily accommodate these changes in an economically efficient manner, given that RID is responsible for water management, and a committee chaired by the Ministry of Agriculture takes the main seasonal allocation decisions.

Indonesia

Real-time management in Indonesia is often uncoordinated. Levels of development in the outer islands do not yet warrant sophisticated management techniques, but this is not so on Java. Striking examples where coordinated management is needed include the basins that make up the Jabotabek urban planning area in West Java (Jabotabek includes Jakarta and nine other major urban centers); the Citarum River Basin to the east of Jabotabek; and the Brantas River Basin in East Java including the city of Surabaya. Inadequacies in real-time management in the Citarum Basin are surprising since it contains both the physical facilities in the way of storage reservoirs--power dams in the upper reaches and the Jatilihur Dam primarily for irrigation in its mid-reaches--to make such operations feasible, and the conflicting demands from irrigation, aquaculture, power generation, water supply and flushing to make such actions necessary. Competent planning studies have been undertaken or are on-going, and it is possible, if political and bureaucratic resistance can be overcome, that appropriate arrangements for real-time management will soon be introduced.

III. SCHEME-LEVEL OPERATION AND MAINTENANCE

GENERAL

Management below the basin can be broken down into management of subbasins, joint facilities and single-purpose schemes. There is considerable overlap between these categories, and comparable issues may be faced at each level, with basin and subbasin agencies, irrigation departments, power corporations, water utilities and other entities variously operating independent or associated facilities. Water management is, however, greatly clarified if unambiguous rights and obligations are established between agencies at each level in the allocation hierarchy. In other words, water service agencies are best organized as utilities that provide a defined service to their customers or members, preferably in return for a fee (Chapter 3). Plans of operation and maintenance can then cover agency responsibilities at each level in ways that reflect the terms on which water is both received and distributed.

As discussed in Chapter 3, water operations in China and Korea come closest in Asia to satisfying these requirements. Elsewhere, rights and obligations are often less clearly formulated. Moreover, construction inadequacies and incomplete facilities may seriously impact on subsequent O&M, while O&M budgetary allocations themselves have typically been inadequate, often grossly inadequate. For these and other reasons, real-time management of joint facilities and single-purpose schemes may be subject to considerable uncertainty, with intermediate and retail agencies facing unknown security of supply and hence often unable to provide a defined service to their customers or members. If a single agency (e.g., an irrigation department) is fully responsible from the source (e.g., a dam) to the final beneficiary, then a defined service can in principle be provided more readily. Even then, however, stochastic variability in water supplies must be fully accounted for and understood, and lack of accountability and incentives can undermine standards of service.

SCHEME OPERATIONS

General Regulations

General approaches to scheme management have evolved in all countries for individual sectors, with rules and regulations formalized to a greater or lesser extent, often elaborated in general O&M manuals that apply throughout a sector or to the operations of a particular agency. Irrigation legislation and manuals in particular have a long history in most countries (Box 5.4). Such practices have developed over time in response to external factors that largely determine the nature of the irrigation service provided, and are implemented more or less successfully depending on how far operational concepts have been thought through, and whether they can be managed under the often difficult conditions prevailing in the field. Depending on legal requirements, scheme-level POMs may be constrained to follow these procedures. For instance, despite a long history of seeking reforms in the methods of delivery of water under Bank projects in Gujarat in western India, the provisions of legislation are such that the Irrigation Department continues to sanction individual farmers under the shejpali procedures. Similarly, attempts to reclassify areas localized for paddy in South India systems have been blocked in the courts on the grounds that the original localization pattern, and the promise that the farmers would be provided with sufficient water to mature a paddy crop, has assumed the nature of a water right (Box 3.2).

Operating procedures in sectors other than irrigation are generally more standardized and straightforward, though there are frequent deficiencies in their practical implementation. Hydropower facilities are invariably integrated within total power system operations, meeting base load or, more usually, peaking requirements, depending on the configuration of the facilities in the overall system. Power operations are typically relatively more advanced than those in other sectors, and significant progress has been made in the region in modernizing operational support facilities. Water supply and sanitation services are subject to quality standards, which may in practice be difficult to enforce, but which in principle are relatively unambiguous and common to all water supply utilities. In all sectors, the application of general administrative and financial

procedures are often deficient, but this is a reflection of weaknesses in government administration as a whole rather than anything specific to water delivery agencies.

Scheme-Level Operations

The variety and complexity of water operations precludes more than a cursory discussion of practices and procedures at the level of the individual scheme. As a general rule, O&M has been relatively neglected in almost all sectors, and scheme-specific manuals to guide day-to-day activities are often inadequate or even completely absent. Moreover, even when manuals are prepared, they often fail to accommodate practical difficulties, being honored more in the breach than in the observance.

The potential for effective real-time management is normally much greater where storage facilities are provided than if supplies are run-of-the-river. Nevertheless, single-purpose reservoir systems are often operated according to fairly basic operating rules. This is seldom a major issue in water supply projects which, given the need for a high degree of security, normally include adequate reservoir capability often in association with, or substituted by, groundwater pumping. Inadequate sources of water can, of course, lead to severe problems--an extreme example being the city of Madras in South India where constraints are such that water must be severely rationed even under normal conditions, and industrial development has been substantially affected. In this sense, real-time management problems are encountered, although reservoir operating rules as such are seldom a major issue. In contrast, while straightforward operating rules for irrigation can represent a pragmatic response to past experience and perform fairly well under normal conditions, they are less able to deal with the extremes of drought and flood and, more generally, often fail to make optimum use of regulating capacity (e.g., in terms of response to rainfall or carryover storage to provide an expeditious start to the main monsoon crop). Systematic reservoir operations to make best conjunctive use of total water resources (surface, groundwater and rainfall) often represents one of the most obvious potential improvements available to irrigation schemes in the region.

Water distribution more generally in surface irrigation schemes also raises particular issues that have been tackled with varying degrees of success in different parts of the region. In India, schemes are normally operated in accordance with past practice using general departmental manuals rather than detailed scheme-specific POMs. In some areas (e.g., Northwest India), these have stood the test of time, but in others (e.g., in eastern and western India and many schemes in central and South India) they have proved increasingly difficult to manage in practice (Box 5.4). In Indonesia, systematic scheme-specific O&M manuals have been prepared under many construction, modernization and rehabilitation programs. While in many respects admirable, they have tended to assume a degree of control and operational finesse that has proved difficult to implement in practice. Comprehensive O&M manuals have also been prepared for irrigation schemes, often by consultants, in other countries (e.g., Sri Lanka, Thailand and the Philippines) although, again, they often assume a level of control that is hard to sustain under Asian conditions.

Problems in irrigation management reflect a wide variety of external factors. For instance, regulation is relatively easy where water demands are predictable, supply is favorable, control is localized, natural drainage is good or where there are few farms. It is much more difficult if demands are uncertain, control is centralized, drainage is impeded or land holdings are very small and fragmented. If to adverse external factors are added failures in planning to anticipate O&M problems and the difficulties of managing enormous irrigated areas--involving sometimes up to a million farmers or more--with poorly paid staff and inadequate O&M allocations, it is perhaps not surprising that effective management of large public irrigation systems often proves elusive. Though farmer and agency discipline are in principle required under all conditions, in many circumstances it may be unrealistic to expect that this objective can be achieved beyond rather limited standards.

Box 5.4: SELECTED IRRIGATION MANAGEMENT SYSTEMS IN ASIA

Warabandi

Warabandi evolved before partition in Northwest India and Pakistan. Water is allocated strictly in proportion to land, normally sufficient to irrigate only about 25 to 30 percent of the total farm. The ungated public outlet is sized in proportion to area and the full (constant) tertiary stream is rotated over a week between farms with turn length proportional to farm size. The farmer thus receives water at a specified time: If the watercourse runs, he takes the full flow, even if a neighbor was deprived of his turn (e.g., if the parent channel was closed due to low river flows). The flow is therefore "owned" at all times, there is no ambiguity as to who should take it, and turns are jealously guarded. Since rainfall is low, the farmer can normally make use of all deliveries. Since allocations are insufficient for the full farm, he has a strong incentive to exploit supplementary groundwater. Since canals run full or are closed, operators must simply ensure that "on" capacity is equivalent to diverted flow so that management is greatly simplified Farmers plan their cropping activities to make best use of a relatively firm "base load" surface supply (once a week during the monsoon, at stated probability levels in the dry season) and expected rainfall, with groundwater pumped to offset shortfalls. Marginal pumping costs can be adjusted to marginal benefits, and the result is a productive irrigation system well adapted to relatively low rainfall, and homogeneous land and aquifer conditions.

Shejpali

Shejpali evolved in response to the variable river flows, topography, aquifers and soils of western India (Maharashtra, Gujarat, parts of Madhya Pradesh). Farmers are sanctioned for specific areas of specific crops, with total area limited by storage and expected inflows. Water is distributed in rotation to meet the approved cropping plan. Hence, design must be flexible, parent channel flows are variable, and outlets must be gated. Since farmers have a right to "adequate" water to mature their crop, and agroclimatic conditions differ, turns tend to be variable. Although in principle water demands are matched with supply, in practice management is complex, and farmers have little incentive for efficient use. Even if neighbors take unauthorized supplies, sanctioned farmers retain their right so that operators play safe by limiting sanctioned areas. Overall irrigation efficiencies therefore tend to be relatively low. Allocation to each farm in proportion to area -- as under strict warabandi -- could be difficult given the variable conditions and generally higher rainfall. But wholesale delivery to farmer groups, which would in turn be responsible for detailed distribution, could simplify management and place the onus on farmers as a group to make best use of fixed supplies.

Localization

Localization evolved in South India to provide irrigation for both paddy and nonpaddy crops. Traditionally water was supplied for 100 percent paddy, with shortfalls usually concentrated at the tail. However, in view of water constraints, nonpaddy crops were increasingly promoted to extend the benefits of irrigation. Initially, it was assumed that farmers would abide by a specified uniform cropping pattern -- the system still followed in eastern India -- but the extreme difficulty of maintaining control, and the chaotic conditions that resulted under variable rainfall and cropping conditions, led to the concept of "localizing" different areas for different crops (paddy, nonpaddy, one crop, two crop, perennials, etc.). As under shejpali, water is supplied to meet a specified cropping pattern but, unlike shejpali, the cropping pattern is uniform and fixed in specified areas. While this in principle simplifies management, there are limited incentives for efficient water use, and major problems have been encountered as a result of unauthorized cropping (especially of paddy) and the difficulties of responding to variable rainfall conditions.

Pasten

Pasten evolved in Indonesia primarily for run-of-the-river paddy irrigation with variable river flows. Cropping is sanctioned each season but, unlike shejpali, the Irrigation Department is responsible only to the public outlet with farmers distributing water among themselves to sanctioned areas. Planned discharges at the public outlet vary depending on sanctioned crops and stage of crop, with gates adjusted regularly usually on a fortnightly basis. If river flow declines, all discharges are in principle adjusted in proportion to the flow available and, if flows fall below a specified level, supplies are in principle rotated according to standard practices. The Pasten system therefore aims to match supply and demand, with equitable sharing of shortfalls according to transparent procedures. However, while there is no attempt to deliver water to individual farmers, management is still relatively detailed and actual practice often differs substantially from that planned.

The "M-Curve"

The "M-Curve" in the Philippines is a tool for planning and monitoring irrigation water operations at scheme level. The initial water supply curve matches expected water availability with a particular (sanctioned) cropping plan. Deviations are reported regularly each fortnight or month, and a final report is prepared indicating the final outcome. In common with most paddy-based management systems, including the localization and pasten systems, it provides for staggered transplanting and variable flows to the public outlet in response to extent and stage of crop but, in contrast to localization, sanctioned areas and cropping pattern may vary and, in contrast to pasten, adjustments to shortages tend to be unsystematic and *ad hoc*. This approach therefore emphasizes the accountability of scheme managers for seasonal performance rather than setting out detailed procedures for responding to variable conditions.

A wide range of institutional, administrative and technical reforms have been suggested--and some introduced--to improve real-time irrigation management. The potential role of institutional reform has been discussed in Chapter 3, for instance, to strengthen accountability in the provision of an irrigation service (particularly in South and Southeast Asia) and increase the

role of farmer organizations, both of which can lead to improved discipline. Technical modifications in design and operation can also often complement programs to clarify rights and obligations. In some instances, this involves modernization and introduction of advanced systems of water control. Canals in the region are almost invariably designed on conventional upstream control principles, which make no attempt to exploit the storage capacity of the canal system. Downstream control might be considered in some circumstances to shift control to lower levels in the system and allow more systematic response to rainfall and demand. In schemes such as Gandak in eastern India (Box 1.1), where drainage is very difficult and expensive, this may also have potential for moderating drainage congestion.[1/] Controlled volume (as being introduced under the Narmada program in western India) and dynamic regulation concepts could also have a role in improving irrigation scheduling through more responsive operation of the primary and secondary conveyance works. However, such systems are normally impracticable for water distribution at lower levels in the system.

A way of thinking about these issues that helps clarify the relative roles of institutional, technical and administrative reform with respect to any particular scheme has come to be called the "structured approach" (Box 5.5). Not only does this approach facilitate response to practical difficulties, but it also complements consideration of institutional reform (e.g., the government agency to operate the main conveyance system above "structured level" and irrigation associations operating the service areas below the "structured level") and the introduction of technical improvements (e.g., the use of advanced water control systems in the main conveyance system down to the "structured level", proportional distribution below the "structured" level to the outlet). No doubt proportional distribution is sometimes unnecessary and supplies can be fully controlled to the field. In most cases, however, simplification of management is an essential pre-condition for gaining control.

1/ An example of how external factors can complicate irrigation management is provided by large irrigation schemes in the eastern Gangetic Plain in India: "The farmer plans primarily on expected rainfall. In a good year, crops may need no irrigation and excess water can do harm (the farmer may have nowhere to put it since his whole farm is cropped and drainage can be a constraint). In a bad year, the whole farm needs water, irrespective of whether crops come within the design cropping pattern or not. Wide fluctuation in need places great stress on management. In principle, as in the west (Indo-Gangetic Plain), 20 to 30 percent of the area could be planted to high value crops with the balance rainfed. But the differences between "high input" and "low input" crops are much less (in many years they receive a similar water supply) so that in a drought, headenders have as much to gain from theft (their standing crop is saved) as tailenders to lose (their standing crop is lost), and are unlikely to stop politely at 20-30 percent. Conflicts among neighbors can be reduced by enlarging or adding (unauthorized) outlets, which tend to stabilize with headenders determined and tailenders needing no irrigation for much of the time. With enlarged outlets, and little demand (elsewhere) in some years, headenders grow paddy, thus increasing returns to land. With paddy established, headenders are even more resolute, tailenders plan their cropping to need no irrigation, and a vicious circle is created. Thus rainfed crops and wide variations in demand result in an unstable, uncertain system with endemic farmer intervention. Since tailenders cannot risk failure in a poor year, they plant low input crops in all years and there is a general failure to make productive use of not only irrigation supplies but also rainfall." (Berkoff 1990).

Box 5.5: THE STRUCTURED APPROACH TO IRRIGATION MANAGEMENT AND DESIGN

The structured approach to irrigation management and design -- long associated with the warabandi system of water distribution (Box 5.4) -- seeks to balance management capability with external conditions (World Bank 1984). It is distinguished by considering the distribution system at three levels: (i) In the main system, above the "structured level", discharge is variable (actively managed) for instance, in response to demand, changing river flows or other factors; (ii) from the "structured level" to the government outlet, canals are operated ON/OFF, with water passively managed using proportional hydraulic structures when ON such that the sum of the discharges of ON canals equals deliveries from the main system; and (iii) below the government outlet, discharge is again actively managed, being divided amongst farmers either in turn (as under warabandi) or by varying discharge (as in many paddy systems). If variable discharge is supplied to the government outlet (e.g., as under pasten) the system is said to be "zero-structured", being actively managed throughout. Thus, the structured approach proposes no particular solution but provides a way of classifying management systems depending on the extent to which discharge is actively managed.

A notional cropping pattern may provide the basis for setting delivery schedules, but -- except in the limit case of a zero-structured system -- the promise is a pattern of water delivery to the government outlet (an "irrigation service") rather than a supply to meet specific crop water requirements. The theoretical flexibility for meeting differential needs is reduced but the system is more manageable since: (i) The number of controls is much reduced (gates below the structured level can be eliminated), (ii) measurement and monitoring are greatly simplified, and (iii) incentives for farmer interference decline (if the parent canal runs full and outlets are ungated, farmers can only increase outlet discharge through major interference and not by simply opening or removing a gate: If the parent canal is closed, there is no point in farmer interference at this level since there is no water). The critical decision is the level at which the system is to be structured. Above this level, full control is essential so as to guarantee the promised irrigation service (improved techniques of water control helping to achieve this objective). Below this level, there is automatic proportional distribution to the outlet on the assumption that neither the authorities nor the farmers are organized to manage variable flow. Below the outlet, the system is again gated with an appropriate streamsize assured through farmer cooperation or government regulation. For nonpaddy, this may be best achieved by rotating the full flow in turn, but for paddy the flow may be subdivided in response to local microtopography and other factors. Variations can be considered. For instance, canals below the structured level may be designed to be proportional at two specified discharges (e.g., one for transplanting, one for crop maintenance; or one for the wet season, one for the dry season). Alternatively a gated, proportional system can be provided below the structured level to permit either variable flow to a lower level (e.g., in response to rainfall) or proportional distribution (e.g., at times of shortage). In other words, the system could be structured at different levels depending on requirements.

Conjunctive Use of Surface Water and Groundwater

Conjunctive use of surface water and groundwater is often recommended but rarely practiced in real-time operations, except in the limited sense of at the farm level when both surface and groundwater supplies are available. The Indian states of Haryana, Punjab, Uttar Pradesh and Madhya Pradesh have installed public tubewell facilities to deliver water to the surface water canal systems to augment total supply. Similar facilities have been tried in East Java, and Pakistan's Salinity Control and Reclamation Projects (SCARP) tubewell systems are designed to deliver water from publicly owned and operated tubewell facilities to the head of the water course(s) serving one or more service areas. But the introduction of groundwater on surface water irrigation schemes is more typically at the farm or farm group level, and this is widely practiced in India and China, and to a lesser extent, the Philippines, Thailand and Java. While direct controls over private extractions in such a context can be achieved only with great difficulty, extractions are indirectly affected by surface management, which can be modified to a greater or lesser extent to reflect the potential response of private pumping. With some exceptions (e.g., augmentation wells), conjunctive use in most irrigation contexts in Asia can be defined as the optimum use of surface water, groundwater and rainfall under conditions where the only significant practical public intervention is the way that water is distributed in time and space in the surface system. Spreading of surplus runoff on zoned flood plans to induce recharge, and recycling treated urban waste water of suitable quality through groundwater systems are, however, also in essence, conjunctive use operations. In the long-term, it may sometimes prove feasible to fully regulate groundwater extractions within scheme operations.

SCHEME MAINTENANCE

In addition to setting out operating procedures, O&M manuals typically also attempt to regularize and standardize maintenance activities. However, institutionalizing maintenance for water development facilities under government ownership is often very problematic. Not only does maintenance suffer from funding shortages as a result of government budgetary constraints and cost recovery shortfalls in most Asian countries, but the problem is often exacerbated where the concerned agencies in turn give the maintenance activity low priority. Routine maintenance is often inadequate with the result that facilities deteriorate until the situation becomes so serious that total project rehabilitation is necessary. Maintenance schedules and budgets rarely provide for the "replacement" category, and planning for emergencies is another area of particular weakness. This situation holds equally for many government-operated flood control, drainage, irrigation and urban water supply and waste treatment facilities.

Maintenance problems are greatly exacerbated if the original quality of construction is deficient. Accountability and clear demarcation of responsibilities when works are transferred to O&M status are critical to the creation of an affordable maintenance burden. Quality of works is not a serious problem in much of China, although projects frequently remain incomplete because of lack of funds. In India, on the other hand, there is often no clear division between construction and O&M in the state irrigation departments, with projects remaining under construction for many years (because of their size and the paucity of annual budgets), and handover procedures are inadequately defined. Moreover, quality of work has proved difficult to assure because of inadequate or corrupt supervision. Similar problems exist in Bangladesh and many other countries in the region. Even though both Indonesia and the Philippines usually ensure clear separation of construction and O&M functions, yet both countries have experienced difficulty in assuring quality of new works. On the other hand, though Malaysia fails in some cases to adopt a clear separation of construction and O&M activities, its high quality of completed works--now mainly constructed by contractors--has a long tradition.

IV. REGULATORY MANAGEMENT

GENERAL

A range of regulatory and demand management measures and programs complement real-time O&M at the basin and scheme levels. These have been discussed under institutions in Chapter 3, and, with respect to the economic and financial policy measures, are discussed further in Chapter 6. Additional discussion risks repetition but legislation alone amounts to little if the necessary regulatory enforcement as an effective real-time water management requirement goes by default. With regard to the regulatory aspects, the effective and continuous administration of systems of water rights and allocations, land-use zoning, quality standards, structural safety and the administrative and financial integrity of service entities, are among critical aspects to be addressed. With regard to demand management, numerous technical programs and economic incentives to reduce water losses and promote efficiency in water use can be envisaged (UN 1991). Three areas (groundwater, water quality and water conservation) are discussed briefly to illustrate some of the issues involved Each of these must also be considered within the hydrological framework at the basin and scheme levels. Program aspects are, however, managed by a variety of service and regulatory agencies which, though overlapping with those responsible for management of specific schemes, also respond to broader administrative and area jurisdictions.

GROUNDWATER MANAGEMENT

Groundwater management is in its infancy in most countries in Asia. In urban areas, wells may in principle be licensed or otherwise controlled in an attempt to maintain the resource and to protect against adverse quality effects. Nevertheless, overpumping and consequent land consolidation and subsidence are already serious in some major urban areas (most notably

Bangkok) and contamination of groundwater resources--due to saline water intrusion in coastal zones and invasion by urban and industrial pollutants elsewhere--is also becoming an increasingly serious issue (as in the case of many urban areas in Java. Pakistan also has difficulty in controlling overdraft in urban areas on the Indus Plain where municipal water supply facilities compete with private tubewells. General administrative weaknesses, coupled with inadequate or constrained public water supply systems, together help explain the failure to institute effective controls. If direct controls through licensing coupled with fines for noncompliance cannot be made effective, then the government's main influence on private action will have to be indirect through the taxation system. But this has proved to be difficult and may cause great inequities. These issues are briefly reviewed in Chapter 6.

In rural areas, groundwater is also widely utilized for drinking supplies, although irrigation is usually by far the largest user. Most countries initiated groundwater development for irrigation using motor-powered pumping units through large capacity tubewell irrigation facilities, owned and operated by government line agencies. Even when well designed and capable of providing a secure service to the beneficiaries, such public facilities have generally proved difficult to manage and have been highly subsidized by governments. By far the most successful groundwater irrigation developments have been achieved through private sector investments, typically to serve a single farm or a small group of farmers. However, as illustrated for the Indo-Gangetic Plain in Box 5.6, groundwater development by the private sector is very difficult to control in most countries. Some Asian governments have attempted to apply control through various measures (e.g., licensing, restriction of credit or restriction of power connection) but with only limited success in terms of effective management of groundwater resources. Even China, which applies a strict licensing system, and which, at least in some areas, imposes a charge on water extracted from "self-developed wells", has not been able to avoid massive overdevelopment on the North China Plain. The Philippines and Indonesia have systems of licensing wells, but these have proved difficult to apply in rural areas. Bangladesh has virtually ceased to apply controls, except in coastal zones, in part because the procedures became corrupted. India has been unable to promote licensing laws at state level, where ownership of all water resources resides. Similarly, Pakistan has no legal system for licensing groundwater abstractions, and limited attempts to give ownership of underlying aquifers to municipalities have been challenged in the courts. Waterlogging control benefits often have been obtained inadvertently (rather than as a planned exercise) from pumping groundwater for irrigation use in some countries in the region, though Pakistan's SCARP tubewell systems proved technically effective in controlling groundwater levels (Box 5.6).

WATER QUALITY MANAGEMENT

Most countries have set standards for the quality of community water supplies and for liquid effluents from point sources of pollution that must be reflected with respect to water supply and waste treatment projects; in particular in urban and industrial areas. Real-time management of water quality in such circumstances--be it for water supply or waste water disposal--is best left to the directly concerned entity, with a government regulatory agency monitoring and enforcing standards. Management of water quality where the pollution originates from diffuse sources has proved much more elusive, and environmental and agricultural policies are often in conflict with quality concerns. Some examples exist where saline drainage from agricultural lands is actively managed by dilution or disposal to a natural sump, as for example in Pakistan, but such actions are essentially palliative responses when large quantities of saline effluent must be disposed of.

Management of water quality is becoming an increasing concern in a number of Asian countries. Even when adequate regulations exist, enforcement is generally poor. In China as a whole, less than 30 percent of industrial waste water is pretreated and less than half of the pretreated water meets the country's discharge standards. Many of the country's rivers are seriously contaminated by urban and industrial waste water. India has water pollution problems from industrial and urban sources on a similar scale. Indonesia has virtually no urban waste water treatment and exercises very little control over industrial waste water. As a result, provision of water supplies to a number of large cities on Java is becoming a problem, and pollution of coastal

waters has reached very significant proportions. Perhaps the water related problem of greatest concern in Malaysia is pollution, in part from urban centers but also from industrial activities such as palm oil mills, rubber factories and saw mills and from mining operations. In fact, only Korea, among the countries of the region, is making effective efforts to manage the quality of its water resources and control pollution.

Box 5.6: TUBEWELL FACILITIES AND LOW-LIFT PUMPS ON THE INDO-GANGETIC PLAIN

Pakistan

Groundwater policies have varied across the Indo-Gangetic Plain. In Pakistan, the Salinity Control and Reclamation Projects (SCARP) included massive investment in large public tubewells. Although initially rationalized in terms of watertable control and land reclamation, in practice investment focused on fresh groundwater supplementary irrigation, with supplies fed directly into tertiary canals of the public irrigation system. Though positive in terms of water level control, the impact on agricultural output was not commensurate with the costs incurred, cost recovery was poor, management proved problematic and the life of facilities proved much shorter than planned. The heavy burden of operation and replacement proved unsupportable and, under the SCARP transition program, the emphasis in fresh areas has shifted to privatizing public facilities and to promoting private investment which, though spreading even in the command areas of public tubewells, had previously been discouraged by the availability of under priced public supplies.

India

In Northwest India, installation of public tubewells catalyzed the private sector and private investment soon took off. Priority was given to credit and to rural electrification and other supporting infrastructure. Hence smaller tubewells with individual owners predominate. Credit recovery fell well below expectations, electric power has been subsidized, and overdrawals have occurred. But the surface water irrigation design is adapted to agroclimatic conditions and facilitates intensive supplementary irrigation by groundwater, which complements a secure but lean base supply from the surface system. Effective conjunctive use supports one of the most successful agricultural systems in Asia. In contrast, conditions in the central and eastern Gangetic Plain are much less favorable for conjunctive use. Faced with moderate but uncertain rainfall, irrigation demands are very variable and management of surface irrigation is much more difficult. Moreover, incentives are inherently lower since rainfall may be sufficient for the main crop, residual moisture may support a second crop, and drainage problems and surface flooding can be acute. Public tubewells have sought to offset deficiencies inside and outside canal commands, but have suffered severe management, cost recovery and related problems. Dedicated power sources seek to correct for power deficiencies but generating constraints are more severe than in the Northwest and, given high costs, high losses and management deficiencies, it is unclear whether dedicated lines (or even rural electrification *per se*) fully account for opportunity costs arising from reduced urban and industrial electricity supplies. Promotion of private tubewells, powered by both electric and diesel motors, has intensified in recent years with a substantial impact. Nevertheless, drainage and cropping constraints remain significant, in particular in the large areas served by poorly performing surface systems. Given the difficulties in metering electricity supplies, charges are often fixed in relation to horsepower providing free power at the margin, and hence few incentives for efficient use. In contrast, though diesel fuel is more expensive, fuel markets are more competitive and diesel motors are mobile and flexible and support active water markets.

Bangladesh

In Bangladesh, large-scale surface irrigation is relatively unimportant. Following the 1972 Bank sponsored Land and Water Study, emphasis has been placed on minor irrigation through low-lift pumps and tubewells, to some extent supported by complementary low cost flood control and drainage projects. Public tubewells, regulation of private installations and public monopolies in the supply of pumps, motors and other equipment in early stages increased costs and adversely effected development. Over the years, however, the potential for dry season irrigation has been well documented. Equipment markets and imports have been progressively liberalized. Flexible marketing and repair facilities, especially for small scale diesel pumps have mushroomed and real costs have declined. In contrast to large fixed electrical facilities, diesel motors are mobile, flexible in use (not only in irrigation, but also transport, milling etc.) and readily repaired. Moreover, diesel prices can be related more easily to efficiency prices since fuel is privately marketed and avoids many of the political pressures and rent-seeking behaviors associated with electricity supplies. Even if electric power is in theory cheaper, opportunity costs in other foregone uses can be very high. Whereas diesel fuel can be readily imported at a cost to meet demand. Active water markets, communal ownership techniques, and water entrepreneurs help resolve the problems of very small landowners. Real resource studies suggest that Bangladesh has a strong comparative advantage in rice production based on a combination of intensive dry season irrigated cropping and low cost rainfed wet season cropping. Farm prices have been kept down in the interest of the urban consumer, and there are severe distribution, storage and related constraints. But, even so, there has been a remarkable growth in paddy output, and Bangladesh is, to the surprise of many, approaching rice self-sufficiency.

WATER CONSERVATION

Water conservation receives attention in all discussions that focus on how to satisfy expanding water demands and on water related environmental concerns. Water price levels can impact on water use and do much to encourage water conservation. Management of a system of

water pricing with a linkage to conservation could be enhanced by improved water supply service measurement, particularly by metering industrial and urban water supplies for the purpose of administering a system of charges. Improved industrial processes offer conservation opportunities, and their application by industries can be influenced through water pricing mechanisms. Pollution charges, when point source polluters can be identified, can have water conservation impacts. However, the "polluter pays" principle is a lot more palatable to government when the object is a private industrial discharger than when it is a government entity such as a city or a state-owned factory. Improving individual or entity user efficiencies may do little to conserve water at the basin level unless the return flows are being irrecoverably lost from the basin (Chapter 4). Water prices are generally too low on government operated water supply systems throughout the Asia region, application of pollution control regulations is generally lax, and systems of charging for pollution are not applied.

V. CONCLUDING REMARKS

With the exception of Korea, real-time management inadequacies are pervasive in all water development related sectors throughout the countries of the Asia region. While development is at a low level relative to resource availability, as in Myanmar, Laos and Kampuchea, the impacts of real-time management failures are felt mainly at the individual project level, though pollution mismanagement may have wider implications. As resources are more intensively developed, real-time management capability is required at both basin and project levels. In every respect, failure to achieve required levels of real-time management capability relates to institutional inadequacies. So long as water rights and allocations are not properly defined, the end-users lack leverage and the operating entities have very limited incentives to provide a defined service. Thus O&M of facilities is regarded as low priority, particularly when it is the responsibility of a government line department, and O&M funding is generally inadequate. Though properly detailed POMs for individual facilities, and for basins when development of the resource is advanced, are essential to achieving appropriate levels of real-time management, these documents in themselves cannot ensure management requirements if O&M is afforded low priority and is underfunded.

A particular weakness regarding real-time management in most Asian countries is in all aspects of regulatory functions pertaining to water rights and allocations, operations, maintenance, water quantity control, water quality control, and even administrative responsibilities and financial accountability. In many instances, the necessary regulations do not exist to ensure appropriate real-time management of water resource in all respects. In more instances, the regulations that do exist are not applied with appropriate force. Many reasons can be cited to explain inadequate application of regulations, including failure to clearly separate regulatory and operational functions between government agencies, and underfunding and understaffing of the regulatory agencies that do exist. However, in the final analysis, failure to establish and impose an appropriate suite of regulations and standards reflects lack of will by governments to implement policies that often have been expressed in legislation. This is particularly true in the case of failure to control private groundwater development by a properly applied licensing mechanism, which will be essential if this resource is to be wisely managed.

Proposals to use pricing mechanisms as a substitute for applied regulations to control the actions of public and private agencies and private individuals that impact on water resources are, in most cases, illusory. In most situations, there is no substitute for a properly applied system of licensing backed by an appropriate system of regulation, which has power to penalize defaulters, if control is the objective.

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ECONOMIC AND FINANCIAL POLICY

I. INTRODUCTION

CONSTRAINTS ON ECONOMIC PRICING

In a perfect market, the price for water would be determined through equating long-run marginal costs (direct, indirect and opportunity) with long-run marginal benefits, leading to an economically efficient solution. Water would be reallocated from low return to high return uses through the market, and new projects would be undertaken only if justified by the marginal benefits in the next-best (unsatisfied) use. Since all costs tend to rise steeply as the resource is exploited, the price would also rise steeply, normally (greatly) exceeding the historic costs of development.

In practice, for well known reasons, few governments in Asia, and throughout the world, are willing to charge for water at levels that even approach its true economic value. The difficult to determine third party costs and the several other noneconomic objectives, often of greater importance than economic efficiency, preclude the application of all but limited free markets. Charges are often set according to financial cost recovery criteria or by political decree rather than in terms of efficiency pricing, and even then are at best limited to recovery of operation and maintenance (O&M) costs and, perhaps, a share of capital costs. Indeed, in many contexts water is provided free of charge. In others, recovery mechanisms are limited to an indirect charge through a land tax or (implicitly) through the general tax system. Given their nature, the burden of meeting allocation objectives must rest almost wholly on regulation. The more effective the exercise of regulatory powers, the closer will water allocations accord with societal objectives as set by government. The weaker the exercise of regulatory powers, the more likely that allocation will reflect rent-seeking activity by an end-user (e.g., farmer) or those involved in distribution (e.g., department staff). If allocation objectives themselves are ill-defined, then water allocation will be ambiguous or even arbitrary.

Besides the cultural and political considerations that commonly limit the **level** of water charges, there are also major constraints on the use of price as a **mechanism** in water allocation. Market failure is a generic issue inherently associated with characteristics of water (Chapter 1). In addition, there are important institutional constraints more specific to the Asian context, including:

1. **Water Rights.** In the absence of clearly administered and enforced property rights,[1/] water allocated to or appropriated by a corporation, private firm, community or individual cannot be sold or exchanged except to a limited extent in the immediate locality (e.g., from a tanker in a drought, by pump owners to their neighbors, by sale or exchange of irrigation turns). There are essentially no mechanisms for marketing on a longer-term or broader basis, and few

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1/ The absence of clearly defined water rights also allows government agencies great freedom to appropriate and reallocate water as they think fit. In principle, such actions could be guided by estimates of marginal cost, and thus, mimic a market outcome. In practice, for many reasons, there are limits on how far this can be achieved since: (i) Water allocation is designed to meet a range of objectives besides economic efficiency; (ii) physical constraints limit how far water can be moved between uses; (iii) governments are severely constrained by past decisions and commitments (e.g., in view of investments in complementary public and private facilities); and (iv) central planning and direction of this type have seldom been successful if not supported by appropriate incentive and market signals.

mechanisms for compensating users deprived of supplies.[1] At government level, judicial awards and provincial agreements often involve joint project financing, but rights and allocations are not leased or sold to neighboring provinces or countries.[2]

2. **Agency Structures.** Water services are best provided by autonomous entities organized as utilities providing a defined service to customers for a fee (Chapter 3). By isolating the service function from other influences, the utility form encourages operational efficiency, service accountability and good financial management. Even if the fee charged is too low to have a significant impact on water use, financial autonomy is fully consistent with the objectives of efficiency pricing; is normally a precondition for sensible introduction of pollution and similar charges; and provides a sound basis for more active approaches to demand management and marginal cost pricing.[3] In contrast, if water is supplied by intermingled units of a line department, incentives for efficient management are inherently limited, and there are generally inadequate preconditions for effective price and incentive systems.

3. **Practical Considerations.** Large differences between the value of water and its price create rent-seeking opportunities, and place a heavy burden on regulatory and implementing agencies to ensure that allocations accord with stated objectives. Given low incomes, poor pay and staff morale, the massive size of irrigation and other schemes, the huge numbers of beneficiaries and difficult external conditions, it is perhaps not surprising that agencies often fall short in this task. Moreover, the costs and practical difficulties of metering water supplies to households or farms may rule out volumetric pricing at this level. Price as a mechanism for demand management can thus often only be effective at a wholesale or group level. The key in each context is to establish a water distribution hierarchy that allows proper measurement at each level (e.g., the river course, a multipurpose facility, the water conveyance system, irrigation service areas).[4] Each level of the hierarchy can then form the basis for a financially autonomous utility. Even if charges are low, the cost of bulk supplies may loom large in the accounts, providing some discipline on water use besides having a positive impact on performance.

If institutional constraints restrict the use of the price mechanism, then greater priority may have to be given to institutional reform if charges are to have any practical effect beyond public resource mobilization. Only if the institutional preconditions are met can price begin to have a significant impact on the efficiency of agency performance or water use.

ISSUES IN FINANCIAL MANAGEMENT

Irrespective of whether the utility form is adopted, appropriate policies are required to finance investment and O&M activities. The issues involved can be briefly reviewed as follows:

1/ Elsewhere in the world, water markets at this level are under trial, for instance, in California, where a recent drought has led to the creation of a state-managed water bank; in the Australian state of Victoria and some western United States, where individual users are allocated specific shares in reservoir storages, subject to specified probabilities, which can be leased, sold or exchanged locally in response to varying demands; and in France and the United Kingdom, where privatized water companies bargain amongst themselves for supplies. See Topic Papers No. 3, "Water Allocation Methods and Water Rights in the Western States of the USA," and Topic Paper 5, "Water Resources Institutions: Some Principles and Practices."

2/ Joint power projects may approximate to this (e.g., the Chukha project developed by India in Bhutan.)

3/ Public utilities, and regulators, often object to marginal cost pricing on the grounds that it would lead to excessive profits, although there seems no reason why excess profits could not be taken care of by taxation policy. For this and other reasons, and despite long standing advocacy (e.g., by the Organization of Economic Cooperation and Development and the World Bank), long-run marginal cost pricing is rarely practiced in water.

4/ The "structured" approach to irrigation management and design provides a systematic way of thinking about these issues (see Box 5.5).

1. **Financial Planning and Budgeting.** The need for sound financial planning and budgeting is self-evident. The utility form provides a transparent framework for accounting for all income and expenditures and for clarifying the extent and nature of any direct financial subsidies. Governments almost invariably expect autonomous agencies to cover O&M expenditures but typically subsidize investment wholly or in part. Subsidies are less transparent in line department accounts. Water charges return to the general revenue account and are frequently less than an amount equivalent even to O&M costs. Moreover, regular government financial procedures provide fewer incentives for efficient financial practice than those of an autonomous agency, whether in the public or the private sector. While full recovery of investment and O&M costs is frequently advocated, in practice this meets strong resistance, in particular in publicly financed irrigation, drainage, flood control, domestic water supply and sanitation facilities.

2. **Cost Allocation.** Few countries in Asia apply consistent cost allocation procedures for multipurpose projects, even where public agencies are organized according to utility principles, in part due to differing cost recovery practices in the various sectors (see below). As a result, there may be hidden cross subsidies, in particular where a lead agency constructs a joint facility (e.g., from power to other sectors, irrigation to domestic water supply, etc.) In all cases, direct costs (capital investment, remedial works, interest during construction, replacement works, operations, administration, and both routine and emergency maintenance) need to be clarified with proper allocation of joint costs to all purposes. Treatment costs to meet water quality standards, notably for urban and industrial point discharges, can be readily identified. Direct costs are measurable on a project-by-project basis and recovery can normally be judged fair to beneficiaries. Even if subsidies are given to compensate for other distortions in the economy or to meet regional or equity objectives, or if taxes are to be imposed, a first need is to clarify direct costs and provide financial transparency. Numerous studies have shown that in most cases beneficiaries are well able to reimburse full direct costs. If they cannot, then the use itself or the type and cost of the facility should be questioned.

3. **Cost Recovery.** Cost recovery practices typically differ in the different sectors. Power agencies often account for a share of joint costs and charge their customers full direct, even marginal, costs. In contrast, irrigation charges are often set as an administrative decision independent of cost.[1/] In some sectors, (flood control, navigation, environmental management, etc.) there are few mechanisms adopted for cost recovery, and these sectors may be completely ignored in cost allocation procedures.[2/] Numerous mechanisms can be used to recover costs, though those that relate payment to service, in terms of quantity, quality and reliability, are generally preferred (Chapter 3). The utility form provides a transparent basis for accounting for such income, while sliding scale charges and other mechanisms can manage demand, encourage water-use efficiency and maintain quality of service.

1/ A good example is provided by Sri Lanka's Mahaweli program. Least cost power investment programs were evaluated using consistent cost allocation procedures which were also reflected in electricity pricing, whereas irrigation projects were justified sequentially assuming sunk costs at each stage with all capital costs and most operation and maintenance (O&M) costs borne by the national budget. Attempts to recover O&M costs from farmers have been largely unsuccessful, and O&M costs have been financed under the development budget.

2/ Although infrequent in Asia, cost recovery mechanisms adopted elsewhere for such sectors can include zoned assessments (e.g., for flood control and drainage), property and land taxes (e.g., for environmental and other services), and augmented charges (e.g., for river locks, port facilities, national parks, etc.).

II. THE ECONOMIC CONTEXT

MACROECONOMIC INTERACTIONS

The impact of water resource programs on overall macroeconomic performance has been mentioned briefly in the context of national development planning (Chapter 4). The provision of water resources infrastructure within the framework of general physical development has been referred to under regional planning. But water resource issues also interact in crucial ways with short-term macroeconomic management. This is most clearly seen in relation to drought and flood emergencies. Steady expansion of the irrigated area and reduced dependance on rainfed agriculture have provided India with some protection against a poor monsoon, and the droughts of the late 1970s/early 1980s caused less economic damage than the comparable droughts of the early 1960s. Even so, a poor monsoon or series of poor monsoons in India--and to varying extents in other countries--can still severely damage short-run economic prospects. Moreover, though irrigation attenuates rainfall variability in the immediate short term, river flows are typically more variable than rainfall from year-to-year. As water resources approach full exploitation, therefore, variability in dry season agricultural output increases. The costs of flood damage similarly rise as development and population intensify. This is illustrated by the 1991 floods in China. Damage in the Tai Lake Basin--estimated at US$2 billion--in large part comprised buildings and factories constructed since the late 1970s. Physical works planned under a proposed Bank project will substantially alleviate the situation Works in the Hang Hu Basin funded by the Pishihang Project (Cr. 1606-CHA) resulted in flood damage being less than in the comparable 1954 event. But in some countries (e.g., Bangladesh) there may be few physical flood protection solutions.

The economic and social impact of drought and flood emergencies can be minimized by proper planning (see Topic Paper 1, "Planning for Droughts: An Essential Action"). Even so, such emergencies will continue to tax short-term macroeconomic management. This is part of a much broader subject that is beyond the scope of this report, but it further emphasizes the importance of obtaining a better understanding of the linkages between the water sector and the broader macroeconomy (Chapter 4).

THE PRICING CONTEXT

Water is but one input within the overall production and pricing system in which governments actively intervene. In Korea, for instance, rice imports are banned and the domestic price is several times the world price. Even so, large irrigation subsidies are necessary to further enhance rural incomes to compete with rapidly rising urban wages. Malaysia cannot afford the Korean practice and, though domestic rice prices are above world levels, some irrigated land lies fallow or are consolidated with adjacent farms as labor moves to higher paid activities. In contrast, in Bangladesh, Myanmar, China and elsewhere, rice prices are kept below world levels through various measures including overvalued exchange rates, forced procurement, (aid) imports, export taxes and other means. There are often offsetting subsidies (e.g., on fertilizer and water) but, even so, competing rural and urban interests and/or rice self-sufficiency objectives have frequently led to economically irrational policies in which irrigation investment and operating subsidies have played a major part. The welfare costs have been large with production enhanced in countries with no obvious marginal comparative advantage in rice (e.g., Korea, Sri Lanka and the Philippines) and suppressed in countries with such an advantage (e.g., Bangladesh, Myanmar and Vietnam).

Energy pricing is another obvious area with direct impact on water. Power prices are almost invariably closer to efficiency prices than those for water but may still suffer significant distortions. Besides direct impacts on the financial viability of hydropower, such distortions feed back into water in other ways. For instance, in some countries, rural electrification has been heavily subsidized. If power shortages are severe (e.g., most of India and Pakistan), opportunity costs in foregone urban and industrial uses may be very high in addition to high direct costs and leakages associated with poorly designed and operated rural electrification facilities. Diesel on the other hand may be moderately taxed and, in contrast to fixed electrical facilities, diesel motors are

mobile, flexible in use and easily repaired. Concurrent subsidization of electricity supplies and taxation of diesel provide distorted signals to the private investor. Policy prescriptions will vary greatly depending on the context. However, experience in Pakistan, India and Bangladesh indicates that, at least in those contexts, liberalized private equipment and investment markets supported by appropriate credit and infrastructural facilities, and subject to appropriate energy and agricultural pricing signals, lead to rapid exploitation of the water resource (Box 5.6).

Agricultural and power subsidies/taxes are by no means the only interventions in the economic system that impact on water. General price reform is clearly beyond the scope of this report but if prices in general are distorted, then full marginal cost pricing for water may be an inappropriate objective even in principle. Real resource studies can help clarify such issues and could in theory be used to estimate the economically efficient level of water charges. In practice this is seldom if ever done. Even so, governments commonly rationalize failure to recover costs in terms of other interventions in the pricing system. Any consideration of financial management and performance must recognize this wider context.

III. Financial Management

Organization and Agency Structure

The merits of the financially-autonomous utility form in the provision of water services have been discussed at length (Chapter 3). In many nonagricultural sectors (power and water supply), in irrigation in East Asia (China and Korea), and in communal irrigation throughout the region, the utility form is the norm. Irrigation departments in South and Southeast Asia represent perhaps the most striking exceptions. Flood protection, river training, drainage and similar services are also normally provided by line departments while rural water supply may be constructed by a line department for subsequent transfer to local government or communities for O&M.

The National Irrigation Administration (NIA) in the Philippines illustrates the problems that can be encountered and advantages realized in transforming a traditional line department to a utility (Box 6.1). The NIA is subject to government control in important matters, including the setting of the level of water charges. Nevertheless, it has responded to financial pressures in at least two important ways: First, by major staff adjustment and incentive programs; and, secondly, by seeking to transfer O&M responsibilities to self-sufficient Irrigation Associations (IAs). Thus NIA has in general adjusted to the volume of construction activity even if irrigation investment itself is driven by government food self-sufficiency and other objectives. Moreover, it is possible to envisage that most O&M will be transferred over time to local organizations with a direct interest in self-sustained performance. Contrast this with the Irrigation Wing of the Power and Water Department in Tamil Nadu which promotes new investment programs even where by most measures water is fully exploited, and which has shown little interest in transfering O&M responsibilities to farmer groups. Yet the state's relatively small, if complex, river basins would appear to be adapted to the evolution of utility forms, with rivercourse agencies managing multipurpose facilities for delivering services according to clearly-defined criteria to autonomous user organizations (water supply, industrial and irrigation) in return for a fee.

The most striking examples where utility forms have been adopted in a consistent manner are in East Asia. All water users in China since 1966 have in principle paid for supplies in relation to the service received:"Payments for water usage are...collected by the Water Conservancy Administration at three levels...the (Provincial) Water Conservancy Bureau collects payments from...River Administration Offices (and major direct users of reservoir supplies e.g. power agencies, municipalities etc)...the River Administration Offices collect fees from the Water Conservancy Offices (and other customers) at water gates and canal heads...and Water Conservancy Offices (and other utilities) levy payments from farmers (and other customers)" (BIEP 1988). Bureaus and offices at each level must cover O&M costs and repay a share of capital

costs. While such cost recovery is by no means always achieved, incentive signals permeate throughout the water administration. The County Water Conservancy Offices are public agencies but act essentially as self-financing cooperatives. The need to reimburse the River Administration Offices results in both cost-saving and revenue-generating activities, besides leading to pressure on farmers to pay their full dues. Even in those cases where a facility is constructed and operated by an autonomous agency, for instance a dam or a "self-developed" well, the agency may be required to pay a resource charge to the State Water Conservancy Bureau. Fee levels may be too low, and there are inconsistencies between uses, with some uses (flood protection, drainage, river training, etc.) paying no charges. Cross subsidies between sectors and inconsistencies in financing between purposes, jurisdictions and agencies result in a premium being attached to revenue generating activities (e.g., hydrogeneration), in part as a means of financing nonrevenue generating activities. Even so, financial arrangements are transparent and, in contrast to much publicly financed investment in the water sector in other parts of Asia, major attention is given to revenue generation at all levels of provincial and national government.

Box 6.1: THE NATIONAL IRRIGATION ADMINISTRATION, THE PHILIPPINES

The old Irrigation Division was abolished in 1963 when its assets were transferred to the newly created National Irrigation Administration (NIA). The aim was to initiate "an irrigation age" through an independent and financially autonomous entity. The NIA was to construct national irrigation systems, recover fees needed for "continuous operation" and reimburse the government all new construction costs "within 25 years." In practice, income failed to cover requirements, and for about ten years NIA continued to be financed essentially through the national budget. Even so, NIA greatly accelerated investments, and the irrigated area has more than doubled since it was created.

In 1974, major changes were introduced to broaden NIA's responsibilities and institute effective self-financing. Capitalization was increased, government equity allocations were provided for investment, and NIA was authorized to retain income from irrigation service fees (ISF) and other sources to finance operation and maintenance (O&M). Communal irrigation and drainage were added to its mandate and NIA was empowered to incur foreign debt. "The overall effect was to maintain the mandate of NIA to recover O&M and at least partial construction costs... while being relieved of the requirement to repay the government for (its) contributions" (Svendsen, Adriano and Martin 1990). These changes recognized the difficulty of establishing full autonomy while introducing financial incentives to the agency which "caused it to begin to respond to the economic and financial implications of its actions." Supplementary operating subsidies were ended in 1981, and NIA came under strong government pressure to accept responsibility for foreign loan repayments. This has proved unrealistic and ownership of all physical assets has now been returned to the government, with investment wholly financed from the regular budget but implemented by NIA for a management fee. Moreover, NIA continues to be subject to government regulation in important respects, including staffing matters, salary levels and ISF rates. Its independence is therefore limited, and it must struggle to fund adequate O&M expenditures.

Despite these drawbacks, NIA has considerable operational freedom and its corporate structure has given it a flexibility and purpose that is lacking in regular line agencies elsewhere in Asia. This is illustrated by its responses to phasing out operating subsidies, which have included cost savings, staff reductions, incentive schemes and devolution of responsibilities to farmer groups. In general, it has had more success in containing costs than in generating revenues. But it has been able to use corporate funds to offset variable government investment allocations and has been a pioneer in promoting farmer groups and farmer participation. In communal irrigation, it has evolved systematic procedures for strengthening irrigation associations (IAs) to take full O&M responsibility and repay a portion of capital costs. In national systems, IAs are responsible for tertiary O&M, and have been increasingly concentrated for main system O&M and ISF recovery. The long-term objective is to fully privatize small and medium schemes and to limit NIA's O&M role to major conveyance facilities. Besides reducing direct costs, the establishment of a utility style of operation should help sustain IAs and improve system performance.

Private Agencies

Communities throughout Asia have invested extensively in irrigation and, to a lesser extent, other water facilities for many centuries, and the need to cooperate in reconstructing, maintaining and operating facilities (brush weirs, earth dams, supply channels, distribution systems, village tanks, etc.) has been both an important cement in community relations and an indication of the value attached to water. Governments increasingly have provided assistance for permanent and more substantial facilities (concrete weirs, higher dams, etc.), and also have constructed larger facilities in the pursuit of national objectives. In many cases, the initial aim was to recover the full financial costs from the beneficiaries. Indeed, the East India Company, the British India Government and some private companies were involved during the last century in

large scale irrigation and navigation canals in India in the expectation that investments would be profitable. But over time, this objective was often lost and governments increasingly emphasized the national economic and social objectives of irrigation. Consequently, essentially all large scale water supply services in Asia are in the public sector.

The question arises whether there is potential for privatization--in the sense of "for profit" entities--of major water supply facilities as has occurred in some developed countries (e.g , the recent shift in the United Kingdom). Privatization in principle has the potential for exploiting the full benefits of the utility form. Nevertheless, the local monopoly and essential service characteristics of water must severely limit the privatization of major facilities in Asia. Besides political objections, any private utilities would need to be closely regulated and the duties and rights of the privatized agency and the beneficiaries would have to be specified with great clarity and detail. While this might have advantages in the sense that nothing would go unexamined, administrative weaknesses in most Asian countries would in practice probably rule out effective regulation. Public water utilities as established in China or "corporatization" of the type implemented with respect to the NIA in the Philippines and the same organizational form that dominates urban and bulk water supply services in the developed countries will therefore remain the most practical approach to extending the use of the utility form for major facilities.

The exception with regard to privatization is in the irrigation sector. In recent years, considerable attention has been given to the potential for turning over small irrigation schemes to farmer organizations as "not for profit" entities. This has always typified irrigation management in Korea, Taiwan and Japan. Pilot and more substantial programs have been implemented in numerous other Asian countries including Bangladesh, Nepal, Pakistan, the Philippines, Sri Lanka and Indonesia. In many cases, this returns the position to the *status quo ante* before governments extended their role into communal systems. Perhaps the most systematic approaches have been developed in the Philippines. The IAs are legally registered under the Security Exchange Commission and have the characteristics of a private company. For small systems, IAs establish contractual arrangements with NIA with respect to equity contributions and partial repayment for capital works, besides assuming full responsibility for all O&M. In larger systems, they contract for O&M work in the main system and irrigation service fee (ISF) collection. Full turnover of small national systems is envisaged. Increasingly, IAs are also active in areas that go beyond irrigation O&M. While this carries certain risks, it also can provide the basis for the undertaking of other income-generating activities more typically associated with the cooperative movement. County conservancy bureaus in China are public bodies, but also have some of the characteristics of a farmer cooperative. There is great potential for extending such approaches throughout the region. Not only could they substantially relieve governments of the burden of O&M, but they should also contribute to improved irrigation performance, and increased communal and cooperative investment. Bangladesh has a policy to divest of the entire inventory of government tubewell irrigation facilities (and low-lift pumps) to the private sector. Pakistan is seeking for a methodology for handover of Salinity Control and Reclamation Projects (SCARP) tubewells into private ownership in useable groundwater areas.

COST RECOVERY AND SERVICE CHARGES

Cost recovery mechanisms can be classified into five broad categories (based on Small, Adriano and Martin 1986): (i) Water prices, based on volumetric supply; (ii) service fees not directly related to the volume of water supplied (for instance, a supplement to property taxes for domestic water supply or an area-based irrigation charge); (iii) betterment taxes on benefitted property (common for drainage and flood protection); (iv) general taxes that do not have specific relation to the water benefits (e.g., a commodity export tax); (v) implicit taxation through the manipulation of other prices (e.g., through the exchange rate); and (vi) supplemental income earned from sources other than the primary water service (e.g., from fisheries in a reservoir, etc.). As indicated above cost recovery mechanisms that relate payment to service (as a price or service charge) are generally greatly preferred and complement the utility form of agency organization. Recoveries based on indirect tax or pricing mechanisms are often easy to collect, and fulfill equity

and resource mobilization objectives, but have no significant impact on efficiency of water use, though it may have on agency performance. Supplemental income can be important (e.g., to an irrigation agency or irrigation association), but is different in character to other types of cost recovery.

Practice varies between countries, purposes and sectors. Power agencies normally aim to cover full costs through power tariffs. Municipal uses commonly pay either a volumetric price or an augmented property tax. A tiered or escalating rate structure can encourage water conservation. In some sectors (flood control, navigation, river training, environmental management, etc.), there are few effective mechanisms for cost recovery in Asia, although experience elsewhere suggests that they can be most effectively and equitably charged through zoned betterment taxes on property. The most varied practice in the region is in the irrigation sector. Box 6.2 summarizes experience in some Asian countries.

There is no reason why all water users cannot be brought within a unified framework as is in principle required in China--Table 6.1 illustrates this with the water prices prevailing in the Beijing area in 1988. There are a number of interesting aspects to this table. First, the large difference between the price charged to agriculture and that to industry, which no doubt reflects considerations of social equity but also reflects differences in the reliability of supply. Second, unusually, hydropower agencies are charged for water released from storage at levels that vary depending on whether or not the release also serves some other purpose. Third, a resource charge is imposed on wells developed by industrial and domestic users for their own requirements, with a surcharge imposed if the well is outside the provincial water plan and with a credit for water returning to the aquifer. Given the acute water shortages experienced in the Beijing area, water is also rationed with penalties imposed for use over and above established quotas. The report from which this table is drawn is highly critical of the general level of prices, the pricing structure and the basis of the rationing system. No doubt there are inconsistencies, and no doubt subsidies are incurred. Nevertheless, this unified framework provides a rational base for discriminating between sectors depending on the level of service provided; ensuring that service agencies are financially autonomous; and even, over the longer term, for increasingly reflecting opportunity costs and externalities in the pricing structure.

Table 6.1. **WATER PRICES IN THE BEIJING AREA: 1988**

		Water Charge (0.001 Yuan/ M^3)
Surface Water		
Industrial Use:	Direct	40.0
	Re-Use	15.0
Hydropower:	Single Purpose Use	2.5
	Combined with Other Uses	1.0
	Cascade Use (per step in the cascade)	0.5
	Re-Use (pumped storage, etc.)	0.8
Agricultural Use		6.0
Domestic and Municipal Supply (Groundwater and Surface Water)		
Treated Water	Urban Residential Use	120.0
	Commercial Use	180.0
	Industrial Use	240.0
Water From 'Self-Developed' Wells		
	Within the Plan	20.0
	Outside the Plan	100.0
	Recharge to Groundwater	-20.0

Source: Beijing Institute of Environment Protection:"Study of Water Resources and Pricing," 1988.

Box 6.2: IRRIGATION COST RECOVERY IN SOUTH AND SOUTHEAST ASIA

India. Water charges for public irrigation services have a long history in India, at one time being a major source of revenue (Tamil Nadu is an exception, although irrigation status helps determine land tax). Arrangements vary from state to state, with irrigation and finance departments variously responsible for assessment and/or collection. Procedures are typically staff intensive, detailed and, in theory, systematic, reflecting past importance. However, rates are established by government, revenue invariably returns to the general budget, and real rates have declined markedly over time. Moreover, rates are expressed in area terms (excepting groundwater irrigation in Uttar Pradesh and Gujarat) and, while there is some discrimination between crops, they are now generally so low as to have minimal impact on water demands. Rates are significantly higher in the western states of Maharashtra and Gujarat, which practice the shejpali approach to irrigation management; generally lower but subject to high levels of recovery in Punjab and Haryana; and both low and poorly recovered in South and East India. Bihar is reported to spend more on water charges administration than it collects in revenue. Although there may be some collateral advantages from maintaining systematic procedures, these are much less obvious than in the case of land tax, which is vital for maintaining ownership records, and Bihar's situation is clearly ridiculous. Experience in Bangladesh, Nepal and Pakistan has been comparable to that of India.

The Philippines. Irrigation service fees (ISF) in the Philippines are expressed in terms of paddy per unit area. Though government is as reluctant as elsewhere to raise rates (these have remained constant since 1975), and paddy prices have declined in real terms by 50 percent since the early 1970s, this provides a degree of indexation. The ISF income is the main source of revenue for the National Irrigation Administration (NIA) (Box 6.1), which therefore has a strong interest in maximizing collections. While it has not been wholly successful in this regard, NIA has been imaginative in providing incentives to staff and farmers, and failure to collect what is due forces it to respond in other ways (e.g., cutting costs). Stagnation in ISF rates means that NIA has been unable to recover capital costs in national systems, although it does recover relatively small amounts of investment in communal schemes.

Indonesia. Indonesia has no history of water charges although irrigation status has traditionally been an important factor determining levels of land tax (Directorate General of Taxation [PBB]). In recent years, however, with World Bank support, an unusual pilot scheme has been initiated to test the feasibility of collecting ISF, and it is planned that this will be extended rapidly over the whole irrigated area within the next decade or so. The ISF rates are set in relation to operation and maintenance (O&M) costs, are related to the standard of irrigation service, and in principle retained for use in the scheme concerned (supplemented where necessary by the government (e.g., if the standard of service is poor and hence rates are relatively low). Systematic procedures provide for farmer consultation and review, and farmer groups are involved in collection. While the pilot scheme is relatively costly, it is hoped that ISF collection will contribute to improved standards of irrigation service through an iterative process involving farmers, irrigation staff and local government, and will lead to increased accountability and locally based financing. Over time, it is intended that smaller schemes and portions of larger schemes will be privatized with the farmer groups retaining ISF collections for their own use.

Sri Lanka. Sri Lanka has no tradition of ISFs. However, enabling legislation has been adopted and two attempts have been made in recent years to collect such a charge. In contrast to the "pilot" approach adopted in Indonesia, in principle farmers in all major and medium irrigation systems (those above 200 acres) were subject to the charge. In both cases, initial collections were appreciable but quickly fell away as farmers complained that others were not paying. Moreover, government agencies (the Mahaweli Authority and the Irrigation Department) lacked the will to make the program a success. Given this dismal performance, emphasis is now being given to transfer of O&M responsibility for medium schemes, and for increasingly significant segments of major irrigation systems, to financially self-sufficient farmer groups. Proposals for general ISF collection to finance public expenditures have been suspended.

Thailand. Thailand has no tradition of irrigation charges. Rice export taxes were seen in the past as a mechanism for indirect cost recovery, and at one time, greatly exceeded irrigation costs (both capital and O&M). As world prices for rice have declined, and farm incomes have been protected under conditions of rapid economic growth, export taxes have been eroded, and to all intents and purposes have been abolished. The ISF schemes have periodically been proposed, but have yet to be considered seriously.

Myanmar. Myanmar has no tradition of irrigation charges. As in Thailand, rice export taxes were eroded even as the volume of exports declined. However, paddy procurement at (relatively low) government prices continues as an important indirect mechanism of cost recovery.

The cultural and political objections to full cost recovery in water need no repetition. The difficulties that the Bank has encountered in both the irrigation and the water supply and sanitation sectors are well known. Nevertheless, while investment subsidies may be justified in some circumstances to meet national objectives, O&M subsidies are seldom warranted, except in extreme cases (e.g., where abnormally high O&M costs are incurred due to poor construction). Private and user-owned systems that have existed for centuries show that water supply and irrigation schemes can be physically and financially self-sustaining provided the system is designed as an affordable facility consistent with its benefits; the construction is of a type and quality that results in affordable maintenance; the beneficiaries contribute to construction and maintenance of the facilities; the service is reliable as measured by stated rules; and a disciplined operation is supported by a strong beneficiary organization. While larger systems will necessarily remain in the public sector, there is no reason why they also should not be financially self-sustaining. Priority should be given to establishing appropriate institutional structures reflecting the utility form where these are absent. If this is done, service charges need to reflect each sector's particular characteristics, but should also seek to be consistent in reflecting the level of service provided and to avoid cross-subsidization between sectors and among systems.

FUNDING CAPITAL AND O&M EXPENDITURES

Capital Expenditures

Sound financial planning is critical to the implementation of major water resource investments, and failure to ensure adequate financing is a frequent cause of delays and reduced benefits. Raising capital to finance construction is a matter of growing concern in all developing countries of the region. While richer countries such as Korea have a range of options for raising funds, poorer countries are dependent on obtaining soft loans from institutions, such as the World Bank and the Asian Development Bank to supplement domestic resources, and on grants from bilateral donors and the U.N. system, especially for technical assistance and related activities. These external sources themselves are facing increasing demands and pressures.

Wherever water services remain in line agencies, as is the case with public irrigation schemes, flood control and land drainage in most countries of the region, there is no alternative to central or state government funding for capital investments, perhaps supported by external assistance. Once the utility form of an entity is adopted, additional financing options become available, including borrowing through the local or international capital markets, including from such organizations as the International Finance Corporation (IFC). This is, however, only possible if such entities remain viable business enterprises. Several power enterprises in the region have borrowed from the IFC, and this may be true also of other utilities. However, where the independence of an entity is constrained by government controls, and/or it is government policy to extend capital subsidies--usually the case in irrigation--such borrowing is normally ruled out. Under these circumstances, governments normally extend loans or grants to the entity on terms that are subsidized to a greater or lesser extent in real terms.

Such financing arrangements typify many programs in China. They were also adopted under the Bank-supported general line of credit projects in India, which largely went to finance minor irrigation. Under these projects, the central apex lending agency was protected through guarantees from recipient state governments. The poor performance of the recipient state-level banks and political decisions to relieve farmers of credit repayments often necessitated the states honoring these guarantees, illustrating the difficulties of establishing self-financing entities in water. The NIA in the Philippines is another good illustration of such difficulties (Box 6.1). It was intended that NIA would be financially self-sustaining. In the event, irrigation investment is now once again undertaken through the general government budget. This has largely resulted from politically inspired decisions to constrain service charges to levels below those for investments recovery and O&M. The NIA earns a management fee for implementing investment programs on behalf of the government, and the government, rather than NIA, retains formal ownership of the facilities constructed.

Operation and Maintenance Expenditures

Irrespective of cost recovery practice, facilities must be maintained if they are to perform as intended. Yet the low priority accorded to funding of O&M is a common characteristic of public sector water resource operations in the region. As a result, facilities frequently deteriorate and cannot be operated to provide the intended and promised services to the customers. A vicious circle is often established with the customers unwilling to pay for poor services, which in turn, results in declining revenues and lower priority to O&M. When facilities are retained by a line agency for management, governments must budget for O&M activities, including replacement items. Irrespective of whether it is government policy to cover full O&M costs, priority should be given to ensure that O&M expenditures are sufficient to sustain the facilities on into the future. For instance, the Government of Indonesia has adopted policies in the context of the Irrigation Sub-Sector Project (Ln.2880-IND) to provide for needs based budgeting for all facilities brought under an improved O&M program. In the longer-term the aim is to generate ISF revenue to cover all such costs but, meanwhile, the government has guaranteed that it will fund O&M at the necessary levels with Bank support. In such cases, the financing of O&M expenditures for public facilities is clearly a decision that is quite separate from cost recovery performance.

In the case that agencies are established as utilities, it is invariable practice that they are required to at least cover O&M expenditures from service fee revenues. Again, as in the case of capital financing, a basic requirement is that such agencies are managed according to sound business principles. If governments feel that they must control the level of the water fees--for developmental or equity reasons -- then it is important that they explicitly reimburse such agencies for any subsidies implicit in the pricing decisions. The NIA once again provides an interesting example. Government sets the level of ISF. The agency has generally covered its O&M expenditures from ISF and other revenue, and its utility form has undoubtedly helped control costs. Nevertheless, there has also been a tendency for O&M allocations to be below what is needed to sustain facilities. So long as NIA is unable to set the price for the service it provides, the government will need to stand ready, at least implicitly, to cover whatever expenditures are necessary to sustain performance (Box 6.1).

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ENVIRONMENTAL AND SOCIAL ASPECTS OF WATER RESOURCES DEVELOPMENT

I. BACKGROUND

INTRODUCTION

Environmental and social concerns relating to development of water resources are cited at appropriate places throughout this report and within each of the three annexes. Indeed, at least one-third of the 96 water resource related problems described in Annex 2 for the 15 Asian countries covered by the report may be regarded as being primarily of environmental concern, and all the remainder have environmental and social implications. This is in the nature of development as essentially all economic activity involves transforming the natural world. And this applies particularly to water with its specific characteristics of being first a limited resource with few, if any, substitutes; and second a unitary resource with interventions in one part of the hydrological cycle inevitably impacting on water quantity and/or quality elsewhere in the cycle. Recognizing the important environmental implications relating to water resources and their development, this chapter brings together a discussion of water resources and the environment and the sometimes enigmatic and/or dilemmatic social problems posed.

POPULATION GROWTH AND WATER DEMANDS

The world's population was about 1.6 billion at the beginning of the present century. The population had increased by a multiplier of 3.3 to around 5.3 billion by 1990 and, according to the forecasts of the United Nations Population Division, could grow to about 8.5 billion by 2025. It should be noted that this forecast is based on certain judgements regarding future trends in fertility, which is expected to decline in accordance with historic patterns. A worst case scenario would have a slower than expected fertility decline with world populations reaching about 9.0 billion by 2025. Under the base case assumptions, the world's population would stabilize at about 12.5 billion by the middle of the 22nd Century, but it could reach around 23 billion by that time under the worst case assumptions.

In 1990, some 2.9 billion people (55 percent of the total world population) were living in East and South Asian countries, and 2.7 billion of these people were in countries that are generally categorized as underdeveloped. But the U.N. forecasts indicate that the populations of these countries will increase to a total of around 4.5 billion in 2025 under the base case assumptions. These Asian countries occupy only about 16 percent of the world's total land surface.

About 24 percent of the populations of the developing countries of Asia region totalling about 2.7 billion, were living in urban areas in 1990. U.N. forecasts indicate that the proportion of urban populations in these countries will increase to 50 percent in 2025. Taken together with the base case forecast population of about 4.2 billion in 2025 in the developing Asian countries, the estimate implies that around 2.1 billion people will be living in urban centers by that time. The estimate also implies only a very small growth in rural populations in these countries from 1990 to 2025.

The forecasts of population growth and its future distribution in urban and rural areas indicate that about the same number of farmers in developing Asian countries will be attempting to grow the food to feed a total population, which will be about 55 percent larger in 2025 than it was in 1990. The future situation regarding food production for the entire world looks equally stark. The Bank's *World Development Report 1992--Development and the Environment*--states, "As the world's population expands to 8.9 billion over the next forty years, the global demand for grain

will nearly double. To match this, total grain output will have to grow by 1.6 percent a year, a difficult target, but less than the 2.5 percent a year increase over the past 25 years."1/ But the basis for past increases in food production in the region was first expansion of the cultivated area and, more recently, massive expansion of the area under irrigation. The last 25 years also saw the "Green Revolution" associated with the introduction of improved varieties of seeds together with appropriate production packages. But in Asian countries, the main impact of the "Green Revolution" was experienced on the irrigated lands, and the associated gains in production on rainfed lands were, in comparison, relatively modest.

A slowed rate of increase in food grain production has been noted in most Asian countries in recent years. For example, in Pakistan it has fallen to 0.6 percent per year. This indicates that the easiest gains of the "Green Revolution" have occurred, and though further gains are expected, they are unlikely to match the increases in production of the past two decades. Moreover, most countries of the region have very limited opportunity for expansion of croplands. In fact, the continuous invasion of fragile forest lands by land-hungry rural populations in most of the countries bears testimony to the fact that most of the land suitable for sustainable agriculture has already been occupied. In addition, most of the easily developed irrigation water supplies have already been mobilized for that purpose. While opportunities for capturing additional water supplies in storages for irrigation and other, often competing, purposes exist in some parts of the region, these almost always have high cost and, almost invariably, excite opposition because of environmental and social concerns. Similarly, any proposals to drain wetlands for agricultural or other purposes are generally opposed for environmental reasons.

The forecast massive growth in urban populations must result in significant encroachment on to scarce agricultural land to accommodate urban dwellings and the industries on which the urban populations will depend for a livelihood. There will also be large increases in water demands for urban water supplies and the industries. And in many cases, this will require reallocation of water from agriculture. In addition to the reduction of agricultural production implicit in such a decision, it also poses the difficult social problem of where will the deprived rural population find their livelihood. It seems inevitable that they will move to the cities and contribute to urban population growth. Moreover, urban growth on the scale envisaged will undoubtedly cause very large increases of the problems associated with urban and industrial waste water disposal and pollution, which are already among the most intractable environmental problems in the region.

As urban populations grow, the cities of the region will be increasingly hard pressed to provide even the most basic requirements for community water supply and sanitation. Such services are particularly important because of their impact on the health of the urban poor. (They are, of course, of no less importance for the rural poor.) In most developing Asian countries, the effort to deliver relatively safe water supply has far outweighed the commitment to properly treat and safely dispose of waste water. The resulting environmental problems appear to have grown much worse during the last two decades as rivers, estuaries and coastal waters and the groundwater systems are increasingly polluted by sewage and industrial wastes.

THE FUTURE THREAT OF DROUGHT

Out in the future is the certainty of occurrence of a prolonged and severe drought affecting an extensive area of the Asian region. In the past, with much smaller populations than now exist and are forecast for the future, such events caused widespread and devastating famines until their impact was reduced by the development of irrigation and other actions. Indeed, the motive for the development of much of the irrigation in British India and elsewhere in the region

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1/ The World Bank, *World Development Report 1992--Development and the Environment.* (Washington, D.C.: 1992).

was to protect against famine. In recent decades, drought caused famines have been rare due to higher food grain production and stocks resulting from the combined effects of irrigation development and the "Green Revolution." However, an extensive area of China suffered famine in 1962, due in part to politically inspired mismanagement. Nevertheless, droughts have occurred and have taken their toll. For example, large areas of Gujarat and Rajasthan (and elsewhere in West-Central India) suffered a prolonged drought over the years 1984 to 1987. Though food supply was not in question, water was in short supply for even basic necessities, as was grazing for the large cattle population. Reservoir supplies in Saurashtra were withdrawn from irrigation (some permanently) to provide domestic water to the population and to serve the cattle. Groundwater systems in hard rock areas were drawn dry. Immense expenditures (said to be US$1,000 million) were made on trucking water by road and rail, on installing pumps and pipelines on reservoirs (often to draw dead storage), and on crash well sinking and deepening programs (many with little or no success). Water rationing was extreme, the shortages were experienced by urban and rural communities alike, and large reductions were made in irrigation. Gujarat again experienced severe drought in 1991/1992 and again had to take emergency actions to provide community water supplies.

When future droughts occur, the impacts of the present and growing water shortages in many parts of the Asia region will be greatly exacerbated. Supplies, albeit rationed, will no doubt be provided to communities and some industries under the action of *force majeure*. But supply to agriculture cannot respond in this way. The threat of food shortages may again loom in parts of Asia if they experience an extensive and prolonged drought. History has shown that high levels of food grain production and of cereal stocks in the developed world are of little use to combat a major Asian shortage, as they cannot be mobilized, transported and distributed either in the quantities required or rapidly enough to have much impact.

GLOBAL WARMING

The theory of the climatic effects of accumulating "greenhouse gases" in the atmosphere was conceived by Fourier in 1827. Arrhenius published the first analysis of possible climate change caused by industrial sources of radiatively active gases in 1896. In the early 20th Century, there was considerable debate on whether atmospheric CO_2 would increase and cause warming or would decrease and lead to cooling. Analyses of data give conflicting results, but some now believe that there is a threat of climatic change due to increasing concentrations of greenhouse gases (of which CO_2 is the most important but not the only one). However, present information and understanding are inadequate to predict what if any changes may occur, and thus the implications for the world at large and society in particular.

Predictions of regional climatic changes are very uncertain if warming does occur. Some countries could experience climatic improvement, and thus may gain. Others may experience a decline in rainfall or growing season, which could result in significant losses. Agriculture stands at greatest risk or possible gain because it is the most climate sensitive part of any economy. And agricultural production will remain a dominating interest in the economies of most of the Asia region countries in the foreseeable future. Concerns about rises of sea levels of several meters due to global warming appear to be receding. Nevertheless, a small sea level rise would have a significant negative effect on a low-lying country such as Bangladesh.

Manmade CO_2 accounts for over 50 percent of the accumulating radiative gases, most of which now originates from the developed countries and, moreover, is amendable to mitigation, albeit at high cost. However, methane produced by irrigated rice production and animal husbandry is probably the most important greenhouse gas for developing countries, including those of the Asia region. The possibilities of reducing methane emissions while maintaining agricultural output are limited.

II. Environmental Considerations of Water Development

Non-Point Pollution by Fertilizers and Pesticides

The food grain production successes achieved over the past 25 years in the Asia region have not been without environmental costs in terms of pollution. The higher yields from improved seed varieties can be obtained only with appropriate doses of fertilizers and pesticides, and are most usually associated with the secure soil moisture conditions provided by irrigation. Part of the applied chemicals is either leached to the groundwater or washed off the fields to rivers and lakes. This type of pollution is now more common in Europe and North America. But pollution by agricultural chemicals could become a problem in parts of the Asia region. Use of chemical inputs in, for example, Northwest India, Java and the Indus irrigation system in Pakistan are approaching levels comparable with the developed countries. Indeed, the Haryana (India) public health officials believe that a large proportion of village water supplies from wells will soon have nitrate levels exceeding safe limits. However, the data bases and monitoring systems necessary to track this type of pollution are generally noticeable by their absence, particularly with regard to its impact on groundwater.

Water Logging and Secondary Soil Salinization in Irrigation Systems

Surface water irrigation development is often cited as the cause of water logging, which may also be associated with soil degradation due to secondary salinization. The true cause lies with failure to provide an appropriate drainage system to remove the drainable surplus and maintain an acceptable groundwater and salt balance in a timely manner.[1/] It is well known that surface water irrigation imposes a positive change on the recharge side of the groundwater balance in the area that it is applied. Moreover, groundwater systems rarely, if ever, have adequate natural drainage to dispose of the additional recharge, which is therefore taken into storage and causes a progressive rise of the water table through time. The rate of rise may be quite small compared to the thickness of unsaturated aquifer available to be filled, and taking water into storage causes no problems until the water table is within 1.5 to 2.0 m of land surface. At this stage, groundwater drainage must be provided; otherwise the water balance is maintained by evaporation and salt accumulates in the soil profile. Both water logging and soil salinization have negative impacts on crop productivity, and the latter eventually precludes use of the land for arable agriculture.

Perhaps the best known example of extensive water logging and secondary soil salinization is in Pakistan's Indus irrigation system. It is estimated that 2.4 M ha now have the water table permanently at a depth of less than 1.5 m below land surface and, according to one estimate, 10 percent of the system covering some 13.5 M ha is now affected by salinity. Large areas of irrigated land in northwest India have developed or are developing water logging/soil salinity problems, and other examples exist elsewhere in the region, for example the Tarim Basin in Northeast China. The solution is clearly provision of groundwater drainage, but this may pose the question of how to dispose of the drainage effluent. Reuse for irrigation is possible if the drainage water quality is suitable for this purpose. However, if the effluent is saline, it must be evacuated from the area to maintain acceptable water and salt balances. In the long term, this usually involves constructing an outfall drain to the sea or, in rare situations, to a natural sink. Actions involving disposal within the irrigation system (for example, by blending) must be regarded as temporary and palliative, and proposals to dispose of drainage effluent to evaporation sinks would today raise many environmental questions.

1/ Drainage usually is not needed at the outset and later, when the need arises, governments resist funding means to combat a slowly developing problem.

EFFICIENT USE OF IRRIGATION WATER

There is widespread belief that large amounts of "new" water can be freed up by improving scheme efficiencies, particularly with regard to irrigation systems. When the water resources of a basin approach full development, this belief is often an illusion. The question then becomes one of basin efficiency, relating to whether water is lost from the area to the sea or to a polluted sink from which it cannot be recovered. Most of the water diverted for an irrigation project in the upper part of a basin and not consumed by plants returns to the surface water or groundwater systems and can then be put to other downstream uses. When a high level of basin efficiency is achieved, there is insignificant water quantity gain by changing individual project efficiencies. If there is unnecessary wastage to the sea at a time when possible users exist within a basin or in an adjacent basin, there is potential for a gain in water quantity from efficiency measures. Many examples of basins exist throughout the Asia region where essentially no water is lost to the sea during much of the dry season. At such times, basin efficiency must therefore be at maximum.

OVERDRAFT OF GROUNDWATER

Groundwater overdraft has occurred in several countries of the Asia region. On the North China Plain, irrigation pumping is the major culprit, but municipalities and industry contribute to the problem. There are several overdraft areas in India, due mainly to irrigation pumping. A number of areas in Pakistan are overdrawn with irrigation abstractions as the major cause, but municipalities cause local problems. Overdraft has occurred in the vicinities of Bangkok, Manila, Dhaka and Jakarta, due to abstractions for municipal and industrial supplies.

In areas of India and Pakistan where overdraft due to irrigation pumping has occurred, most of the groundwater development for this purpose has been by the private sector. In both countries, no system exists for regulation of groundwater abstraction. Moreover, it is believed that if a system of licensing were imposed, it would be liable to corruption. In China, all wells are licensed, charges are sometimes made for the groundwater abstracted by development entities, and irrigation wells are typically owned by cooperatives. But this has not prevented overdraft in huge areas of the North China Plain. In some circumstances, overdraft causes no physical damage to the groundwater system. The water level declines, pumping becomes more expensive and some facilities become inoperable. It may be argued that the market will eventually solve the problem. But when the water has very high value, as around Coimbatore in India, farmers continue to compete to maximize their share of each year's supply. In other circumstances, essentially irreversible damage to the aquifer system occurs when saline water intrusion is induced by overdraft. A striking example is the coastal aquifer system of southern Saurashtra in India where overdraft induced saline water intrusion has negatively impacted on many thousands of hectares that were irrigated by groundwater. But the farmers continue to overdevelop areas where the groundwater is still useable. The situation is extremely fragile on the North China Plain where groundwater levels are below sea level in about 14,000 km^2 around Cangzhou, and extensive groundwater depressions have occurred elsewhere.

The overdrafts caused by abstractions for municipal and industrial uses are usually more limited in area extent than those caused by irrigation abstractions, but their impacts can be dramatic. Water level decline below Bangkok has caused land subsidence at a rate of 5 to 10 cm per year for the past two decades, which has contributed much to the storm drainage problem at the city. Subsidence is known to have occurred due to groundwater overdraft beneath part of Beijing and Tianjin national municipalities in China. Overdraft for urban and industrial uses is causing salt water intrusion of coastal aquifer systems in parts of Java. The problems are known, but only limited efforts have been made to eradicate them.

POLLUTION BY URBAN WASTE WATERS

As noted previously, lack of treatment of urban waste water is already a massive problem throughout the Asia region. It is common that untreated sewage is discharged to open water bodies such as rivers, lakes, estuaries and the sea, and under some circumstances, seeps to groundwater. While biological clean up of organic matter will occur with time if dilution is sufficient, fecal organisms persist. These become a health hazard if water is then taken for domestic supply and is inadequately treated. Sea beaches become unsanitary, sea water unsafe for bathing, and coastal fisheries become disease infested. On many rivers to which sewage is discharged, dry season flows are naturally, or for man-made reasons, so small that dilution to the required degree is not possible, and rivers become little more than sewers that are flushed in the wet season. Examples of environmental hazards created by untreated urban waste waters are too numerous to list individually. Indonesia as a whole has virtually no sewage treatment, and water supplies must be dedicated to flushing open drains in cities. The urban poor, which form large proportions of all Asian cities, may be unable to pay for water supply let alone sanitation and water treatment. Moreover, service charges are generally set low for political reasons, metering water supply (a common way of assessing charges in developed countries) is difficult because instruments are vandalized, and billing and collection are poorly performed. As a result, even the richer part of the population in many Asian cities contribute less than the costs of water supply and sanitation services provided. Thus municipal water authorities are hard pressed to find funding to provide water supply and rudimentary sanitation facilities that are financially sustainable for much of their populations, and water treatment goes by default. Disposal of solid wastes is a major problem for most cities. Unsuitable land fills are often used and leachates from these sources discharge into surface water bodies and seep to groundwater, polluting both. The basic solutions to the problems are clear--establish regulations and enforce them, and provide the funding so that cities can perform the necessary treatment to meet the regulations. This is easily said, but governments must set this priority, and until they do, waste water treatment and solid waste disposal regulations will not be met.

INDUSTRIAL POLLUTION

Industrial processes frequently produce waste, some of which is toxic even in small quantities. Major contributors to pollution are the pulp and paper, chemicals, petrochemicals, refining, metalworking, food processing and textile industries. Some of the waste produced is biodegradable, but much is in the form of chemical compounds that will not degrade. Industrial pollutants reach surface water bodies as direct discharges or through the atmosphere and also seep to groundwater bodies. This last form of pollution is pernicious in that it occurs unseen, and is typically the most difficult to clean up. Some industrial pollutants are discharged to surface water bodies as part of the untreated waste waters from urban centers. But many industrial operations have captive water supplies and, in turn, become individual point sources of pollution with their effluents. The energy industry using fossil fuels is a major contributor to atmospheric pollution that can return to water in the form of acid rain. Discharged cooling waters from generators can become sources of heat pollution, which impacts on the biological quality of the receiving water body, though often favorably.

The highly polluted industrial areas and rivers found in all developed countries bear witness to the problems of controlling industrial pollution. Though many industrial discharges are now controlled through strictly enforced regulations in the developed countries, pollution of water bodies still continues from wastes that have accumulated over the past 100 years or more. The Rhine remains to this day a highly polluted river, with heavy metals among the pollutants, though some improvements have been made in the last decade. Although Holland strictly enforces the doctrine that "the polluter pays" within its own jurisdiction, it has had to make financial contribution to France to help pay for that country's actions to store effluents from its potash mining operations that had previously been discharged to the Meuse River.

All countries of the Asia region have developed industry in attempts at self-sufficiency, economic growth and to provide work for growing populations. The implication of the foreseen huge increase in urban population in the region by 2025 is that this must be accompanied by a similar increase in industrialization with increasing demands for water and potentials for pollution. With the exceptions of Afghanistan, Kampuchea and Vietnam, all Asian countries have some form of national environmental agency, but many of the agencies have been formed only recently and are underfunded, understaffed, underqualified and ineffective. In many cases, the legislation necessary for administration of environmental standards, including industrial pollution of water, is missing or incomplete. Where regulations exist, they often remain unenforced.

The industrial pollution problems of the region are compounded by the fact that industrial operations in many of the countries are only marginally financially viable. Governments then face a dilemma if the "polluter pays" doctrine is applied, in that industries may be forced out of business and employment for the workforce is lost. The pollution impacts of small and scattered industries are also difficult to monitor. The success of China's rural industrialization policy contributes to the spread of industrial pollution of water through the countryside.

SAFE WATER SUPPLY AND HEALTH

The potential health benefits from providing populations with access to clean water and sanitation are large, and provision of such services must be a priority environmental challenge in all developing countries, including those of the Asia region. Definitions of safe drinking water differ between countries. Figures published in *World Resources 1990-91* indicate that access to safe water in urban areas of the region's countries in 1985 ranged from a low of 25 percent in Bangladesh to as high as 81 percent in the Philippines.1/ However, the high range may, in some cases, be misleading as pipe distribution systems from water treatment plants are commonly depressurized when supplies are discontinuous, allowing backflows of polluted water. The above publication indicates that 77 percent of Nepal's urban population has access to safe drinking water, but this would appear to be optimistic as the water supply reticulation systems for towns in the Kathmandu Valley and on the Terai are commonly depressurized when supplies are discontinuous. China's Ministry of Public Health believes that most of the urban population has safe drinking water as it leaves the treatment plant, and that 100 percent of the populations of major cities have safe water. Other authorities are more pessimistic. A nationwide survey of 28,000 sampling sites from 1983 to 1988 showed that only 50 percent of 200 million people served by reticulated municipal supplies received good quality water. The Bank's *World Development Report 1992* remarks that "In Jakarta an amount equivalent to one percent of the city's GDP is spent each year on boiling water."2/ The provision of safe water supply for the region's rural populations is also poor. The overall health impact of poor quality water supply and lack of sanitation is indicated by figures quoted for Pakistan, where it is estimated that 45 percent of childhood deaths and 25 to 30 percent of all visits to dispensaries and hospitals are attributable to diarrheal dehydration, an illness directly linked to water supply of poor biological quality and inadequate sanitation.

INSTREAM WATER USES

Major instream water uses in the Asia region are hydropower, fisheries, navigation, and control of sea water intrusion into deltas and estuaries (including protection of mangrove areas). Few examples exist in the region where use of water is dedicated primarily for the amenity value of an unspoiled environment, as is the case with the "white water" rivers in parts of the developed world.

1/ World Resources Institute, *World Resources 1990-91*. (Washington, D.C.: 1991).

2/ The World Bank, *World Development Report 1992*. (Washington, D.C.: 1992).

Hydropower

Use of water for hydropower on run-of-the-river facilities imposes virtually no change on its quality. And consumption is negligible except when water is retained by reservoirs and some is lost to evaporation. A major environmental concern of hydropower development relates to the necessary structure on the river that must impose some impediment to its natural flow and may affect the natural habitat of fish life. Even a run-of-the-river hydropower facility may be restrictive unless it is compensated by a fish ladder or similar device. Major dams to create large reservoirs create many environmental and social concerns. They have the definite intention to impose a significant change on the rivers' hydrographs, and lands are submerged by their reservoirs. Reservoirs can cause water quality problems if they are not cleared of vegetation before they are filled. They may also cause water temperature problems due to stratification, particularly when they collect snowmelt water, but this can be mitigated by outlet design. Against this must be measured that they generate "clean" energy, they can be operated for flood protection, they enhance flows in the low-flow season, and the lake created can have an amenity value and be a source of fish. Most important are the direct health benefits of an increased and reliable water supply.

Fisheries

Wild fisheries in lakes, rivers, deltas and estuaries form important sources of food and employment in many of the region's countries, and many water related developments have impacted negatively on the environments in which the fisheries exist. Mention has been made previously that an otherwise environmentally benign run-of-the-river hydropower facility may restrict the habitat of anadromous fish. Other developments involving storage plus diversion or diversion alone for irrigation have completely removed fish habitats during the dry season. For example, the lower reaches of many rivers in China are completely dry during that season. Delta developments involving polders, use of water for irrigation and gating of distributaries, have had negative impacts on fisheries, as on the deltas of the Red and Mekong Rivers in Vietnam and the Irrawaddy in Myanmar. And pollution on lakes and river systems, particularly from urban and industrial centers, has degraded fish habitats throughout the region, in some cases to the degree that fishlife is essentially impossible. Kampuchea's ill-advised drive to maximize land development under the Khymer Rouge regime in the late 1970s led to the clearing of swamp forest around the Great Lake, damaged the breeding grounds of fish and crustaceans, and reduced the capacity of what had been considered one of the most productive fresh water ecosystems in the world.

Navigation

Inland navigation is or has been of great economic importance in many countries of the Asia region. But single sector oriented planning to use water for other purposes has reduced the capacity of this transport subsector in several instances. Historically, China's numerous waterways provided important means of transport in many regions of the country. The length of navigable waterway (defined as minimum depth of 0.3 m) peaked at about 170,000 km in 1960, but had reduced to about 109,000 km in 1984, in part due to building of dams. In the case of Bangladesh, a change in government policy regarding private river transport (it now favors rail and the public inland shipping corporation) would probably be environmentally positive as well as economically sensible, in that it would relieve pressure on the overloaded roads and reduce polluting traffic.

Flows to Estuaries and Deltas

It is necessary to ensure that flows to the sea through estuaries and particularly through deltas do not fall below defined minimum levels for both economic and environmental reasons. These include: Control of intrusion of sea water into these parts of river systems to

protect land and the surface water and groundwater systems; and protection of mangrove areas, which in turn afford natural protection against coastal erosion and also provide a specialized habitat required for breeding of some fish species and crustaceans. The first demand on the water balance for the real-time management of Thailand's Chao Phraya River system is the specified flow at the head of the river's delta. A major and very evident impact on Bangladesh of India's unilateral decision to divert Ganges dry season flows from Farraka barrage to the Hooghli was a very rapid advance of the saline front in the western part of the delta. This may be naturally irreversible as many distributary channels are now choked. It is commonly reported that China must dedicate 20 to 24 BCM of water each year to carry silt through the lower reach of the Yellow River to the sea during the summer-autumn flood season. Vietnam must also set minimum flows to the sea on both the Red River and Mekong Deltas to control sea water advance into the distributary channels and preserve the coastal mangrove areas.

PRESERVATION OF WETLANDS

Many countries of the region have limited opportunities for expansion of agricultural lands. It is therefore extremely tempting for them to consider reclamation of any wetlands that are available and suitable for conversion to agriculture. They have many examples to follow from the developed countries of the world. Holland was essentially created by its historical construction of polders and drainage systems, and would hardly exist without them. But the preservation of wetlands, mainly for wildlife habitat, has become an environmental issue that some developing countries find difficult to understand.[1] China has 3.1 M ha of coastal wetlands and around 11 M ha of inland marshes, some of the latter being inviolate for reasons of climate. In general, the Chinese regard wetlands as "wastelands", which is understandable, given that cultivable land area is a major constraint to expanding food production. And the Bank's recent environment paper for China, *China Environmental Management Study; 1990*, seems to fail to make its case that coastal wetlands are under immediate threat. The Yellow River Delta is expanding to create new wetlands at a rate of 25,000 to 33,000 ha per year. The areas of reclamation in the coastal zone appear meager by comparison--40,000 ha of mud flats since 1949 (World Bank 1990).[2] The Sanjiang Plain in northeastern China contains some 1.1 M ha of inland marshes, which are utilized for fisheries and for the reed harvest. The Bank's 1990 report states, "unfortunately these marshes have been under rapid development since the mid-1950s," though no figures are quoted. The forthcoming Eighth Five Year Plan proposes further development of some 266,000 ha of marshes in Heilongjiang province for agriculture. The Bank's paper is on safe ground with regard to the 300,000 ha of marshes in northwestern Sichuan. To use them for dumping industrial waste is indefensible. Reclamation of peat bogs is extremely difficult, and large scale excavation of peat will have water quality related impacts downstream of the bogland. It is considered that China's plans for reclamation of its wetlands needs balanced evaluation to take into account all the country's needs, of which preservation of ecology is only one.

Concern about preservation of wetlands in Bangladesh also appears to be misplaced. First, the average population density of this country (with a very high level of poverty) is 863/km^2, and the cropland to population ratio is 0.08 ha/capita (based on 1990 population estimates). Second, very large areas of the country are flooded even in the normal year, and this situation cannot be changed by any physical works in very extensive areas. Talk of wetland preservation in a country where the major water resource related problem is flooding must reflect the actual conditions and the alternatives available to that country.

1/ On the global and regional scale, there is continuous net loss of wetlands still, and that is ecologically and probably economically unsound, but the 'global commons' argument has little impact in the developing world.

2/ The World Bank, *China Environmental Management Study, 1990*. (Washington, D.C.: 1990).

CATCHMENT DEGRADATION

Catchment degradation is a major problem in virtually every country of the region. While uncontrolled and badly managed logging operations for timber is part of the problem in some countries (parts of Malaysia, the Philippines, India, Indonesia, Nepal and Pakistan as examples), the major culprit is population pressure. Land-hungry peasants increasingly are driven to encroach onto lands that are ecologically fragile and use agricultural practices that are unsustainable. Overgrazing of large areas by livestock is very common. And the need to use large amounts of wood for fuel compounds the problem in many countries. The results are soil erosion on a massive scale leaving degraded catchment areas as barren wastes, acceleration of runoff and increasing flood damage in the lowlands, and increased siltation of streams and reservoirs, to name some of the more important.

Solutions involving improved land management are known and could be effective in some situations, even when catchment degradation is relatively advanced. In other situations, degradation has proceeded almost beyond repair. In most Asian countries, implementing a program for catchment management would require reforms of government agencies, policy and the legislation and a change in approach to human resources development with regard to catchment populations. And in some circumstances, it requires measures not only to contain, but to actually reduce population pressures.

CREATION OF RESERVOIRS AND THE ENVIRONMENT

The annual rainfall patterns and associated surface water runoff regimes in most countries of the region are such that the only possibility remaining to capture additional surface water for beneficial uses is by the creation of reservoirs by the construction of dams. In most countries, essentially all options for schemes based on run-of-the-river flows have been exhausted, and a large number of dams have been constructed in the region. While physical possibilities exist in a number of the region's countries for creation of a large volume of additional reservoir storage, which could have single or multipurpose uses, proposals to create such storages are almost invariably opposed for environmental reasons. And the concerns of the environmentalists are generally strengthened by their alliance with real concerns for the people who would be inevitably displaced if a reservoir was created. Unfortunately, the impacts creating these concerns are not compared to the same types of impacts caused by not building the storage.

The Bank has become extremely wary about lending its support to projects to create large reservoirs. There is a number of large dam projects in the region with which the Bank has had involvement during the design stage and would have been asked for financial assistance for construction, but which are now in abeyance for environmental reasons. These include: Kalabagh Dam to create 9.9 BCM of live storage on the Indus in Pakistan; Narmada Sagar Dam to create 9.7 BCM of live storage on the Narmada River in Madhya Pradesh, India;[1/] and the Three Gorges Dam to create 22 BCM of flood control storage on the Yangtze in China. The Sardar Sarovar Dam on the Narmada River in Gujarat is under construction with Bank assistance and will create live storage of 4.5 BCM. Despite large sunk expenditures on the structure and its associated irrigation system, the environmental/social opposition continued to the point that continued Bank involvement had to be reviewed. The proposed Xiao Langdi Dam on the Yellow River in China would create an initial storage of 12.65 BCM, but will almost certainly meet opposition if the Bank actually provides support. Opposition may be foreseen to the creation of any of the potential major storages (totalling around 75 BCM) on the Ganges River system in Nepal if they ever proceed beyond the design stage, though they offer immense potential benefits to Nepal, India and Bangladesh and to the environment on the delta. All the above projects are multipurpose and would have potential for creating enormous benefits, many of an environmental nature, if and

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1/ India is now proceeding with construction of Narmada Sagar Dam without Bank assistance.

when they are constructed, but all present other environmental and resettlement impacts of various degrees that have received greater attention.

It is not proposed here that the negative environmental and social aspects of creating large reservoirs should be ignored. Nevertheless, there must be an unbiased assessment of all benefits and losses before a "do nothing" decision is made. Objectors to large reservoirs typically do not highlight the often times huge environmental and social costs of not implementing a project, and the Bank has not been effective in presenting a complete case, covering all environmental, social and economic aspects of such developments, to the public.

III. Environment in the Context of Managing Water Resources

General

A country's policies and objectives with regard to development and management of its water resources are normally framed to take full account of perceived social priorities, aspiration for economic growth, security, and environmental concerns. Thus, the environment is one of four important national objectives that determine the framing of policies and development actions. With the foreseen growth of the world's population, and that of the Asia region in particular, over the next 30 to 40 years, and the change in urban/rural population distribution that this will entail, massive developments in the water resources fields will be essential. As all such developments must involve environmental changes, the challenge will be to make any negative changes as benign as possible and also to take actions that will enhance the environment.

This report has been framed to discuss water resources development in the region from the aspects of the following: The related institutions and their role; resource planning and long-term management; water operations and real-time management; and economic and financial policy. Within each of these major groupings, which are all necessary and important for rational development of a country's water resources, environmental policy and action requirements are represented and are discussed at appropriate places. The consistent theme is that the function of a country's environmental agency(s), which must be within government, should be to set criteria and standards, to monitor conditions and to ensure that the laws and regulations that pertain to maintaining the standards are complied with and enforced. The operating line agencies, the private sector and the public at large must be held accountable and take appropriate actions to adhere to the standards. In order that this can be properly applied, it is essential that the principle of separation of the executory from the regulatory functions be followed.

Environmental Assessment

Environmental assessment (EA) forms part of the water resources development planning and long-term management processes at the basin and project levels, as discussed in Chapter 4 of this report and in Part 3 and elsewhere in the accompanying Annex 1. Environmental assessment is used in planning to devise environmental management measures that minimize, to an acceptable level, the adverse environmental impacts of a water resource project and, where possible, to enhance beneficial impacts. The major feature of EA is the evaluation of impacts of the water resources development project under consideration on the significant beneficial uses of the water bodies affected. These beneficial uses variously include: community water supply; industrial water supply; agricultural/irrigation uses; power generation; navigation; fisheries and aquatic wildlife; flood control; forests, wildlife and other watershed benefits; and recreation. In the cases of almost all diverted water uses, EA must also be concerned with waste water disposal from the uses to which it was applied. Alteration of beneficial uses may impact, negatively or positively, on other human use and quality-of-life values. The fundamental concept of EA as a continuous planning tool is that it be concerned with all phases of project development. However, it is essential that all important components of the environmental management plan are defined within

the overall project plan, and that this in turn fits within a defined basin plan for development and management of water resources, before construction work on a project or program is initiated. In many cases, EA may serve as a "reality check" on engineering design features of a project so that alternatives may be identified, which could avoid, reduce or eliminate adverse impacts. To achieve maximum benefits, the EA report should form the basis of the environmental monitoring of project operations, with feedback so that the information gathered can be used to bring further environmental improvements or corrective actions can be taken against unforeseen negative environmental impacts.1/

IV. Social Issues of Water Resources Development

Preamble

All government sponsored water resource related developments have the intention of creating benefits for society. No doubt in the past (and to a lesser extent, at present) individuals or small groups have been able to appropriate and exploit water resources in a manner that has had negative impacts on a much larger number of members of society that previously had benefits from the resource. Social customs generally included concepts that reacted against such selfish activities, and many very ancient codes of behavior relating to sharing water resource benefits were surprisingly equitable and were often hydrologically sound. The codified suites of water-related legislations, regulations and standards that all countries have developed through time have aimed to protect society in law against potential abuses of common rights to a water resource by the actions of a minority, while also establishing systems of water rights and allocations so that investments in water resource development could be firmly based.

Despite a variety of legal actions, it is evident that society is not fully protected in many developing (and some developed) countries. New upstream diversions and storages on rivers sometimes impact negatively on long-established downstream uses. In some cases they result from the actions of private individuals or groups, but in others they happen as a result of a considered decision by government (for example, the developments on some rivers in Tamil Nadu (Box 3.3), and India's unilateral decision to construct Farakka barrage on the Ganges for diversion of water to the Hooghli and to the detriment of Bangladesh [Chapter 3]). Over-development of groundwater also occurs (for example, in China where a system of licensing is in place, and in India and Pakistan, which do not have recourse in law for control of groundwater) and may have irreversible detrimental results. Degradation of catchments due to poorly controlled or illegal logging, and/or encroachment by agriculture, overgrazing and excessive harvesting of fuel wood is a feature of most Asian countries with many socially negative aspects. Perhaps the presently most widespread abuse of water resources with major negative impacts on society is the pollution of water bodies with untreated urban wastes and untreated industrial effluents.

There can be no question that good water development planning must take account of social and environmental matters in all respects, and if properly done, projects or programs with net positive social benefits should normally result. Nevertheless, it must be accepted that some water resource projects prepared by good water resource technicians have proven to be socially counterproductive and/or environmentally harmful (see, for example, the discussion of Sri Lanka's Mahaweli Development Program [Box 4.1]). Projects to improve water supply, sanitation or drainage in urban areas should, in principle, provoke few negative social effects. But in a highly developed basin, water may have to be withdrawn from agriculture to augment a city's supply to the detriment of the livelihood of farmers. However, such actions rarely excite the social concerns associated with more physically evident water resource projects, such as dams. Moreover, efforts

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1/ The Bank's Operational Directive 4.01 on Environmental Assessment lays out the steps and provides guidance to Bank staff during the preparation, appraisal and supervision phases of a project.

to expand formal sanitation and/or drainage facilities in urban areas that have not been matched by development waste water treatment capabilities have had negative social and environment impacts due to the concentrations of pollution produced. And examples exist where water supply and/or sanitation facilities have been provided to urban communities that have proved to be unaffordable to the recipients and have then become unsustainable in the absence of large public subsidies.

Irrigation systems, if based on a sound water supply, appropriate design and a clearly established cropping improvement, should have few negative social impacts and be generally beneficial, though they do require land acquisition for right of way of facilities. Nevertheless, examples exist where such facilities have produced very little overall social (or economic) benefits (see, for example, the discussion of India's Gandak and Kosi Projects [Box 1.1]). Major flood control schemes have clearly defined winners and losers in the social context: The losers located between the bund and the river are exposed to a greater flooding hazard; others loose land for the structure; the winners are afforded protection, though this may be of questionable value to some if provision is not made for evacuation of runoff generated within the protected area. Creation of large reservoirs, in every case involves, in various degrees, displacement of populations, loss of their lands and dwellings, submergence of infrastructure, and a loss of perceived environmental assets. The social negatives are clearly evident. They can be large and rightly excite concerns. But the social positives can be immense and should be properly evaluated for measurement against the negatives. While this appears self-evident, the positive social benefits are never fully or fairly acknowledged by opponents of any particular development.

RESETTLEMENT AND RELOCATION

Any water development project that involves alienation of land in direct use for agriculture or other personal use can imply displacement of people, and they must be compensated and perhaps resettled. Land acquisition for irrigation and drainage facilities may be difficult, but rarely involves significant resettlement. Major flood control projects can be more contentious as they not only require significant amounts of land acquisition, but also expose part of the population to a higher degree of flood hazard. These people should be compensated and may require resettlement. Creation of a formal game reserve can deprive populations of benefits that they previously enjoyed. But it is the case of resettlement and relocation (R&R) of reservoir area populations made necessary by construction of dams that now attracts the highest degree of concern.

Though R&R has been a component of all Bank supported dam construction projects, it did not become an issue of paramount importance until the 1980s. Take for example the Tarbela Dam Project in Pakistan, one of the largest projects of this type with which the Bank has been involved, which created a reservoir with an area of 25,900 ha and on which Pakistan Rupees (PRs) 2.49 billion were expended on resettlement over a 19-year period (1968 to 1984). Yet there is little in the record indicating concern over R&R problems, and one searches in vain for any reference to resettlement in the Project Completion Report of 1986, apart from a basic statement of expenditures. It is noteworthy that much of the compensation to the oustees was paid in cash, though a lavish land for land alternative offer was available (albeit undeveloped land requiring investment in tubewell irrigation facilities) and was taken up by some of the displaced farmers. Though on a smaller scale, the resettlement issues of 18,200 persons to be displaced were afforded little importance at the appraisal of the Bank supported Gujarat Medium Irrigation Project (Cr. 808-IN), which became effective in 1978; but resettlement practices in Gujarat were considered to be adequate at that time.

Resettlement issues came to the fore at the beginning of the 1980s with regard to Indonesia's transmigration program, which had received Bank support and became the object of publicized criticism. Unlike a reservoir from which population must be displaced, the transmigration program aimed to improve the lot of the people resettled on the outer islands, as well as relieving population pressures on Java and Bali. The program continues, but many social

problems remain (Annex 2). However, as noted previously, the R&R problems and associated issue of reservoir displaced populations have become the most contentious and, together with environmental concerns, provide the basis for publicized objections by nongovernmental organizations (NGOs) to the creation of new reservoirs. In response to this relatively new aspect of public awareness, the Bank has prepared detailed guidelines and policy statements to direct the actions of its staff with respect to projects presenting R&R issues. But the long list of reservoir creation projects now held in abeyance for clearance of Bank support indicates how difficult the social and environmental issues of new dam projects can be.

The Bank supported concept of recompensing displaced families on the basis of "land-for-land", and even giving land to landless oustees, has a basis in equity, but can present practical problems to governments when rural areas are very densely populated and there is little new land to be allocated. Indian Punjab's reservations about the "land-for-land" concept (with respect to a small number of oustees from some small reservoir to be created under the Punjab Irrigation and Drainage Project--Cr. 2076-IN/Ln. 3144-IN) appear to have some merit when considered with the argument that the oustees were to be very highly compensated in cash and could easily buy replacement land of their own choosing through a very active land market. In the event, the Bank allowed some deviation from a rigorous "land-for-land" requirement in approving the project.

The question remains of what is the real outcome when the Bank withholds support for a project because of unresolved social/environmental issues, and the government then decides to go-it alone? This is the outcome in the case of Madhya Pradesh's Narmada Sagar Project involving R&R of at least 60,000 people and with potential negative impacts on a total of about 130,000 people. No doubt, the Bank is removed from the firing line. But lacking the Bank's good offices, leverage and financial support, the Governments of India and Madhya Pradesh State may be tempted to deal with resettlement problems in a much more cavalier manner than would have been the case if the Bank were involved. But again, the irrigation of close to 400,000 hectares of currently low productivity lands will provide vast opportunities in the new agriculture and related activities for the 30,000 affected families.

PUBLIC PARTICIPATION IN DECISIONMAKING AND OVERSIGHT

Participation of nongovernment individuals in advice and oversight roles is traditional in the water resources sector in many developed countries. Beneficiaries serve on agency boards, outside government experts serve on technical committees, and public figures serve on policy and oversight commissions. Such interactions provide timely inputs to decisions from an outside perspective. Such participation is particularly effective with regard to environmental, regulatory and resource allocation issues. Greater public understanding and support of all government actions are an important result, which is often essential for instituting major changes and to avoid exciting uninformed opposition to government action from the public at large. For example, the public will more readily accept the drastic measures often inherent in drought plans if their development is overseen by a citizens' panel and their need is fully understood by the public.

This institutional principle of public participation in decisionmaking and oversight generally is not followed in most Asian developing countries. Political leaders may be wary of public participation and direct influence. Bureaucracies oppose sharing management decisions or being subject to oversight. The public often lacks information. But the growing importance of public opinion and NGO activities must be recognized and accommodated, and direct participation in decisionmaking from outside government will be productive for everyone. A small start is being made in this direction in the case of design and layout of irrigation and drainage systems, particularly minor networks, when proposals are discussed with and demonstrated to potential beneficiaries; and, if necessary, modified to accommodate their requirements (as, for example, under the Bank assisted Mahakali Irrigation II Project-Cr. 1924-NEP). And people to be resettled from reservoir areas are now better informed about the conditions under which R&R will be implemented than here-to-fore. But public participation in the government decisionmaking process

is generally in its infancy in most of the region.

WATER USER'S ASSOCIATIONS

Bank supported irrigation and rural water supply projects are now often including provisions for devolving responsibility for operation and maintenance (O&M) to the beneficiaries through water user's associations (WUA). While it is recognized that such associations can contribute substantially to cost recovery and more effective water use, project designs and perceived operational characteristics often pay too little attention to the preconditions necessary for creation of effective associations. Often the macro level framework of legal policies and regulations is not adequate. Water rights are not always clearly defined; institutional linkages to government agencies may not be appropriate; and the flow of funds may not be well thought through. In other cases, inadequate attention is paid to providing WUAs with extension support or technical assistance for institution-building and transfer of knowledge. In the particular case of rural water supplies, specific measures generally are not included to ensure active representation of women in WUAs.

There is a range of situations and experience with WUAs in the Asia region. Informal associations of some kind formed the basis for community-based, water-related developments of many kinds (village tanks, village irrigation systems, village water supply wells, and even small scale flood protection facilities) which have a long history and are ubiquitous in one form or another throughout the region. The Philippines was a pioneer in establishing formalized irrigation WUAs for national irrigation systems (to undertake O&M and collect irrigation service fees contributions from members), and for community systems (to become the owners, to arrange repayment of credit advanced for construction and to be responsible for all O&M of facilities). China has an effective and efficient system of local responsibility for water facilities based on clear institutional arrangements. Indonesia has established WUAs with a legal basis over the past decade for management of tubewell irrigation facilities, for takeover of small surface water irrigation systems, for participation in management of larger systems (following the Philippine pattern) and, more recently, for management of reticulated village water supplies. Nepal has a long history of communal irrigation and has the greatest proportion of its irrigation systems in private ownership. It has recently moved to establishing formal WUAs to raise credit for construction of tubewells and for rehabilitation or creation of new small surface water irrigation systems to be managed by the association. It is also forming WUAs in government irrigation systems to undertake O&M of minor networks. A privatization policy for groundwater irrigation in Bangladesh involves, as necessary, the establishment of WUAs for ownership and management of facilities, but the choice is left to the groups whether or not they wish to be legally established or remain informal. There are important lessons to be learned and applied as appropriate from experience with indigenous water use groups. Examples of interest are the "water panchayats" of South India, the complex and interconnected diversion systems of Java and Bali (notably the subaks of Bali) and the Banawe terraces of the Philippines (Chapter 3).

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THE BANK'S ROLE IN WATER RESOURCE DEVELOPMENT

I. INTRODUCTION

THE BANK'S PAST INVOLVEMENT

The Bank's involvement in development of Asian water resources has been extensive and diverse and accounts for a high proportion of the Regions' total concerns. It is discussed in detail in Annex 3 to this report. The lending program has supported development projects and programs in essentially all water-related subsectors, including: (i) Irrigation and drainage; (ii) flood control and protection; (iii) hydropower; (iv) water supply and sanitation; (v) urban drainage; (vi) inland navigation; (vii) freshwater (and marine) fisheries; and (viii) port development. Most projects have been sector-specific, excepting mainly a small number of large dams, which were designed to provide irrigation, flood control and hydropower benefits. A recent innovation has been involvement in projects for control of pollution by industry and other environmental programs. Water-related developments have often comprised a significant part or even the major component of urban and rural area development projects. And financial intermediary operations providing credit for the agriculture sector have had large water-related components for development of private sector owned minor irrigation facilities. Sector investment projects, for instance, to address operation and maintenance (O&M) of irrigation systems, have been financed in recent years for several countries. Some aspects of policy-based lending have related to water through conditionalities under structural and sector adjustment loans. Moreover, the Bank has financed projects and programs in other sectors with clear linkages to water, as for example: Watershed management and reforestation programs; road development in settlement irrigation schemes; and resettlement of reservoir displaced populations.

The Bank devotes a significant proportion of its human resources to economic and sector work (ESW). Economic work seldom addresses water issues directly, although they are covered along with other sectors in general economic and investment reviews. Sector work has also failed to address the water sector in its entirety, and water is typically discussed in the context of individual economic sector reviews and memoranda. Numerous reports of this type have been prepared, notably in agriculture, irrigation, power, transport, water supply, waste handling and treatment, and fisheries. Environmental reviews are an exception to this sectorial parochialism and address water in general in the context of the environment.

The Bank's involvement with technical assistance (TA) for water-related activities in the region has been varied and extensive. This has involved: (i) TA components in water-related project lending (by far the most important in terms of funds provided); (ii) free-standing technical assistance projects with water-related subprojects; (iii) the Bank's Project Preparation Fund (PPF); (iv) United Nations Development Programme (UNDP) programs for which the Bank is the executing agency; and (v) activities financed under donor Trust Funds, which the Bank administrates. The Bank also provides TA through its staff and directly employed consultants as inputs during the project development cycle; through its ESW program; and through courses and seminars organized by the Economic Development Institute (EDI) and some other Bank departments. Training is commonly included as a subcomponent of TA financed under project loans/credits and under subprojects of free-standing TA projects, and is also important in UNDP funded projects executed by the Bank. Research activities undertaken or financed by the Bank have led to a range of publications and proposals, which have interest for or impact on water-related developments.

In the international arena, the Bank has provided support to a wide range of activities involving bilateral donors and other international agencies through leading or participating in country aid consortia, cofinancing major projects and programs, and in other contexts. The

Bank's aid coordination role has, in a few cases, extended to cover major water-related programs. It organized and managed the Trust Funds established to finance construction of the link canal system and storages on the Indus River system in Pakistan following the 1960 Indus Basin Treaty. It sponsored coordinated international funding for Sri Lanka's Mahaweli program in the 1970s. And, it has coordinated international TA inputs for Bangladesh's ongoing flood protection studies and investigations. The Bank has also had a major role in several international initiatives with water implications for the region including the establishment of the Consultative Group for International Agricultural Research (CGIAR), the formation of the International Irrigation Management Institute (IIMI), and the recent initiation of the International Programs for Research in Irrigation and Drainage (IPTRID). It has also provided financial and staff support to international conferences focusing on water resource issues.

Scope of the Chapter

The scope of the Bank's activities in the water sector has thus been very considerable. It is not the purpose of this chapter to discuss individual sectors or subsectors in any detail. Nor has it been possible to discuss each and every program with the Bank staff concerned. The aim is to provide a straight forward overview of problems encountered, lessons learnt and the scope of Bank activities as background to the report, and to highlight issues that are relevant to evolving a strategy for the water sector as a whole. With respect to Bank supported projects, the emphasis is on those that have been completed, since this permits an evaluation of implementation and operational performance based on project completion, audit and impact reports and studies. This may mean that insufficient attention is paid to ongoing and proposed lending activities, some of which may be seeking to tackle broader issues of water resources development and management. There are also inevitable inconsistencies in the estimates of economic performance undertaken at different periods. For instance it has not been possible to reestimate Economic Rate of Return (ERRs) based on consistent projections of expected commodity prices. A deliberate attempt is given to highlight issues in some of the less prominent sectors since the discussion given elsewhere in the report has tended to quote experience from the more prominent, in particular irrigation. Much of the irrigation experience quoted elsewhere in any case is itself derived from Bank supported operations. The discussion of economic and sector work programs (ESWP), TA and aid coordination is more up-to-date than for the lending program, although it does not cover informal reports, which in many cases are important. The coverage of formal reports may also be incomplete in some respects, in particular with regard to ongoing and proposed activities.

II. The Lending Program

Project Support Portfolio

The Bank has supported projects of various types for development of water resources in Asian countries since the beginning of its lending activities in the region early in the 1950s and more particularly since International Development Association (IDA) funds became available at the beginning of the 1960s. By the end of 1990, the Bank had provided funding for some 274 projects which have as their primary purpose development of water resources for various uses (Table 8.1).[1/]

The irrigation and drainage (I&D) and the flood control and drainage (FCD) project categories, which both aim to improve agricultural production, represent almost 65 percent of the total number of projects listed in Table 8.1.[2/] The proportion increases to 69 percent if multipurpose projects--which all have irrigation benefits--are included. The predominance of

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1/ A number of project investments in port facilities are omitted from Table 8.1, and some of the credits and/or loans were in the form of tranches to support the same major project or program.

2/ Urban flood control and drainage has formed a component in many urban development projects.

agricultural production-oriented water development projects in the Bank's lending portfolio in the region reflects the importance given to increasing food production to feed growing populations in most countries. India's water development projects with agricultural production objectives represent about 24 percent of the total number of projects of this type in the region, and the proportion would be much larger if it was expressed in investment terms. The water supply and sanitation category is next in importance in terms of numbers of projects, representing 22 percent of the total, and almost all the projects are to provide services to urban communities. Single purpose hydropower projects represent only 9 percent of the total, but power generation is a component of all the multipurpose dam projects.

Table 8.1: **BANK SUPPORTED WATER RESOURCES DEVELOPMENT PROJECTS BY COUNTRY AND TYPE TO END OF 1990**

	Type of Project							
Country	Multipurpose	I&D	FCD	WS&S	H'power	Inland Navigation	Inland Fisheries	Totals
Bangladesh	-	12	10	5	-	2	2	31
China	-	2	1	1	3	-	1	8
India	2	42	1	13	6	-	1	65
Indonesia	1	22	3	7	2	-	-	35
Korea	1	3	-	4	-	-	-	8
Laos	-	-	-	-	-	-	-	1
Malaysia	-	4	-	4	1	-	-	9
Myanmar	1	2	3	-	-	1	-	7
Nepal	-	10	-	4	4	-	-	18
Pakistan	4	14	3	5	-	-	-	26
Philippines	3	15	-	12	3	-	-	33
Sri Lanka	1	8	1	3	1	-	-	14
Thailand	-	10	-	2	5	1	-	18
Vietnam	-	1	-	-	-	-	-	1
Totals	13	155	22	60	26	4	4	274

Note: I&D = Irrigation and Drainage; FCD = Flood Control and Drainage; WS&S = Water Supply and Sanitation
Source: Compiled from Bank Statements of Development Credits and Loans.

In addition to the projects listed in Table 8.1, which are primarily for water resource development, the Bank has supported a large number of projects of various types in the region, which have significant water resource development components. The lending portfolios developed under a number of Bank supported agricultural credit projects, including large amounts for minor irrigation development by the private sector. India was the most important recipient of Bank funding for this type of project. Bangladesh and Pakistan have also used agricultural credit programs with Bank support to provide finance to private investors in minor irrigation facilities, and the Philippines and some other countries have also had lending activities with this objective. Bank supported rural development programs in a number of countries in the region included components for irrigation and/or rural water supply development (e.g., in Sri Lanka). Most of the large provincial agricultural development programs that the Bank has helped finance in China, and that have been the primary vehicle for Bank lending in the agricultural area, have large irrigation, drainage and flood control components. Indeed, in most cases these account for more than 50 percent of the total project costs. Many urban development projects have included components for improvements of water supply, urban drainage and flood control, and sewage disposal and treatment services.

IMPLEMENTATION PERFORMANCE OF WATER RESOURCE DEVELOPMENT PROJECTS

Multipurpose and Hydropower Dam Projects

With the exception of India, all countries in the region have been prepared to employ international consulting organizations to assist with feasibility studies and final designs for large storage facilities intended for multipurpose or single purpose hydropower uses, and in most cases, to assist with construction management. China has employed consulting engineering companies to assist with design only of the largest structures (e.g., dams on major rivers) but has employed foreign specialists more broadly to give advice on specific technical problems. Otherwise, most of the Bank supported projects of this type have actually employed international consulting organizations for feasibility studies, final design and construction management. As a result, design problems have been minimized, but implementation experience has ranged from poor to good, due mainly to various institutional, procurement and finance problems particular to the recipient country. Pakistan's Tarbela dam project had the assistance of international consultants for design and implementation, but still had severe construction problems. By contrast, Bank supported large dam projects in India, which have relied almost entirely on their own technical resources, have generally experienced design, implementation and resettlement problems. Important examples are the Chandil and Iccha Dams in Bihar (financed under the Subernarekha Irrigation Project: Cr. 1289-IN), the Upper Indravati Hydropower Project in Orissa (Ln. 2278-IN) and the Sardar Sarovar Dam and Power Project in Gujarat (Ln. 2497/Cr. 1552-IN). The Bank has attempted to provide TA to these and other projects in India through large project preparation and supervision inputs.

Irrigation and Drainage Projects

This general category includes a wide range of actual types of I&D projects. A number of projects included construction of a single purpose dam (usually of small to medium size) in addition to irrigation and drainage networks. A few were located below multipurpose dams. Many were to rehabilitate and/or extend irrigation systems below an existing dam or diversion structure. Some aimed to "modernize" old systems to improve their performance. A few were planned to provide small-scale surface water irrigation facilities for operation under farmer group ownership. The category also includes projects for provision of groundwater irrigation facilities, in some cases for public ownership and in others for private ownership. In numbers, India has received support for 27 percent of the total Bank supported projects in this category in the region (Table 8.1).

Bank experience with implementation of I&D projects has ranged from good to disastrous, but the majority of projects have experienced at least fairly serious implementation problems. The causes of implementation difficulties have generally related to one or more of the following: Inadequate surveys and design; poor implementation planning; works and/or materials/ equipment procurement problems; poor construction quality control; and funding inadequacies by the recipient countries. Though many of the countries have utilized foreign and/or local consulting firms to assist with project designs (and often with construction management), this has not always been effective in assuring the quality and performance of completed works. Works have been implemented by contract and, more rarely, by force account, but in a great many cases, supervision of works has been inadequate.

Flood Control and Drainage Projects

Bangladesh has been by far the main recipient of Bank support for FCD projects with nine projects of this type since 1972 (including two flood rehabilitation projects in 1988 to 1989, mainly for repair of embankments). Myanmar's Lower Burma Paddy Land Development I (Cr. 642-BA) and Paddy Land Development II (Cr. 835-BA) projects were focussed on flood control also. India's Punjab Flood Protection and Drainage Project (Cr. 015-IN) was the only Bank

supported project in that country concerned solely with FCD works. Pakistan's three flood related projects were all for restoration and rehabilitation of flood damaged works (Crs. 466, 683, 2003-PAK). Many irrigation projects implemented with Bank assistance have included drainage and/or flood control components.

The Bangladesh experience with FCD projects is revealing with regard to the evolution of the Bank's understanding of how to lend money for flood control operations from the points of view of design concepts, implementation, sustainability and the likely benefits. The Brahmaputra Flood Embankment Project (Cr. 39-PAK) was approved in 1963 (the country was then East Pakistan). The idea was to rehabilitate 40 km of embankment built in 1957 on the right bank of the river and to extend the embankment to a total of 225 km to afford protection to 72,000 ha in the Brahmaputra and Teesta basins. The major difficulties in implementation were associated with land acquisition for civil works that both protected and consumed land and, moreover, increased the flood hazard to farmers located between the river and the embankment. The Chandpur Irrigation Project (Cr. 40-PAK), also approved in 1963, introduced the concept of flood control within a polder cell with large reversible pumps for drainage in the wet season and irrigation in the dry season. By 1966, the irrigation component was abandoned. But, it then became apparent that an exclusively flood control operation was no longer economically viable and the entire scheme was stopped in 1967, though most of the polder works were completed. The undisbursed funds were used to completely redesign the project. Chandpur II Irrigation Project (Cr. 340-BD) emerged from the redesign in 1970 with the concept that farmer groups would use diesel engine powered pumps to draw water from natural and artificial drains within the polders supplied by the main pumps for dry season irrigation.

The FCD Project (Cr. 864-BD), that followed Chandpur II, was approved in 1978. It involved two simple polder subprojects which did not incorporate large fixed pumps for either drainage or irrigation purposes and a component for further works on the Brahmaputra right embankment. Though numerous changes were incorporated in the final designs of the two polder projects, they were constructed essentially as scheduled. Implementation of the Brahmaputra right embankment scheme ran into fundamental problems from the outset, mainly regarding the notion of embankment retirement (repeated relocation) before an advancing river versus protection of the existing embankment--the technicians favoring the former while the farmers and politicians favored the latter. Political pressure won the argument, though the Bank refused to finance the technically and economically questionable protection work. But the river prevailed in the end, enforcing the retirement approach, but as a disaster response rather than a properly planned retreat from the migrating stream. The simple polder without drainage pumping has persisted as the basic design concept for a series of flood control and drainage projects, the most recent being the Fourth Flood Control and Drainage Project (Cr. 1784-BD) approved in 1988.

The three projects with the major investments in flood control and drainage in Myanmar are all located on the Irrawaddy Delta.[1/] They involved rehabilitation of embankments, which had deteriorated subsequent to World War II, as well as construction of new embankments. The design concept involved creating polders with encircling embankments to protect from external flooding, and improved drainage within the polders to dispose of excess rainfall but with outfall controls to store water on the drains in times of need and (where necessary) to prevent entry of saline water. The needs of navigation were provided for by locks for country boats on the drainage outfall sluices. The projects all experienced implementation delays, due mainly to procurement, government funding and shortage of materials problems.

Water Supply and Sanitation Projects

The Bank has provided support for 60 water supply and/or sewerage projects in eleven countries in the region. Most have been aimed at provision of services to urban communities

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1/ Irrigation I (Cr. 483-BA) approved 1974; Lower Burma Paddy Land Development (Cr. 642-BA) approved in 1976; and Paddy Land Development II Project (Cr. 835-BA) approved in 1978.

except in India where some statewide projects included components for rural water supply. India has been the recipient of 22 percent of the projects in the region of this category that have received Bank support. The urban water supply projects have included one or more of the following major components of such facilities: Prime source supply works, water treatment works, and delivery systems. A number of projects included components for or were entirely concerned with sanitation or sewage disposal. Excepting the four water supply projects in Korea, which were implemented without undue difficulties, the remaining water supply and sanitation projects in the region experienced a range of implementation problems including *inter alia:* Government budgetary inadequacies; management failures in construction scheduling; procurement delays; and right-of-way impediments. In some cases, design inadequacies were encountered during construction. Such problems inevitably led to construction delays and/or cost overruns.

Inland Navigation Projects

The Bank has supported four inland water transport projects in the region (Table 8.1). The objective of the Myanmar project (Cr. 413-BA) was to rehabilitate the fleet of the government owned Inland Water Transport Corporation, increase its capacity with six new passenger vessels, and provide dockyard equipment and navigational aids. The project was approved in 1973 and closed in September 1978 with a time overrun of 50 percent. Price increases caused a reduction in project size by about 45 percent. The projects in Bangladesh (Cr. 424-BD in two tranches and Cr. 735-BD) supported the government owned entities involved in inland water transport: The Bangladesh Inland Water Transport Corporation (BIWTC), the Bangladesh Inland Water Transport Authority (BIWTA) and the Bangladesh Steel and Engineering Corporation (BSEC). The first project, approved in 1973, was to provide spare parts, tools and equipment to the above agencies for inland water transport rehabilitation, and to repair or modify the off-shore oil terminal at Chittagong (this last component proved to be uneconomical and was replaced by provision of two lighterage tankers, which was the main reason for the supplementary credit). The materials and equipment procured under the inland water transport component had to be reduced by about 25 percent because of cost increases and the project had a time overrun of 85 percent. The second project was approved in 1977 and was intended to provide cargo handling equipment, materials and spare parts for vessels, navigational aids and hydrography equipment, and telecommunications equipment to support the activities of BIWTC and BIWTA. The goods actually procured were very different in quantities to what was envisaged at appraisal. The project had a time overrun of 38 months. Thailand's Inland Waterways and Coastal Ports Project (Ln. 1889-TH) intended to improve inland navigation on the Chao Phraya and Nan River from the mouth up to Taphan Hin. It included components for river channel upgrading, construction of river ports at Nakhon Sawan and Taphan Hin and provision of floating craft, cargo handling equipment and maintenance equipment. A separate part of the project, was to improve navigation conditions at some 40 coastal ports. The project was approved in 1980, and the loan was closed in 1989, more than four years behind schedule.[1/]

Inland Fisheries Projects

The Bank has financed few completed inland fisheries projects in Asian countries, though many are underway now in India, China and Bangladesh. To end 1990, only four completed projects exclusively or predominantly concerned with inland fisheries development had been financed (Table 8.1).[2/] In addition, inland fisheries development has formed a component of

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1/ As may be seen, Bank support for navigation has been made in equipment and port facilities rather than in river flow modification or channel improvement, with the exception of a component of Thailand's project.

2/ These included: The Oxbow Lakes Fishery Project (Cr. 890-BD) in Bangladesh, which was initiated in 1979 and completed in 1986; the Shrimp Culture Project (Cr. 1651-BD) in Bangladesh, which was initiated in 1985 and is scheduled for completion in 1991; the Inland Fisheries Project (Cr. 963-IN) in India, which was approved 1979 and finally completed in 1989; and the Freshwater Fisheries Project (Cr. 1689-CH) in China, which became effective at the beginning of 1987 and was scheduled for completion in 1991. The list has been increased by the Third Fisheries Project (Cr. 2146-BD) in Bangladesh, which was initiated in 1991.

several broadbased projects in the region, for instance some provincial agricultural development projects in China. Project completion reports are available for only two predominantly fisheries projects (Cr. 890-BD and Cr. 963-IN). Bangladesh's Oxbow Lakes Fisheries Project aimed at development of six oxbow lakes through providing hatchery facilities, providing assistance with lake management, stocking operations and marketing, and provision of training to staff of the Department of Fisheries (DOF) and fishermen. Progress was slow during the early years of the project, due mainly to delays in appointing consultants, selecting and acquiring land, carrying out surveys, and preparing civil works designs. The construction phase was prolonged due to continuing land acquisition problems, delays in tendering and awarding contracts, and poor performance by some civil works contractors. The project was completed in 1986 with a two-year time overrun. India's Inland Fisheries Project was to assist the government and five participating states--West Bengal, Bihar, Orissa, Madhya Pradesh and Uttar Pradesh --in developing underutilized fresh water ponds through improved fish farming practices involving the introduction of polyculture techniques with Indian and Chinese carps. The project experienced: (i) Considerable delays in the construction of hatcheries; (ii) some early problems with the sanctioning of credit for fish pond improvements; (iii) a large cost overrun (US$66.9 million versus US$40.8 million at appraisal); and (iv) a time overrun of three years. China's Freshwater Fisheries Project is the most ambitious investment supported by the Bank in this subsector in the region. The prime objective is to assist the government in developing freshwater fish culture in eight major urban centers. The project appears to have been implemented without major problems.

OPERATIONAL PERFORMANCE OF WATER RESOURCE DEVELOPMENT PROJECTS

Multipurpose and Hydropower Dam Projects

As of September 1990, only four projects in this category (three multipurpose and one hydropower) had been audited, and the number increases to only ten if projects with completion reports are included. Table 8.2 lists the projects by country and indicates the ERRs assessed at appraisal, completion and audit as available.

Table 8.2: ECONOMIC PERFORMANCES OF SELECTED MULTIPURPOSE AND HYDROPOWER DAM PROJECTS

Country	Project Name	Audit Date	ERR Estimate (by percent) Appraisal	Completion	Audit
Korea	Chungju Multipurpose Project	-	12.0	13.9	-
Laos	Nam Ngum	-	17.9	16.6	-
Malaysia	Ninth Power Project	-	13.8	13.5	-
Nepal	Kulekhani Hydroelectric Project I	1986	6.0	3.0	6.0
Pakistan	Tarbela Dam Project	-	9.0-13.0	12.5	-
The Philippines	Magat River Multipurpose Project	1989	13.0	12.0	9.5
Thailand	Sirikit Dam Project	1980	6.0-10.0	17.0	14.0
Thailand	Pattani Hydroelectric Project	-	11.0	12.0	-
Thailand	Power Sector Project	-	12.0	9.0	-
Sri Lanka	Mahaweli Ganga Dev. Project	1981	12.0	20.0	20.0

The singularly poor economic performer is Nepal's Kulekhani Project, which had an estimated ERR at appraisal of only 6.0 percent but fell to 3.0 percent at completion due to large cost and time overruns. The audit ERR of 6.0 percent took account of an expected energy tariff increase. The Philippines Magat River Project's ERR of 9.5 percent at audit was based only on the irrigation benefits, and would have been somewhat higher had the power benefits been taken into account (the power facilities were not financed by the Bank and were relatively small). The Mahaweli Ganga Project in Sri Lanka showed an ERR increase to 20 percent at audit due mainly to a much higher value of energy and rises of sugar and rice prices as compared to what was foreseen

at appraisal. However, this was largely a question of the timing of the audit report. If the evaluation had been undertaken at a later period, the economic returns would undoubtedly have been much lower, in particular due to very much lower expected world rice prices. The reevaluation of Pakistan's Tarbela Dam project (ERR 12.5 percent) attributes 75 percent of project benefits to power and the balance to agriculture, which is the reverse of the proportions originally anticipated.

Irrigation, Drainage and Flood Control Projects

Table 8.3 shows the ERRs estimated by the Operations Evaluation Department (OED) for 41 selected irrigation, drainage and flood control projects in the region, which have been audited, and compares these with the ERRs estimated at appraisal and at project completion. With few exceptions, the PPARs indicate lower ERRs than were estimated at appraisal or at project completion, and many project completion reports (PCR) reevaluated ERRs downwards from appraisal estimates. Some 39 percent of the projects audited had ERRs assessed at less than 10 percent, and 24 percent had reassessed ERRs of 15 percent or greater. The reasons given for reductions of the economic performances of projects from those foreseen at appraisal included cost overruns and much delayed implementation of works. But the common theme is an overestimation of benefits. This in part reflects the major reduction in world prices of food grains that were experienced from the 1970s, when many of the projects were appraised, to the late 1980s, when most of the projects were audited. However, overestimation of both yields and production was common in many appraisal reports. Moreover, the failure to account for high levels of O&M costs and rehabilitation programs as early as 10 to 15 years after project completion has further reduced real economic rates of return.

Water Supply and Sanitation Projects

The major institution building thrust of Bank projects in this sector has been support of public utilities that have management and financial autonomy and aim to be financially viable. Project completion and audit report indicate that most projects were successful in establishing managements that have fair to good levels of autonomy in their structure, but the positive effects of this are often at least partly negated by staffing problems. In most of the authorities, there is a predominance of engineering expertise, but financial accounting skills are typically lacking. Relatively few projects achieved full financial autonomy. Though a number could be regarded as financially viable, many are loss makers that require subsidy from government. When subsidies are not fully provided, services and facilities suffer, particularly with regard to maintenance. Tariffs for services are often set by government rather than the concerned agency, and the charges made typically reflect political expediency rather than the cost of providing the services. Billing and collection is often lax. This said, many cities contain large populations of poor people who are unable to pay for services. These are usually served water through public stand pipes, and its use cannot be accounted for individually and must be financed from general revenue. A similar situation pertains to many rural water supplies that cannot be individually metered, measured or charged. Many projects have unacceptably high levels of water that is unaccounted for. Many delivery systems are poorly maintained, and losses by leakage are high. The quality of the water supplied by some systems does not meet required health standards. In rare cases the quality of the water supplied to the system is lower than desirable, but more typically the quality deteriorates in the delivery network, often as a result of loss of pressure. The projects that included a sanitation component experienced difficulty in making charges and recovery of costs for the service.

Table 8.3: COMPARISONS OF SAR, PCR AND PPAR ESTIMATES OF RATES OF RETURN FOR IRRIGATION, DRAINAGE AND FLOOD CONTROL PROJECTS

Country/Project Name	ERR Estimate (by percent)			
	Appraisal	Completion	Audit	Audit Date
Bangladesh				
Chandpur II Irrigation Project (Cr. 340-BD)	16	13	13	1981
Northwest Tubewells Project (Cr. 341-BD)	26	23	23	1982
Barisal Irrigation Project (Cr. 542-BD)	28	11	NQ	1986
Karnafuli Irrigation Project (Cr. 605-BD)	15	13	Q	1986
Drainage and Flood Control Project (Cr. 864-BD)	34	30	Q	1990
Maburi Irrigation Project (Cr. 725-BD)	16	12	12	1990
Low Lift Pump Project (Cr. 990-BD)	100+	59	100	1990
China				
North China Plain Agriculture Project (Cr. 1261-CHA)	30	56	NQ	1988
India				
Orissa Irrigation Project (Cr. 740-IN)	20	19	6	1985
Karnataka Irrigation Project (Cr. 788-IN)	10	9.5	NQ	1991
Gujarat Medium Irrigation Project (Cr. 808-IN)	20	30	Q	1991
Second Maharashtra Irrigation Project (Cr. 954-IN)	15	0.6	NQ	1991
Subernarekha Irrigation Project (Cr. 1289-IN)	17	7	<7	1991
Andhra Pradesh Irrigation and CAD Project (Cr. 1251-IN)	15	4	NQ	1991
Indonesia				
Irrigation Rehabilitation Project (Cr. 127-IND)	52	30	30	1978
Fifteenth Irrigation Project (Cr. 995-IND)	17	5	NQ	1989
Fourteenth Irrigation Project (Ln. 1811-IND)	25	10	NQ	1989
Tenth Irrigation Project (Ln. 1578-IND)	14	6	NQ	1989
Malaysia				
Kemubu Irrigation Project (Ln. 500-MA)	13	10.5	10.5	1976
Muda River Irrigation Project (Ln. 434-MA)	10	18	18	1976
Muda II Irrigation Project (Ln. 1717-MA)	18	5	5	1991
Myanmar				
Lower Burma Paddy Land Development (Cr. 642-BA)	30	19	NQ	1987
Nepal				
Birganj Irrigation Project (Cr. 373-NEP)	21	21	16	1982
Bhairawa-Lumbini Groundwater Project (Cr. 654-NEP)	19	-	10	1984
Sunsari-Morang Irrigation and Drainage (Cr. 812-NEP)	17	13	0.5	1990
Pakistan				
Pakistan Flood Rehabilitation (Cr. 466-PAK)	large	large	large	1978
Pakistan Flood Drainage Restoration (Cr. 683-PAK)	large	large	large	1980
The Philippines				
Upper Panpanga River Irrigation Project (Ln. 637-PH)	13	14	14	1980
Aurora-Penaranda Irrigation Project (Ln. 984)	17	11.6	8.6	1983
Jalaur Irrigation Project (Ln. 1367-PH)	20	24.4	20	1985
Tarlac Irrigation System Improvement (Ln. 1080-PH)	15	15	13	1985
Chico River Irrigation Project (Ln. 1227-PH)	15	15	7.7	1989
Magat River Multipurpose (Lns. 1154,1567,1639-PH)	13	12	9.5	1989
Sri Lanka				
Lift Irrigation Project (Cr. 121-CE)	25	16	Neg-16	1979
Mahaweli Ganga Development Project (Cr. 174/Ln.653-CE)	12	12	20	1981
Second Mahaweli Ganga Development Project (Cr. 701-CE)	21	-1	Neg	1989
Thailand				
NE Thailand Irrigation Improvement Project (Cr. 461-TH)	25	11	11	1982
PilsanalokIrrigation Project (Ln. 1149-TH)	20	6.7	4.8	1989
Chao Phraya Irrigation Improvement II Project (Ln. 1468-TH)	31	18	Not est.	1989
Irrigation XI Project (Ln. 1787-TH)	32		7	1990
Irrigation XII Project (Ln. 2022-TH)	23	11	7	1990

Note: NQ = SAR/PCR estimate not questioned in audit; Q = SAR/PCR questioned in audit as too high.

Inland Navigation Projects

The PPARs were prepared for the Burma Inland Water Transport Project (Cr. 413-BA) in 1979 and for the Bangladesh Inland Water Transport Project (Cr. 424-BD) in 1982. An audit report is under preparation for Thailand's Inland Waterway and Coastal Ports Project (Ln. 1889-TH). The main purpose of the project in Myanmar was to maintain and slightly increase the transport capacity of the government-owned Inland Water Transport Corporation (IWTC). The objective of improving IWTC's transport capacity was essentially achieved. But the utilization of the dry cargo and passenger fleets proved disappointing. The PPAR concludes that the project has proved of lesser economic importance than anticipated, which is reflected in a PPAR estimated ERR of 10 percent compared to 24 percent at appraisal. The purpose of the inland navigation component of the project in Bangladesh under Cr. 424-BD was to reduce transport costs of goods and make oil supplies cheaper and more reliable through improving the carrying capacity of inland water transport fleet. The PPAR concludes that the component contributed substantial improvements to the then existing water transport system in Bangladesh. The audit report for Thailand's Inland Waterway and Coastal Ports Project is not as yet available. However, the Back-to-Office Report dated August 6, 1991 on the field audit activities gives a clear indication of what the report will contain. "The most important river transportation component has been a spectacular failure while the more mundane dredging component has been a qualified success. Overall, the project will be rated as a failure....The most obvious proof of failure ...is the existence of two beautifully designed and constructed river ports which have never been used since their completion three years ago."

Inland Fisheries Projects

Out of the five major inland fisheries projects with which the Bank has been involved in the region, a PPAR is available for Bangladesh's Oxbow Lakes Fishery Project (Cr. 890-BD) and a PCR has been prepared for India's Inland Fisheries Project (Cr. 963-IN). The audit for the Oxbow Lakes Fisheries Project concludes that the project has succeeded in demonstrating that the productivity of oxbow lakes can be increased substantially, though it notes that average yields subsequent to facility completion remain less than half appraisal expectations. The audit evaluates the ERR as only 3 percent compared with the appraisal estimate of 24 percent. High investment costs, inappropriate designs and poor standards of execution are identified as reasons for the unsatisfactory economic and financial outcomes, and imply that the project is unlikely to be sustainable without continuing government subsidies. Although India's Inland Fisheries Project encountered severe implementation problems, the PCR concludes that the final results of the project have been laudable. The ERR of fish farmers is estimated at over 100 percent compared to 55 percent at appraisal and the ERR of the project is estimated in the PCR as 65 percent (42 percent at appraisal). The project is expected to be sustainable and new development is expected to expand even if the subsidy is abolished.

Agricultural Credit Projects

The Bank has supported agricultural credit projects that had large components for development of privately owned and managed minor irrigation facilities in several countries of the region--notably in India, Bangladesh, Pakistan and the Philippines. Most, if not all of them, experienced loan recovery problems from the farmer borrowers, and in this respect must be judged as failures. Political posturing and actual legislation were major contributing causes. Nevertheless, the capital costs of the facilities in terms of unit area expenditures were in all cases very low when compared to major surface water irrigation schemes, which were entirely financed from the public purse with no attempt at capital cost recovery from the beneficiaries. Moreover, the farmers fully financed the O&M of their facilities, a situation which has never been achieved through water charges collected from publicly managed surface water and groundwater irrigation schemes. Thus an argument can be made for at least the partial success of the agricultural credit

projects as a means for governments to develop minor irrigation at relatively low capital cost and with no recurrent costs apart from subsidized electrical energy in some cases.

III. Economic and Sector Work Programs, Technical Assistance and Aid Coordination

Economic and Sector Work

Country Economic Reports

The Bank has prepared reports on a wide range of macro-economic studies for all countries that are borrowers in the region--the archives contain more than 200 such reports produced during the period 1970 to 1991. They range in scope from indepth country economic reports covering all aspects of the economy, to more focused studies of particular aspects of the country's economy sometimes in companion volumes. The former are, in general, the most important for their implications with regard to water resources development (except when the agricultural sector is focused within a special report). They are updated at regular intervals--annually when aid coordination groups require it. Most country economic memoranda and reports have limited time horizons of less than 10 years and are often formulated in relationship to the five-year development plans of individual countries. In this respect, they do not capture the long-term aspects of sustainability of resources, a serious deficiency. However, the policies that the reports propose may have long-term implications for this aspect of development.

Sector Reports

The Bank has prepared 63 formal sector reports with clear linkages to water resources development for 14 of the 15 Asian countries covered by this study. The Bank has not, as yet, carried out any substantial sector studies for Vietnam, but an agricultural sector study made by the Food and Agricultural Organization (FAO) of the United Nations in 1989 covers the irrigation and inland fisheries subsectors in some detail. The distribution of the Bank's water related sector studies in the region by countries and categorized according to the sector/subsector covered by the reports is shown by Table 8.4. The reports listed have dates ranging from 1961 to 1991, and in a number of cases, the sector/subsector in some countries has been reviewed on two or more occasions over a period of years as the Bank reassessed its evaluation of the sector. The Bank's activities in water related sector work in the countries of the region generally reflect the duration and importance of its lending activities in the country concerned. However, exceptions are China and India where little sector work relating to water development has been undertaken, and then only in recent years. In the case of China, the paucity of studies in water related sectors probably relates to the relative shortness of the period of the Bank's lending activities in the country, as well as the scale of the work involved in making an indepth study of a sector in that country. However, India has until recently resisted Bank attempts to initiate water related sector studies, particularly with regard to the irrigation subsector, but the first irrigation sector review was completed in 1991. But again, it was of limited horizon.

Table 8.4: SUMMARY OF FORMAL WATER DEVELOPMENT RELATED SECTOR/SUBSECTOR STUDIES BY CATEGORY AND DATE

Country	Sector/Subsector Category					
	Irrigation, Flood Control & Drainage	Water Supply and Sanitation	Hydropower	Inland Navigation	Inland Fisheries	Water in the Environment
Bangladesh	1968 1970 1972	NR	NR	1984 1991[1]	1990	1991
China	NR	NR	NR	1987	NR	1991
India	1991	1986	1991[2]	NR	NR	NR
Indonesia	1975 1978	1971	1981[2]	NR	1974[3]	1989
Kampuchea	1970[3]	NR	NR	NR	NR	NR
Korea	1973[3]	1988	NR	NR	NR	NR
Laos	1980[3]	1980[3]	NR	NR	NR	NR
Malaysia	1971[3]	NR	NR	NR	1977[3]	NR
Myanmar	1974[3] 1977[3] 1978[3]	NR	NR	NR	1978[3]	NR
Nepal	1974[3] 1979[3] 1990[3]	NR	1983[2] 1988[2]	NR	NR	1991
Pakistan	1968 1976 1979 1983 1984	1978	1968 1980	NR	NR	NR
The Philippines	1982 1991	NR	1988[2]	NR	1973	1989
Sri Lanka	1961 1972[3] 1975	1984	1980[2] 1986[2]	NR	NR	NR
Thailand	1972[3] 1976 1980[3] 1986	1976	1972[2]	1985[1]	NR	NR

1/ In context of transport sector. 2/ In context of power/energy sector. 3/ In context of agricultural sector. NR = No report.

The Bank has undertaken 30 formal studies covering the irrigation, flood control and drainage in 13 countries of the region. The only countries in which the subsector has not been assessed by a formal Bank study at some time are China and Vietnam, although irrigation in China was reviewed along with other aspects of agricultural development in the context of the initial 1985 economic report. Sixteen of the studies covered the subsector within the context of overall agriculture sector reviews while the remaining 14 studies were devoted to the subsector and treated its individual components in the detail appropriate to their importance in the country concerned. Considering the importance of the Bank's lending activities for International Finance Corporation Development (IFCD) projects in the region, the sector work in this field is in many countries very out dated. For only four countries were reports prepared in the last decade, and in six countries, the most recent reports are dated 1975 or earlier. In the cases of some countries, the apparent

defect may have been counteracted by detailed treatment of the IFCD subsector in the context of more recent country economic reports.

The WS&S has received remarkably limited attention in the Bank's formal sector work in the region despite its important relationships to public health and well-being, industrial and commercial development in urban areas, and its general importance in the water environment. This may reflect the very extensive program of TA undertaken in the context of U.N. supported programs, which are discussed later in this chapter. Only seven studies have been carried out in seven countries. The Indian study was limited to a review of the Bank's direct experience with WS&S projects in the country. The Laos study touched only on rural water supply in the context of an agriculture sector study. The Thailand study was limited to the water supply problems of Bangkok. The Pakistan study was made in the context of the overall social services sector. For the remaining three countries--Indonesia, Korea and Sri Lanka--the WS&S studies reviewed the sector in depth and countrywide, though the 1971 study for Indonesia is now outdated.

The sectorial implications of hydropower developments in the region have been dealt with in the context of Bank reports covering either the entire electric power or energy sectors of a country, with the one exception of the 1968 report for Pakistan, which concentrated on water and power. The coverage has been rather sparse--in only seven countries (India, Indonesia, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand). Hydropower development has been covered indepth in a total of ten power and/or energy sector reports. The Bank has produced four sector reports covering inland navigation in three countries of the region. In the cases of the most recent Bangladesh report and the Thailand report, inland navigation was reviewed in the context of overall transport sector studies, while the Bangladesh 1984 report and the China report focused only on inland navigation. Sector reports covering inland fisheries have been prepared for five countries of the region (Bangladesh, Indonesia, Malaysia, Myanmar and the Philippines). In three cases, the inland fisheries subsector was covered in the context of general agricultural sector reports, while two studies focused exclusively on the fisheries subsector. The relatively sparse treatment of inland fisheries in the region's formal sector work is somewhat surprising given the potential for development of aquaculture and wild inland fisheries in most countries of the region, the importance of fish as a protein source in the diet of the populations of those countries, and the economic and financial viabilities of aquaculture developments as a private sector undertaking in many Asian countries.

Water in Relation to the Environment

The Bank has produced four formal country level reports that review aspects of water development from the perspective of the environment (China, Indonesia, Bangladesh, and the Philippines), and a report for Nepal is under preparation. An OED study of 1989 analyses the results of 335 Bank funded agriculture and forestry projects distributed in developing countries in the tropics and examines the findings in case studies of 12 countries, including four in the Asia region (Indonesia, Malaysia, Nepal and the Philippines).[1/] World Bank Technical Paper No. 127, "Watershed Development in Asia" covers many aspects of water and soil conservation and the impacts of catchment degradation in the Asian context.[2/]

The China "Environmental Strategy Paper" embraces essentially all aspects of the environment.[3/] It has three main objectives: (i) To describe the priority environmental and ecological problems; (ii) to assess the country's current policies for addressing the problems; and (iii) to propose a Bank program for environmental assistance to China on the basis of the above assessment. Water and land use and their preservation are recurrent themes in the report under

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1/ The World Bank, Operations Evaluation Department, *Renewable Resource Management in Agriculture*.. (Washington, D.C. : March 1989).

2/ The World Bank, *Watershed Development in Asia*.. Technical Paper No. 127. (Washington, D.C.: July 1990).

3/ The World Bank, *China : Environmental Strategy Paper* (Washington, D.C.: 1990).

major headings of: Pollution; agriculture; loss and degradation of natural ecosystems; and the proposed Bank program for environmental assistance. The "Environmental Strategy Review" for Bangladesh takes a similar broad approach, covering such subjects as: Cyclones; water management; urban, rural, industrial and agricultural pollution; and fisheries; with recommendations for each.[1] The Indonesian environmental sector paper "Forest, Land and Water: Issues in Sustainable Development" covers the aspects of the environment implicit in its title.[2] It presents a very balanced perspective, which attempts to identify an approach to development that is sustainable while recognizing that development will inevitably proceed. The Philippines environmental sector report "Forestry, Fisheries and Agricultural Resource Management Study" has a similar scope to that of the Indonesian study and develops a similar perspective to sustainable development of the forest, land and water resources of the country.[3]

TECHNICAL ASSISTANCE

Sources of Technical Assistance

Borrowers receive TA from the Bank under two main categories: TA financed through Bank loans/credits, which are therefore repaid by the borrower; and TA provided at no direct cost to the borrower. Under the first category, the Bank lending for TA is to facilitate implementation of the projects and programs that it finances, and the funds may be provided: (i) As a component of a development project implementation loan/credit; (ii) from free-standing multisector TA loans/credits; or (iii) from the Bank's PPF. This lending for TA has the following characteristics: The borrower uses the funds provided to procure services in the open market under a contract between the borrower and the supplier; and the borrower exercises a considerable measure of discretion regarding the nature, cost and source of the TA, subject to provisions of the loan agreement and the Bank's guidelines on the use of consultants.There are two subcategories of TA provided free of charge: TA provided by the Bank as a development institution through its staff and directly employed consultants; and TA funded by other donors/agencies on a grant basis and administered by the Bank. The major parts of the first subcategory are: (i) The Bank's staff and consultancy inputs during the project cycle; (ii) through the Bank's ESW; and (iii) from transfer of skills and know-how through courses and seminars organized by EDI and specialized courses organized by some Bank departments. The second category of free TA to borrowers includes Bank executed UNDP financed projects and TA financed under member country Trust Funds administered by the Bank.

Technical Assistance as a Component in Development Project Lending

Essentially every Bank funded water development project includes a component for TA, and this forms the most important source of TA financed in cost terms. However, the proportion of the lending devoted to TA activities varies widely between countries and between projects, and the allocations given to the various classes of TA also vary very widely. Historically, lending for TA has been subdivided into four categories: Engineering/implementation support; studies; training; and expert/consultant services. Although the above categorization has been used for many years for classifying TA activities, it remains conceptually problematic in that the categories tend to overlap in a wide range of TA activities with the exception of clearly defined funding for training by fellowships and study tours.

Given the large number of water related projects that the Bank has financed, it is beyond the scope of this report to analyze the characteristics of loan components for TA in any detail. However, Table 8.5 gives a profile of recent lending for TA under development projects in the

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1/ The World Bank, *Bangladesh : Environmental Strategy Review.* (Washington, D.C.).

2/ The World Bank, *Indonesia : Forest, Land and Water: Issues in Sustainable Development.* (Washington, D.C.: June 1989).

3/ The World Bank, *Forestry, Fisheries, and Agricultural Resource Management.* (Washington, D.C.).

region. It indicates the proportion of the loan allocated to TA and the proportions of the Bank's categories that form the TA component for 23 water related projects of various types located in eight countries of the region that were approved in FY1988 to 1990. Overall, TA components represent 7.2 percent of the total of US$2,262.8 million of the loans/credits approved for these projects (US$162.3 million). But at country level, the costs of TA financed under the loans/credits range from 1.8 percent (India) to 17.2 percent (Indonesia), and the range is wider if specific projects are considered.

Table 8.5: A PROFILE OF TECHNICAL ASSISTANCE FUNDING UNDER RECENT BANK CREDITS/LOANS FOR WATER DEVELOPMENT PROJECTS IN SELECTED ASIA REGION COUNTRIES (Fys1988-1990)

Country/ Project Title	Total Credit/Loan	Allocation for TA Component (US$ M) Engineering Implement.	Training	Experts, Consultants	Studies	Total	Total TA as percentage of Credit/Loan
Bangladesh							
BWDB Systems Rehab.	53.9	1.62	0.33	0.18	-	2.11	3.9
Second Flood Rehab.	25.0	1.20	-	-	-	1.20	4.8
Third Flood Rehab.	133.6	4.00	-	-	-	4.00	3.0
Second Small Scale FCD&I	81.5	6.57	-	2.00	2.40	10.97	13.5
Subtotals	294.0	13.39	0.33	2.18	2.40	183.28	6.2
China							
Henan Agricultural Dev.	110.0	-	2.00	0.20	-	2.20	2.0
Hebei Agricultural Dev.	150.0	-	6.24	0.24	-	6.98	4.7
Shaanxi Agricultural Dev.	108.0	-	1.98	0.56	-	2.54	2.4
Shandong Agricultural Dev.	109.0	-	1.80	0.10	-	1.90	1.7
Northern Irrigation.	103.0	0.53	1.81	0.34	0.55	3.23	3.1
Subtotals	580.0	0.53	13.83	1.44	0.55	16.35	2.8
India							
Hyderabad Water Supply & San.	89.9	1.37	1.60	1.54	0.29	4.80	5.3
Punjab Irrigation. & Drainage	165.0	-	0.17	0.13	3.70	4.00	2.4
Upper Krishna (Phase II) Irrig..	325.0	-	1.10	0.60	-	1.70	0.5
Subtotals	579.9	1.37	2.87	2.27	3.99	10.50	1.8
Indonesia							
Jabotabek Urban Development	150.0	11.52	3.92	8.74	3.60	25.78	17.2
Malaysia							
Sabah Land Settlement&Env. Mgt.	71.5	2.38	-	-	-	2.38	3.3
Nepal							
Bhairawa Lumbini GW Irri. III	47.2	4.25	0.44	0.46	2.25	7.40	15.7
Mahakali Irrigation II	41.3	2.80	0.50	0.50	-	3.80	9.2
Subtotals	88.5	7.05	0.94	0.96	2.25	11.20	12.7
Pakistan							
Second Irr. Systems Rehab.	79.5	3.70	-	0.10	3.50	7.30	9.2
Punjab Urban Development	90.0	5.60	5.70	3.80	9.60	24.70	27.4
Private Tubewell Development	34.4	1.15	0.96	-	-	2.11	6.1
Second Karachi WS & S	125.0	12.90	1.15	3.99	0.08	18.02	14.5
1988 Flood Drainage Rest.	40.0	0.90	-	-	-	0.90	2.3
Subtotals	368.9	24.25	7.81	7.89	13.18	53.03	14.4
The Philippines							
First Water Supply & San.	85.0	1.50	1.37	1.63	0.50	5.00	5.9
Irrigation Operations Support	45.0	3.50	0.69	0.13	0.07	4.39	9.8
Subtotals	130.0	5.00	2.06	1.76	0.57	9.39	7.2
Totals	2,262.8	65.49	31.76	25.24	26.54	162.27	7.2

Source: The World Bank. *Annual Technical Assistance Reports: FYs 1988 to 1990.* (Washington, D.C.).

Free-Standing Technical Assistance Loans/Credits

The Asia Regions make the smallest use of free-standing loan facilities for TA activities of all regions. During FY1986 to 1990, free standing loans totalling US$703.3 million were approved worldwide but only 7.2 percent of this funding went to Asian countries.[1] Moreover, of the total lending to the region for TA for all sectors in FY1986 to 1990 (US$2,090 million), only 2.4 percent was provided under free standing loans, the balance being obtained under TA components of projects. The main users of free standing TA loans in recent years have been China, Bangladesh and Nepal. Table 8.6 shows the mix of water related projects/studies financed under five ongoing or recently completed free standing TA loans provided to Bangladesh (one credit), Nepal (one credit) and China (three credits). A total of 33 projects and studies have been financed to date under the five credits. They cover all major categories except inland navigation.

Table 8.6: WATER RELATED TECHNICAL ASSISTANCE PROJECTS AND STUDIES FUNDED UNDER FREE-STANDING TECHNICAL ASSISTANCE CREDITS ACTIVE IN 1988-1991

	Category and Number of Project/Studies								
Country/ Credit No.	Multipurpose & General Planning	Irrigation & Drainage	Flood Control & Drainage	Water Supply & Sanitation	Hydro-power	Inland Navigation	Inland Fisheries	Environ-ment	Totals
Bangladesh									
Cr. 1440-BD (SDR 23.8M)	1	2	2	2	-	-	1	-	8
Nepal									
Cr.1379-NEP[1] (SDR 5.6M)	1	1	-	-	4	-	-	-	6
China									
Cr. 1412-CHA[1] (SDR 9.4 M)	1	2	-	1	2	-	1	-	7
Cr. 1664-CHA (SDR 18.0 M)	3	2	-	4	2	-	-	1	11
Cr. 1835-CHA (SDR 15.9 M)	-	-	1	-	-	-	-	-	1
Totals	6	7	3	7	8	-	2	1	33

1/ Project completed.
Source: World Bank Asia Technical Department, Technical Assistance records.

Project Preparation Facility

PPF advances are made prior to loan/credit approval and are subsequently refinanced under Bank loans/credits or are repaid. They typically finance such activities as: Strengthening the entity responsible for project preparation; completion of preparatory work and detailed designs so that implementation activities can start shortly after loan approval; certain essential startup activities without which project implementation would be seriously delayed; and design of training programs and training of local staff. However, the Asia region as a whole makes relatively limited use of the PPF for development projects in all sectors. Of the PPF advances made worldwide in FY1986 to 1990 totalling US$282.7 million, only 5.5 percent were made to Asian countries.[2] During FY1988 to 1990, the PPF was used in the region for only six water development related projects, of which four were in Indonesia (three urban and one irrigation), one in Pakistan (irrigation) and

1/ Pakistan is not included in the figures, as it was classified as an Europe Middle East and North Africa Region country during much of the period, but its inclusion would not make a significant difference.

2/ Pakistan is omitted from the figures, as it was then included under Europe, Middle East and North Africa Region.

one in Nepal (Water Supply and Sanitation [WS&S]). However, India has in the past used the facility for preparation of several multipurpose and irrigation projects, including the Narmada River developments in Madhya Pradesh and Gujarat.

The Bank's Special Grants (SPG) Program

The Bank does not normally provide grant funding for TA. However, there is a range of development activities in priority fields that cannot be assisted through the Bank's regular lending program. The SPG has become an important instrument in support of these activities, some of which have TA benefits to Asian countries. Noteworthy for their water development relationships are the CGIAR, IIMI and the recently initiated IPTRID.

Technical Assistance Projects Executed by the Bank and Funded by the United Nations Development Programme

The UNDP is a major source of TA grants channelled through the Bank as the executing agency. The UNDP projects finance a broad range of investment related studies as well as providing advisory services and training to facilitate implementation of investment projects. As all borrower countries in the region with the exception of Korea qualify for UNDP assistance, UNDP funded TA is commonly applied to water related developments, and a significant number of such projects are executed by the Bank. Most countries apply UNDP grant funds through projects that are fully identified at the time of grant approval. However, China, Myanmar and Nepal have used the "Umbrella Project" concept under which funds are earmarked for TA projects and studies related to developments (in specified sectors) that are not specifically identified at the time of grant approval. All such Umbrella Projects have been executed by the Bank. Table 8.3 provides a profile of UNDP funded TA projects for water development with Bank execution in the region, covering the period March 1988 to September 1991. It indicates the country distribution and type of development category of the projects. The projects are distributed in 12 countries and, in addition, there are four ongoing regional studies in two water development categories. The number of studies totals 66 when individual water studies under the Umbrella Projects are included. The WS&S category is the most important in terms of number of projects (23), which represent 35 percent of the total water related projects with UNDP funding and Bank execution.

Technical Assistance Financed under Trust Funds Administered by the Bank

One of the Bank's strengths in the area of TA is its ability to mobilize donor resources. This is exemplified by the growing Trust Fund operations administered by the Bank. Each fund is used according to the terms of an agreement with the donor or donors providing funds. Donors include countries, multinational agencies, nongovernmental organizations, foundations and other private organizations. The funds may be directed to a single recipient country, or to a region or used globally. They are also used to support the Bank's operational and research programs and other development initiatives. A special arrangement is the "Consultant Trust Funds" under which a number of countries have placed grant funds at the disposal of the Bank to be used for the payment of consultants hired by the Bank from the donor country. By the end of FY1990, the Bank was administering 527 trust fund operations for a total of about US$2.5 billion equivalent. The total disbursement reached US$454 million worldwide in FY1990, of which almost 30 percent was for TA. A review of the portfolio of projects supported by Trust Funds in 1990 indicates that 17 of the projects in individual countries of the Asia region were directly water related (with nine of the projects in Pakistan), while three global or regional projects related directly to water development. In March 1990, the last tranche of the three-year Japanese Grant Facility (JGF) of ¥ 30 billion was allocated. The JGF provided grants for TA to support preparation and implementation of 134 Bank projects, and more than 50 percent of the grants (by value) went to countries in the Asia region. Significantly, almost a third of the grants financed environment related TA (e.g., India's Industrial Pollution Control Project).

Table 8.7: A PROFILE OF UNDP TECHNICAL ASSISTANCE PROJECTS FOR WATER DEVELOPMENT WITH BANK EXECUTION BY COUNTRY AND CATEGORY (MARCH 1988 TO SEPTEMBER 1991)

	Category and Number of Project/Studies								
Country	Multipurpose & General Planning	Irrigation & Drainage	Flood Control & Drainage	Water Supply & Sanitation	Hydro-power	Inland Navigation	Inland Fisheries	Environ-ment	Totals
Bangladesh	5	1	3	2	-	2	2	1	16
China	1	3	1	5	-	-	-	-	10
India	-	-	-	-	-	-	-	-	-
Indonesia	-	-	-	2	-	-	-	1	3
Laos	-	-	-	1	2	1	-	-	4
Malaysia	-	-	-	1	-	-	-	-	1
Myanmar	-	3	1	3	-	2	-	-	8
Nepal	1	2	-	2	1	-	-	1	7
Pakistan	2	-	-	1	2	-	-	-	5
Sri Lanka	1	-	-	2	-	-	-	-	3
Thailand	-	-	-	2	-	-	-	-	2
Vietnam	1	-	-	-	-	-	-	1	2
Regional	-	-	-	2	-		-	2	4
Totals	11	9	5	23	5	5	2	6	66

Notes: Figures in parenthesis indicate projects proposed as of September 1991. Subprojects financed under Umbrella Projects (CPR/86/03, BUR/82/004 and BUR/86/012) are listed according to category.
Source: World Bank Asia Technical Department, Technical Assistance records.

AID COORDINATION

The Bank has had a long and active role in aid coordination. This subject has become increasingly important in recent years as external aid resources for development became increasingly scarce, as the channels of assistance became more diversified, and as development programs became more complex. Though the responsibility for aid coordination rests primarily with the recipient government, the Bank is often asked to play an active role in carrying out this function. Both donors and recipient countries attach considerable importance to the Bank's role as a global development institution, and it has long been active in organizing, sponsoring and participating in aid coordinating groups and consortia. In some cases this has called for overt Bank leadership. In other cases, the Bank's involvement has been more modest, especially where other institutions, such as the UNDP, a regional bank or a donor country, are better placed to play the lead role. Currently, there are aid coordination groups under Bank leadership for seven countries in the Asia Region (Bangladesh, India, Myanmar, Nepal, the Philippines, Pakistan and Sri Lanka) though the group for Myanmar has recently not been particularly active. The Inter-Government Group for Indonesia, in which the Bank participates, is chaired by the Netherlands Minister of Development.

Aid coordination groups most typically focus on evaluation of a country's development prospects, capital requirements and credit worthiness within a general economic framework, or address sectorial issues of economic development. However, on a few occasions in Asian countries, Bank led groups have become involved with large water development programs or projects. In this respect, the Bank provided the leadership for establishment of the donor consortium to assist Pakistan's Indus water development following the Indus Water Treaty of 1960 between India and Pakistan. This led to the establishment of the two Trust Funds under Bank administration that have been used to finance construction of the link canal systems and multipurpose storage reservoirs on the Indus River system in Pakistan. The Bank led aid group for Sri Lanka was instrumental in organizing donor support for the Mahaweli development in the late 1970s in connection with the accelerated Mahaweli Development Program, preparing several joint status statements with the government for this purpose which reviewed the program and its financial requirements. In June 1989, the Bank agreed to a request from Bangladesh to assist in

coordination of international efforts to provide flood control and protection facilities for that country and to prepare a "Plan of Action for Flood Control in Bangladesh" to cover the period 1990 to 1995. In addition, the Bank has been instrumental in organizing, cofinancing, or parallel financing from the Asia Development Bank and/or bilateral donors for many water related development projects that it has financed in the region.

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FUTURE BANK STRATEGIES AND PROGRAMS

I. INTRODUCTION

A PROPOSAL FOR CHANGE

The variety and complexity of water issues in Asia is self-evident. In the past, the Bank has implemented a range of programs that have responded to this wider context. Multipurpose projects by their nature involve cross-sectorial issues and in many cases (e.g., the proposed Xiao Langdi Project in China) both the implementing agency and the Bank have been careful to maintain a multipurpose framework. There are also many other projects in specific sectors that have responded to wider water resource issues, including water supply programs in the Philippines which have had basin planning as their focus; urban programs in China and elsewhere, which have reflected both regional water resource and environmental issues (e.g., the recent Beijing Urban Environmental Project); proposed approaches to irrigation lending in India, which envisage coordinated state lending activities; and the Irrigation Subsector Operation and Maintenance (O&M) Project in Indonesia, which has focussed on irrigation institutions within a river basin framework. In addition to project activities, the Bank has been involved in a variety of water resource planning and associated undertakings, ranging from its early involvement in the Indus waters dispute through to major water planning and flood protection studies in Bangladesh.

Even so, as indicated in the previous chapter, most Bank involvement in the Asia region has been in sector-specific activities and many of the broader operations have arisen in the course of work in individual sectors. Given this background, there appears to be three ways in which the Bank could approach the complex and varied issues of water:

1. As predominantly in the past, by responding to borrower and donor requests; developing sector specific strategies, programs and projects; supporting complementary research and studies; and seeking broader institutional reform and consistent planning more as a byproduct of operations than as an end in itself.

2. As under some ongoing initiatives, by tackling broad water resource issues directly within the context of environmental concerns while continuing with sector-specific and related activities as above.

3. As is recommended, by addressing water resource issues more directly on a comprehensive basis; actively promoting international and interprovincial basin agreements where they are necessary; requiring institutional reform as a condition for lending in specific sectors; and positively helping to develop capacities for integrated water planning and management in borrowing countries.

Arguments in favor of the last of these approaches are persuasive.[1/] Emphasis on specific projects, each with a "given" water requirement, is inherently inadequate for managing a complex unitary resource coming under increasing pressure. Projects formulated in isolation do not constitute a strategy and, while much has been achieved, there is a clear necessity for a broader approach. Nor would consideration of water only under the banner of "the environment" provide a sufficient basis for sound management. No doubt important issues can be tackled within such a framework, and water is always a critical -- often the critical -- factor in sustaining a balanced environment. But water resources planning and management go beyond what is typically regarded as of environmental concern, and relevant experience, skills and technologies must be drawn from

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1/ Similar arguments lie behind the Bank's draft Water Policy Paper and activities being undertaken in other regions of the Bank, notably Middle East and North Africa.

wider traditions than those that most typify environmental work. Approaches that emphasize water primarily as an environmental issue tend to limit the area of concern, cause confusion as to what should be involved, and can loose the essential focus on water resources management to satisfy all a nation's goals (economic, social, security and environmental).

A more activist role in water could be relatively staff intensive. The Bank's resources are limited and such a role would thus compete with other pressing concerns. Moreover, water in any country involves vital national and local interests. Any Bank initiatives in this area must therefore develop in truly consensual ways, contributing positively to the combined actions of many international, national, private and voluntary agencies. This said, there appears to be no other agency with the potential influence of the Bank for promoting integrated water resources development and management. If it is accepted that large water resource programs are inevitable, then the Bank's financial strength, international perspectives, technical experience and operational involvement combine to suggest that water is an area in which it has an explicit comparative advantage. At the very least, it will be an essential partner in assembling the finance needed for most large water resource development programs. If it uses the leverage that this will give to encourage appropriate reforms in its borrowing countries, it could contribute in important ways to the orderly development in an area of critical importance for long-term prosperity and well being in every nation.

BANK STRATEGIES AND APPROACHES

General Strategy

Bank strategy must be tailored to regional, subregional and country conditions. Even so, four main elements of a broader strategy can help guide individual country and basin discussions. First, all Bank activities in water resources should be viewed from the perspective of water as a fixed resource to be developed and managed to best meet all a nation's objectives (economic, social, security, and environmental) rather than as an input into specific sectors. Second, a primary focus of its activities should be on capacity building and institutional strengthening for the total resource to help sustain policies, programs and projects in a coherent manner in the country and/or basin concerned. Third, the Bank should evolve lending instruments to pro-mote its objectives supported by economic and sector work program (ESWP), technical assistance (TA), research and donor coordination. Fourth, particular attention should be given to international and interprovincial river systems since these have high priority in their own right and the Bank has a strong comparative advantage to support countries in their efforts in this area.

Policy Guidelines

The Bank needs to establish and maintain clear policies to guide its work at the regional level and, in greater detail, at the country level. The general content with respect to such policies has been suggested in earlier chapters under the four framework areas: Institutions, planning, real-time management, and economic and financial policy. With respect to country-specific approaches, the country departments (CDs) need to review and clarify water resource objectives for the country concerned, and formulate all Bank activities to promote these objectives. Based on an internal concensus, the Bank should articulate its revised approach to water resource issues to the government concerned and indicate the conditions under which it could support operations in the water sector. The aim should be to agree on country-specific strategies at senior government levels to guide subsequent country strategy and provide a framework for Bank support. Borrowers should be encouraged to undertake systematic water resources assessments to help formulate comprehensive approaches to water resources development and management.[1/] Assistance could be provided as necessary in undertaking such an assessment.

1/ A detailed description of all the elements of a comprehensive approach to water resources management is given in Annex 1 to this report.

BANK ACTIVITIES

Resource Level

Bank activities need to be undertaken both at the level of the resource and at the level of individual sectors. At the level of the resource, emphasis should be on comprehensive approaches to water resources development and management with emphasis on institutional capacity building at the national and provincial levels. Lending instruments should be developed to promote agreed upon objectives in each of the four framework areas, and should be supported by appropriate economic and sector work and TA. A more proactive approach to interjurisdictional disputes could also lead to a stronger role in aid coordination and in the mobilization of the financial and technical resources of bilateral donors and other international agencies. Initiatives in the environmental area should complement and be coordinated with this approach. Environmental efforts would focus primarily on the regulatory function, promoting clear objectives, measurable criteria, and competent review and enforcement procedures for holding water service agencies accountable for their actions. They would seek to promote complementary incentive mechanisms, particularly for pollution control.

Individual Sectors

Activities in individual sectors would need to be fully consistent with the overall country water resources strategy, and activities in specific sectors should be conditional on satisfactory progress in meeting general water resource objectives. Within each sector, approaches are needed that complement those at the level of the resource, with emphasis on comprehensive analysis, and institutional strengthening and capacity building.[1/] Multipurpose and single purpose investment projects should be framed within national, regional and basin plans, and their priority should be established within the context of total sector investment programs.

Lending Program

In most cases, the lending program will remain the primary vehicle for achieving the Bank's objectives. As in the past, the Bank should stand ready to provide TA, and training and research support as necessary. However, other agencies (the United Nations and its specialized agencies, bilateral donors, private organizations and academic institutions) are well placed to focus on such activities and are often the primary sources of the grant funds needed to carry them out. Cooperation and coordination with these bodies is crucial. But the particular strength of the Bank will remain in its lending activities. If large financial flows are required to help resolve major water resources problems, then the Bank--and regional banks such as the Asian Development Bank (ADB) are well placed to use the leverage that resource transfer provides. It is no doubt true that where water resources are fully developed, or overriding environmental concerns deter investment, "the age of large dams" may be over. But even if emphasis is on management and reallocation, substantial resources will still be needed to consolidate, modernize and sustain infrastructural facilities. Moreover, as argued elsewhere in this report, additional large water resource development programs are inevitable in several parts of Asia. Indeed, it is hard to envisage agreement on some of the more intractable interjurisdictional disputes without the provision of additional major multipurpose water developments. In order to reach agreement, it may be necessary to incur costs that are not fully consistent with maximizing economic returns. The Indus treaty after all was successful in political rather than direct economic terms (Chapter 3), but it was effective in removing one major cause of conflict between the two riparians. In each case, good planning would indicate whether such costs are worth the benefits, and the Bank could play an important role in sponsoring such planning and facilitating agreements between riparian countries and provinces.

1/ The proposals for the Indian irrigation sector provide an example of what might be involved. See The World Bank and The Government of India, "Proposed Bank Operational Strategy and Lending for Indian Irrigation." (The World Bank, Washington, D.C.: October 8,1991.)

II. LENDING OPERATIONS IN WATER RESOURCES

Four types of lending instruments are proposed for addressing water resource issues across sectors and jurisdictional boundaries: (i) Country Water Resources Sector Projects, (ii) County Water Resources Sector Support Projects, (iii) Interjurisdictional Development and Management Projects, and (iv) Multipurpose and Single purpose Sector Projects.

COUNTRY (PROVINCIAL) WATER RESOURCES SECTOR PROJECTS

Policy-based lending has been an important feature of recent Bank approaches with respect to structural adjustment lending and sector-specific operations. Water resource conditionality has on occasion featured in the context of policy-based operations, most notably under agricultural, urban and energy sector loans. It has also featured in the growing number of environmental operations launched in recent years. There has yet to be a policy-based operation directed specifically at water resources as a whole in the Asia region. Such an approach is being proposed in the Middle East and North Africa region. Such actions would be consistent with activities in other sectors. Policy-based lending would clearly provide a context for reviewing arrangements for water resources as a whole and for tackling issues that go beyond the concerns of individual sectors or implementing agencies.

The design of such an operation would have to be closely tailored to the specific requirements of the country or province concerned. Consistency of approach, however, would be greatly facilitated if conditionality were established in each of the four framework areas, and guided by the considerations presented in Chapters 3 to 6 and in Annex 1. This is not the only way of evaluating these issues. Nevertheless, the four framework areas provide a coherent and comprehensive approach with an institutional focus such that proposals in any one area can be formulated in the context of decisions in all other areas. Issues that might be addressed include:

1. **Institutions.** Allocation policies for all uses; water rights systems and their administration; other regulatory areas (water quality, pollution control, environmental, financial, dam safety, etc.); agency functions, organization and accountability; personnel policies; consumer responsibilities, obligations and rights; and agency programming and budgeting.

2. **Long-Term Planning.** Goals, objectives and policies; scope of national, regional, basin and project planning; data collection and processing systems; planning criteria and methodologies; value of water for economic and noneconomic uses; resources and sites for future generations; and implementation of priority planning activities.

3. **Real-Time Management.** Preparation of plans of O&M; basin and scheme operations under normal and emergency conditions; maintenance programs and procedures; legal powers; organizational capabilities; rules, procedures, guides, equipment, staff training and oversight consistent with sound management and business practice; and public awareness and participation.

4. **Economic and Financial Policy.** Pricing principles and policies; subsidies and taxes; agency finances; identification and allocation of capital and O&M costs between sectors; composition of service charges and their link to the service; cost recovery schedules and mechanisms; demand management tools; and environmental and pollution control charges.

Once agreement has been reached with the government concerned on a general country strategy, a comprehensive water resource assessment could provide the initial mechanism for defining in detail what might be involved. This could either take the form of a free-standing item of sector work or, preferably, if agreement in principle on a Bank-lending operation had been reached, it could be the project preparation document. In the latter case, it would *inter alia* propose conditionality and implementation procedures for a Bank-supported operation. Its content would vary in scope and detail. The status of, and prospects for, water resources development and

management would provide the basis for project design. An institutional review would invariably be a critical element.[1] Specific long-term planning and real-time management activities would most likely be scheduled for implementation during the project. For instance, a loan condition might be, say, a two-year national planning effort, with priority regional and basin plans undertaken in parallel or sequentially.

Implementation arrangements would in all cases need to go beyond the traditional sector agencies. In those countries with a central water unit or entity--responsible for policy and control over and above sector-specific agencies--this might provide an appropriate unit to sponsor the project. More commonly, lead water resource ministries may have an implementation bias, and it may be better to approach political leadership at the highest level through the Ministry of Finance or National Planning Agency. How this is best done is debatable and will no doubt vary. The role of sector agencies will be crucial and as a matter of course they would be fully involved from an early stage. In some cases, it may be appropriate to agree in principle on the need for, and scope of, such an operation (for instance, at the Annual Meeting discussions or during a country programing exercise) and then build up the involvement and trust of implementing agencies within the context of a country water assessment. In other cases, it may be best to initiate a country assessment under the leadership of the Ministry of Water Resources or similar agency as a mechanism for "selling" the concept to senior political leadership. In all cases, the borrower must have primary responsibility for project preparation, supported by guidance from Bank staff and consultants.

Loan and credit arrangements could vary, depending on country requirements and conditions. In countries facing balance-of-payments problems, a quick disbursing loan or credit could be consistent with Bank macroeconomic objectives and prove attractive to a finance ministry. If so, it might prove a useful mechanism for creating an initial water resource institutional framework and for launching appropriate planning, real-time management and policy improvements. In other cases, it may be more appropriate to provide a sector investment credit, for instance, disbursing against total investment programs in priority water areas, together with provision for the creation of cross-sectorial institutional arrangements. In others, comparable conditionality could be associated with the investment program of a dominant agency or even one or more selected investment projects, in which case it would approximate to the proposed sector specific projects described below (and proposed for the irrigation sector in India).[2] Finally, while it is understood that there is some reluctance in the Bank to consider hybrid loans, these could have the merit of being attractive to both a finance ministry and the sectoral agencies, which could receive direct support in priority activities.

Irrespective of the characteristics of the final operation, there is merit in pursuing the idea of a broad based water sector policy operation to establish its practical viability. It may be premature to suggest specific countries and provinces since these should emerge as the outcome of CD discussions and country expressions of interest. However, such an operation would clearly be well adapted to medium-sized countries (Malaysia,Thailand and Sri Lanka) or provinces (Gujarat, Rajasthan and Tamil Nadu) facing difficult water resource problems and associated issues. Such an operation could be envisaged either as the first of a series of water sector operations, each building on the results of the previous exercise or, more probably, as establishing the preconditions necessary for further lending for major multipurpose projects and individual sectors

COUNTRY WATER RESOURCES SECTOR SUPPORT PROJECTS

Most countries that require support in strengthening their water resources management capability must remedy generic sector-wide deficiencies, which are obstructing sound management. In small or medium-sized countries and provinces, such deficiencies would

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1/ A series of workshops reviewed water resources institutions in Indonesia in 1992.

2/ The World Bank and the Government of India, "Proposed Bank Operational Strategy and Lending for Indian Irrigation." A draft paper. (The World Bank, Washington, D.C.: October 8, 1991.)

probably be best tackled within the context of a country based operation of the kind discussed above. But in large, in particular federal, countries, there may be opportunities for tackling generic issues in their own right or to complement province-wide operations. Possible areas could include:

1. **Data Collection, Processing and Dissemination.** The Bank could support the upgrading of national data programs. Expanded collection, processing, analysis and dissemination could be systematically designed to meet national and provincial needs in planning, implementation, operation and regulatory activities for government agencies and for private agencies and the public at large. Coverage of surface and groundwater quantity and quality characteristics will require rules, standards, procedures, office accommodation, field and office equipment and communications capacity. Some countries may wish to incorporate broader communication needs for operating schemes into this system. A contemplated hydrology project in India has characteristics that approached this concept, although it is more limited than suggested here and, as conceived by the government of India, is to be confined to selected states.

2. *Dam Safety Assurance.* A dam safety assurance program has been implemented in India under a Bank-supported credit (Cr. 2241-IND/Ln. 3325-IND) and could provide a model for other countries with numerous dam structures (China and Thailand). A second is now under discussion with Indonesia. The India program initially focused on selected states and the strengthening of central government, but also made provision for the inclusion of additional states over time. The program was designed to implement activities already largely called for by law, funding remedial work identified under the project to bring dams to safe standards. It is important to recognize that it was essential to incorporate both the investigative and agency strengthening activity with support of the substantial corrective work resulting from the investigation process.

3. *Operation and Maintenance.* There has in the past been a tendency in Asian countries to neglect O&M, although the Bank has given it increasing attention in recent years. O&M is often best tackled on a sector basis as has been done, for instance, under recent irrigation sector operations (e.g., the National Water Management Project in India, the Irrigation Operations Support Project in the Philippines and the Irrigation Subsector Projects in Indonesia). Nevertheless, there may also be opportunities for implementing broader O&M programs, across sectors or in the context of improvements in real-time management of multipurpose facilities. A component for strengthening the operations of Bhakra-Beas Management Board activities in Northwest India was in the event dropped from the Punjab Irrigation II project (another source of funding became available), but the action envisaged provides an illustration of what might be attempted under such an operation.

4. **Environmental Control.** The accumulation of environmental problems in many Asian river systems, groundwater systems and urban and rural areas has provided an important rationale for environmental improvement projects, both in relation to regions under immediate stress and more broadly in a province or nation as a whole. Such projects typically focus both on strengthening the regulatory framework involving the relevant regulatory units and on remedial works involving the responsible operational agencies.

Other examples could be noted. In federal countries, in particular, it may be appropriate to implement a countrywide operation focused on a high priority area to complement comprehensive provincial water resource programs and sector-specific activities. A combination of different, but complementary, lending activities could in such cases represent a suitable compromise since not all provinces will be ready or suitable for comprehensive treatment, and in any case, the Bank would be hard pressed to undertake more than a few selected programs at any one time.

INTERJURISDICTIONAL RESOURCES DEVELOPMENT AND MANAGEMENT PROJECTS

International Rivers

Large investment programs on international waterways provide the Bank with potential leverage in promoting international cooperation. In some cases, Bank involvement could initially be confined to its good offices, (e.g., in support of data pooling, planning or other joint activities). In most cases, however, the promise of funding and donor coordination for joint projects can provide the Bank with a unique role in catalyzing agreement. This is not the place to propose specific projects or particular solutions, which will depend on detailed feasibility studies, discussions and requests from the countries concerned. However, Box 9.1 summarizes some tentative approaches with respect to the three main international river systems in Asia to illustrate how a more proactive approach might be adopted in specific instances. Projects on most other international rivers in the region are unlikely to be as controversial. For instance, hydro-projects on the Salween would raise few riparian issues provided Thailand and Myanmar were to cooperate. An exception is the North Han in Korea but, in this instance, there is little prospect for short-term cooperation between the two Koreas and, indeed, North Korea is not a Bank member.

Any project on an international waterway is subject to international law and to Operational Directive (OD) 7.50. Even so, the Bank has considerable leeway in the extent to which, and the stage at which, it becomes involved. In the past, the Bank has tended to interpret OD 7.50 in a fairly restrictive way--for instance, supporting Left Bank Outfall Drainage in Pakistan, assuming it will have no adverse effect on India. No doubt it is always easier to limit international involvement and, if consistent with OD 7.50, confine projects and activities to single countries and even purposes. Limited resources will also constrain the Bank's ability to be involved, and lending pressures will tend to compress the time that can be allowed in pursuing these complex issues. However, if the Bank fails to address these issues, then opportunities for promoting international cooperation may well go by default, since there appears to be no other agency that could perform this particular role. U.N. and bilateral agencies are no doubt often better placed than the Bank to provide TA and related support, but only the Bank and perhaps the ADB have the particular combination of financial strength, international perspective and technical involvement needed to mediate some of the more intractable riparian disputes.

The sensitivity of these issues is self-evident. Only the countries concerned can reach agreement and the Bank has a role to play only if this is acceptable to all parties. Even so, the Bank could indicate positively, at an early stage and at the highest levels of governments, the conditions under which it would be willing to be involved. Such an approach risks failure and, indeed, may abort some "second-best" solutions. Nevertheless, the potential benefits could be very substantial, and it is strongly recommended that approaches such as those suggested in Box 9.1 be considered.

Box 9.1: TENTATIVE BANK APPROACHES IN SELECTED INTERNATIONAL BASINS IN ASIA

Ganges-Brahmaputra

The three main riparians are already discussing cooperation on the Ganges. The Bank could informally offer assistance and stand ready to provide any reasonable support. Moreover, financial assistance for a major multipurpose project such as Karnali, in conjunction with technical assistance activities, could provide the Bank with considerable leverage for promoting cooperation. Agreement between Nepal and India would be inherent in such a project. The critical Bank objective might be to ensure that Bangladesh is also a party to: (i) Protect its interests, and (ii) help create conditions for broader, long-term cooperation in the basin. It is not possible to prejudge the outcome of such a sensitive involvement, which would be a major challenge. However, some elements can be tentatively suggested. Bangladesh's predominant interests on the Ganges relate to sustaining low flows passing Farakka. A subsidiary interest is to limit -- to the degree possible -- monsoon floods. Both interests could be served to an extent by adopting appropriate real-time operating rules for a major storage facility. While in principal Bangladesh may be indifferent to the means of regulating flows to Farakka, in practice, partnership in a major facility, together with rights to locate staff at the dam and barrage and other arrangements, might provide the best guarantees. Additional dry season flows would ease India's difficulties at Calcutta, in addition to providing power, irrigation and flood control benefits, and might create a window of opportunity for interstate coordination within India. Nepal would no doubt welcome the political balance and cost sharing arising from Bangladeshi participation. Besides helping finance the contributions of each of the three parties, the Bank -- in association with other donors -- could seek to encourage a program for basin data collection, exchange and analysis; a joint framework for planning and management; and coordination in operations beyond the particular facility financed.

Indus

The Bank is deeply involved in both Pakistan and India in programs to help resolve country-specific drainage problems in the Indus Basin. In Pakistan, it has *inter alia* made a major contribution to the first stage of the Left Bank Outfall Drain (LBOD) which, though to date confined to Sind, will ultimately also extend to serve Punjab. In India, the Bank is supporting studies, investigations and pilot developments under the Punjab Irrigation and Drainage Project, which seeks to identify solutions to long-term drainage problems for India's Northwest region as a whole (Punjab, Haryana and Rajasthan). In both countries, follow up operations are envisaged. Resolution of drainage problems in the Indus Basin would clearly benefit from international cooperation. India would no doubt be the main beneficiary, but Pakistan could also benefit from joint funding and orderly disposal of Indian drainage effluents. Political sensitivity has so far ruled out cooperative ventures. Indeed, the Bank accepted the urgent need for Pakistan's construction of a direct outfall to the sea. Given the project's complexity, the number of donors involved, and the urgent need to accelerate construction, this may have been necessary at the time. But in principle, there seem to be strong arguments for international cooperation on additional facilities. It is understood that the two riparians have recently discussed drainage in the context of their regular meetings on Indus issues, and the Bank could confidentially explore what the prospects would be for including such conditionality.

Mekong

The Bank has provided consistent support to the Mekong Committee's Secretariat in its planning activities for the lower Mekong Basin, and has stood ready to finance projects that are consistent with its long range perspective plan. To date these have been confined to relatively small tributary projects. The Bank is also currently executing agency for a United Nations Development Programme--financed planning exercise for the delta area within Vietnam, which *inter alia* aims to identify a project for possible Bank support (Chapter 4). Finally, the Bank is considering proposals for a storage project on the Yom River in the Chao Phraya Basin of Thailand. Although at present limited to projects within in the Yom catchment, these would in principle be consistent in the longer term with tentative proposals that have been made for interbasin transfers from the Mekong to supplement Chao Phraya supplies. Any Bank initiatives in the Mekong Basin need to be fully consistent with riparian agreements and plans prepared under the auspices of the Mekong Secretariat. Subject to this, the Bank could broaden its role to encourage cooperation between riparians with respect to any specific activities in which it is involved. For instance, the ongoing delta study is limited to Vietnam, yet brief examination suggests that effective water resources development could require joint construction of facilities by the two downstream riparians, Kampuchea and Vietnam. Recent political developments in Kampuchea may facilitate such cooperation, and the Bank could explore opportunities before committing itself to any project specifically limited to Vietnam. Diversions out of the basin (e.g., in Thailand) and mainstream projects would also be dependant on international agreement and feasibility investigations. Subject to their outcome, the Bank could play a valuable role in forging concensus on such proposals.

Domestic Rivers and Interbasin Transfers

Conflicting interjurisdictional interests and objectives are inevitable in federal countries where resource ownership is devolved to the provinces, and even in unitary countries where local government has developed strong management control of resources without ownership. The Bank's role with respect to major interjurisdictional domestic basins and interbasin transfers, in principle, are no different to that for international rivers. Although, there is no OD comparable to OD 7.50, the Bank generally requires, as a condition of lending, that allocations among provinces and jurisdictions be spelled out in government directives, tribunal awards or interprovincial agreements. For instance, in India, it has declined projects in the Cauvery Basin in the absence of an award or agreement; has financed projects in the Krishna Basin given an award, and in the Subernarekha basin given an interstate agreement; and delayed participation in the Narmada Basin until an award had been made. In China, the irrigation components of province-based agricultural development loans in the Yellow River Basin have similarly been predicated on allocation directives from the central government.

As for international rivers, the Bank has considerable leeway in how far it involves itself in domestic basin arrangements, and can accept varying levels of detail and coverage in awards and agreements. For the Narmada, for instance, the tribunal award *inter alia* detailed water allocations; the primary configuration of basin facilities; cost-sharing and ownership of storage and power facilities by riparians; rules for real-time operations; and institutional arrangements. Only with a comprehensive sharing system in place did the Bank provide finance for the Sardar Sarovar project. In contrast, for the Subernarekha, the Bank financed primary storage and diversion features without clear definition of real-time operating rules, ownership rights in the reservoirs, or water quality provisions in the agreement. While these were covered to varying extents in credit conditionality, in practice these conditions were far from fully met, and there have been no revisions or additions to the interstate agreement. For the Krishna, no basinwide conditionality has been included in any of the numerous project and credit agreements, and the Bank has confined itself to confirming that project allocations are consistent with the rather unspecific tribunal award (Box 3.2).

The Bank could be more positive in promoting agreements for interprovincial rivers in federal countries. Such an approach would in no way supplant any legal requirements of the country concerned. However, it might involve the Bank more actively in suggesting or defining legal or administrative agreements, or in supplementing them if they fail to cover specific aspects adequately (for instance, real-time operations are often a particular weakness). Conditionality could be confined to lending for a specific project or, more generally, be related to lending for water resources as a whole. Box 9.2 proposes a project concept for South India to illustrate how the Bank's leverage might be used in a specific context (although, in this instance, no information is available on whether transbasin diversions across the western Ghats are economically justified, and Kerala may, in practice, rule out such a proposal). In other cases, there may be less need for positive Bank involvement in interjurisdictional issues. In China, for instance, the central government retains ultimate power to decide questions of provincial allocations, even though provinces remain powerful actors. For instance, with respect to the proposed south-north transfer of water from the Yangtze to the North China Plain, it is understood that demands by riparian provinces en route represent a major issue in the choice of alignment, since they could affect how much water could be delivered to areas of most acute need. In such a case, the Bank could emphasize its position, giving due weight to consistent economic evaluation in project design while providing financial support in ways that facilitated interprovincial concurrence with the preferred alternative.

Box 9.2: PROJECT CONCEPT: JOINT KERALA AND TAMIL NADU WATER RESOURCES DEVELOPMENT PROJECT

The steep west flowing rivers of Kerala carry an average annual flow of about 2.1 BCM, largely during the dominant southwest monsoon. A relatively small proportion is devoted to water supply, irrigation (mainly of paddy on the narrow coastal plain) and hydrogeneration. There is some further potential for power, but that for irrigation is limited and high cost, and, other things being equal, the state can be expected to remain substantially in water surplus. River flows also interact in complex ways with Kerala's lagoons and coastal waters and fresh, intermediate and saline waters sustain important fisheries resources besides fulfilling transport, social, tourism and environmental functions. On the negative side, heavy rainfall when river stage is high can lead to severe local flooding.

Much of Tamil Nadu, in contrast, lies in the rainshadow of the western Ghats and receives limited rainfall with the southwest monsoon. Rainfall also comes with the short, intense northeast monsoon, but in coastal areas this can be controlled to only a limited extent. Development has been longstanding and extensive and, besides river diversion schemes (e.g., serving delta areas) and dam storages constructed over the past century or so, includes innumerable small traditional tanks and diversion projects. Pressure for irrigation development has proved irresistible (Box 3.3) and, given increasing demands for municipal and industrial water, several of the state's river basins are already seriously in deficit. Irrigation intensities in many areas have declined, and, in extreme cases, previously irrigated areas are reverting to rainfed farming. These pressures can only become more acute as population increases and development intensifies.

The obvious complementarities between Kerala's surpluses and Tamil Nadu's deficits have been recognized at least since the last century when a scheme to transfer water across the Ghats from the Periyar River to the deficit Vaigai Basin was constructed. This transfer has sustained one of Tamil Nadu's most prosperous irrigated areas for more than a century. Another major interbasin transfer has been built since independence serving the PAP system through the Phalgat Gap. Smaller diversions include the Radapuram Canal at the tail of the Kodayer system in the far south. Proposals for further substantial transfers have been made by Tamil Nadu and by the Government of India in the context of the national perspective plan (Chapter 4) but have to date been strongly resisted by Kerala.

As far as is known, planning studies are inadequate to judge whether -- politics apart -- further diversion schemes are viable. However, several Tamil Nadu basins could readily absorb additional supplies in already developed areas, and there is a strong *prima facie* case for investigating opportunities in greater detail. If the Bank sponsored such studies, holding out the promise of substantial finance if schemes proved viable, then this might also provide the context for pursuing major institutional reform of the Tamil Nadu water sector; perhaps including the creation of autonomous basin operating entities serving irrigation, water supply and other utilities according to defined rights, allocations and operating rules. Advantages to Kerala are, of course, far less obvious. As a minimum, full account would need to be taken of environmental concerns, together with consideration of any hydrogeneration, flood protection and other benefits to Kerala. However, in themselves, it is very unlikely that these would be sufficient to overcome Kerala's past categorical opposition, and other innovative approaches would almost certainly be required. One possibility would be for Tamil Nadu to pay in some way for the resource, perhaps in terms of joint sharing of power benefits or, more radically, regular subventions. Such an arrangement would be unprecedented, and would require very careful evaluation. But, given Tamil Nadu's needs and Kerala's monetary resource constraints, a compromise, though extremely difficult, may prove possible if associated with appropriate Bank sponsorship and support.

The range of conditions, issues and sensitivities will vary enormously. As in the case of international basins, there are no doubt risks of rejection by concerned countries, and staff resource requirements could be substantial. The potential payoff, however, could also be considerable, and it appears that the Bank has a clear comparative advantage in seeking a more active role in this area.

MULTIPURPOSE AND SINGLE PURPOSE SECTOR PROJECTS

As discussed above activities in individual sectors (irrigation, inland fisheries, water supply and sanitation, hydrogeneration, navigation, etc.) need to be consistent with the overall country water resources strategy, and be conditional on satisfactory progress in meeting general water resource objectives. Within each sector, there may be opportunities for developing approaches comparable to those suggested above at the level of the resource. Emphasis again

should be on comprehensive analysis, and institutional strengthening and capacity building. It is beyond the scope of this report to suggest development programs for specific sectors, but options for lending might include: (i) Comprehensive support projects to strengthen an agency's institutional capacity; (ii) creation of public and private utilities; (iii) investment consolidation and rehabilitation programs; and (iv) O&M strengthening programs.

Comprehensive agency support projects would focus on capacity and performance as a whole (institutional, programing, and areas of work, etc.) rather than on implementation of individual projects. Such operations could be designed to strengthen the agency's performance within a water resources framework; clearly identify and clarify functional responsibilities, with due provision for functional specialization; and support activities to meet all of an agency's functional responsibilities formulated to balance priority needs in each area and across areas within an assured multi-year budget. The **principles of a utility form** could be introduced, either in a comprehensive agency program or in separate lending operations with this objective, and complemented by appropriate regulatory and related measures and organization.

Investment consolidation/rehabilitation and O&M strengthening programs would focus on important aspects of a particular sector and would be comparable to a number of recent operations in several sectors (for instance, in the irrigation sector). Investment priorities would be clearly established, with emphasis on completion of outstanding works. The recent proposals for provincewide water resources consolidation projects in India would fall into this category, and this approach could be extended to other countries and sectors. The aim would *inter alia* to create the necessary preconditions for sustainability, reliability of service, reasonable maintenance costs, service charge collection and ultimate turnover of appropriate facilities to beneficiaries. In each case, investment and/or O&M activities would be conditioned on sound facilities and appropriate policies and administrative arrangements.

In addition to such broad-based programs, there will continue to be important opportunities for more traditional multipurpose and single purpose investment projects. As in the case of other sector-specific activities, they could be placed within a multipurpose water resources context with flexibility to accommodate changing resource demands. Investment projects would in all cases need to be framed within national, regional and basin plans, and their priority established within the context of total sector investment programs. Bank involvement could be preconditioned on an adequate national water institutional framework and an appropriate basin water and land-use plan, or sequenced following a country or province water resource sector project as suggested above.

III. Strategy Implementation

Regional and Country-specific Strategies

Four major steps are recommended for implementing a strategy to address water resource issues in a more comprehensive manner and to prepare lending operations as suggested above. First, an internal regional concensus is required that such a strategy is necessary and feasible. If so, policies should be formulated to guide the CDs in preparing country-specific programs and internal organizational arrangements should be established to facilitate implementation. Second, within the framework of the regional strategy, the CDs should formulate country-specific water resources policies and strategies that integrate ongoing sector programs and provide a coordinated basis for discussions with concerned governments. Third, discussions should be held with governments at appropriate levels and in appropriate forms to agree on a coordinated approach to activities in the water resource sector as a whole and to identify an appropriate lending program and supporting studies and TA, both at the level of the resource and in relation to individual sectors. Fourth, in the light of an agreed country strategy, project preparation and other activities should be initiated by the country concerned. These, if appropriate, could include a full water resource assessment following agreed upon guidelines with support from the

Bank, UN and other sources. In the light of the outcome of country and/or basin-specific strategies, the Bank should stand ready to support identified lending and TA operations and, if necessary and requested by the governments concerned, take a lead in resource mobilization and donor coordination.

In many cases, this represents little more than a broadening of existing and planned CD activities; although in all cases it would ensure that critical cross-sectorial approaches are fully adopted. Besides helping initiate new proposals, ongoing activities will benefit from being placed within a broader water resources initiative; for instance, in terms of their priority and greater consistency of approach. Guidelines would be prepared to guide preparation of the documentation necessary for each of the subsequent stages. International waters issues, possible approaches, and Bank involvement, and the conditions under which it could be provided, would be discussed informally with the countries concerned. Subject to response from each of the riparians, the Region involved would prepare a strategy and program of activities specific to each basin concerned.

REGIONAL ORGANIZATIONAL ARRANGEMENTS

Subject to the review of this report, it is recommended that organizational measures be implemented to strengthen the Asia regions' capacities to undertake water resources activities in a coordinated manner. These should include measures to strengthen regional policy and coordination, establish country and river basin water resource committees, and initiate detailed divisional programming and budgeting to reflect the decisions taken.

Regional Policy and Coordination

This report comprises the outcome of Stage I of the Asia Water Resources Study (AWRS), and has attempted to define the key issues and propose a strategy for the Asia regions. Based on a review of this report, it is hoped that a formal water resources strategy for the regions will be adopted as proposed in this chapter. In the event that there is a concensus that this is both feasible and necessary, Stage II of the AWRS would comprise the totality of the follow-up activities. Its objective will, thus, be to evolve an internal consensus on water related issues, and the policies and strategies that the Regions should adopt, and, in close association with the countries concerned, formulate water sector strategies to guide subsequent country and Bank activities. The center for these activities within the Bank would therefore move from the Technical Department (TD) to the CDs, although, it is proposed that the TD should continue to have an important role in regional coordination and support.

The Asia TD should be strengthened to assist the CDs in: (i) Formulating policies and approaches to water resources issues; (ii) preparing individual country strategies; (iii) promoting cross-sectorial programs and projects; and (iv) initiating programs for shared international waters. TD responsibilities would also include: (i) Finalizing the documentation proposed above; (ii) furthering technical agreement on the scope and content of country and basin water resources assessments, if required, and preparing detailed guidelines for all levels of planning; and (iii) sponsoring implementation and/or completion of individual studies on water resource issues, for instance those leading to AWRS "topic" papers. Initially, the Water Resource Unit within Asia Technical Department, Environmentally Sustainable and Natural Resources division would no doubt continue to be responsible for these AWRS activities. The relationship of this unit to other units in the TD should, however, be reviewed to decide how coordination can best be maintained in the longer term. Among other steps, it is recommended that a standing committee on water resources be created in the TD as a forum *inter alia* for reviewing regional water resource policies and guidelines; becoming acquainted with water related programs and projects in the region; and discussing technical and other issues in the field.

Country Water Resource Committees (WRCs)

The CDs remain fully responsible for all country specific programming. But CD divisions are sector-specific and mechanisms are needed to ensure consistency in water resources among divisions operating in the same country. It is recognized that informal personal contacts and official peer review procedures already provide a degree of cross-sectorial interaction. However, informal contacts sometimes fall down (e.g., due to staff changes, and conflicting mission schedules) and peer review procedures tend to be one-off and organized at a late stage of project identification and formulation.

Informal country-based working groups have therefore been proposed, and in part established, as a flexible vehicle for achieving the objective of improved CD coordination. The essential aim is to create a mechanism for reviewing all water resources initiatives, especially at the stage of conceptualization and project formulation, to ensure consistency and avoid subsequent conflicting demands and problems. It is suggested that the WRCs should be required to identify priority cross-sectorial issues in the country or countries concerned and, if appropriate, recommend sector work activities to be carried out under its auspices. They would be an appropriate vehicle for mobilizing CD inputs in preparing country-specific strategies and for reviewing progress in the evolution of a strategy at each stage. Regular membership would be drawn from each of the divisions concerned, but attendance would depend on the particular activity or item under discussion, with the chairman calling meetings when required, on his own initiative or at the request of individual members. The working group for Indonesia has shown its utility over two years, sponsoring sector work and providing a useful forum for discussing upcoming projects and other activities without creating an excessive bureaucratic burden. Those for other CDs have been less active, in part because they have not received Country Assistance Management (CAM) allocations. Subject to any decision on a regional strategy, it is recommended that working groups should be activated for all CDs and that they should be provided with formal CAM resources.

International rivers that traverse countries in more than one CD, obviously call for special considerations. One option would be to establish separate informal working groups related to the river basin concerned (notably the Indus and Ganges). Alternatively, joint meetings could be called of the CD WRCs concerned. In the event that the Bank becomes active in the manner suggested above (Box 9.1), regular review of the lending activity itself could be undertaken within the framework of the country WRCs acting jointly as required.

Divisional Programming

Activities in water resources, as in all sectors, would be subject to normal Bank and regional staffing, budgeting, programming and review procedures. In the event that a lending or sector work activity is identified, a task manager would be appointed from one of the divisions concerned, and provisions would be made in divisional work plans and budgets. Any task manager would need to have particular regard for the intersectorial nature of the water resource activity, and it would be essential to draw members of the project team from each of the main concerned divisions.

Staffing Implications

The proposals made in this report have significant staffing implications in both the CDs and the TDs in terms of the numbers of staff involved in water resources issues and of the skill mix required. Subject to the outcome of the review of these proposals, it is recommended that the staffing position be reviewed and the necessary augmentation of staff be scheduled to handle the proposed strategy.

COUNTRY DISCUSSIONS

Management approval of the proposed regional water resources strategy and the WRC preparation of draft country strategies would be followed by discussions with selected borrowers. These discussions would have two primary objectives: First, to explain the aims and scope of the water resources strategy and obtain reactions in principle as to the country's interest in participating in joint water resource activities; and, second, to initiate a process of preparing country or basin strategies to define the basis for specific-lending operations or other activities.

It will be important to maintain a proper balance between, on the one hand, preserving the objectives of the water resources initiative and, on the other, obtaining the full participation and commitment of the borrower concerned. This balance will differ between countries and activities. Discussions should be held at two levels:

1. At the level of government that transcends individual sector agencies and interests (for instance, at the annual meetings or during high level country programming discussions) to obtain agreement in principle, that action is warranted. Besides briefing government on the nature of the initiative and the lending instruments envisaged, management would need to articulate a strong case for proposing action in the specific case.

2. At the level of sector agencies to help create a concensus in favor of such an initiative and to encourage participation by those responsible for implementing water resource programs. An initial approach could be made in the context of regular discussions with a Ministry of Water Resources or comparable lead agency. One option would be joint sponsorship of a intersectorial country seminar or workshop, based on documentation prepared in the context the AWRS, as well as by relevant local agencies.

Discussions at a high level of government could be emphasized where there are major inter-sectorial water resource issues. It would normally also be necessary in relation to international river basins where agreement at the highest levels will be required. Discussions at implementing agency level could be emphasized where it is judged necessary to create a domestic concensus before approaching the highest levels of government. Often both approaches could be pursued in parallel. Whatever approach is adopted, the aim would be to agree tentatively on possible lending operations or, in default of these, ESWP or TA activities.

The form of any follow-up discussions on international water issues need not be pre-judged in this context. However, if concensus was reached in the Bank on the conditionality that might be attached to Bank lending (e.g., for the LBOD in Pakistan to involve India, or for a major dam in the Himalayas to involve Bangladesh, [Box 9.1]) then it might be advisable informally to obtain the reactions of all the riparians concerned and to ensure that there is no subsequent ambiguity. This process that would clearly need very sensitive handling.

DOCUMENTATION FOR COUNTRY STRATEGIES

Formulating a detailed country-specific water resources sector strategy (WRSS) is necessarily an iterative process. Though based primarily in a country concensus, it must also be consistent with the objectives of the regional strategy. The documentation to be prepared for use in formalizing a WRSS will depend on the approach selected for the specific borrower. Only a draft document will be required to initiate preparation with the borrower if the strategy will be formulated through informal exchanges with the borrower agencies. The draft, prepared by the country WRWG, would present the problems and issues, the possible solutions and a proposed strategy of actions to address the problems in the order of urgency.

The draft WRSS would have two main objectives: To reflect internal Bank concensus; and to provide guidance to regional and CD management when approaching the government concerned. Its coverage could depend in part on the level at which the government is approached.

It would normally set out the Bank's rationale for proposing a water resources initiative; the preconditions under which it would proceed; major issues that should be addressed; and the scope and tentative content of a lending program. The final WRSS for the country would evolve through discussion and study using the draft as the base. Once agreement is reached on the proposed strategy, it would be finalized to guide formulation of any projects to be initiated and to reflect any other associated activities.

However, if the borrower wishes to undertake major investigations for refining the WRSS under a project, then the associated project must be prepared for consideration. If necessary, funding for the project could be provided under an ongoing lending activity; from the project preparation fund; or by the United Nations Development Programme or a bilateral donor agency. Its scope would define the TA component of the proposed institutional area; priority planning (national, regional, basin or project) and real-time management studies and assistance; and policy studies (economic or financial management). Agreement on these studies would be a normal element of the appraisal process.

In principle, these procedures are no different to those required for any lending operation. However, particular attention would be given to cross-sectorial issues and to ensuring that a coherent approach is followed with respect to all water resource related issues. Comparable documentation would be required for other lending operations that have been suggested above, but which are less broad based than a full country or provincial sector operation.

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Cover design by Walton Rosenquist

ISBN 0-8213-2527-2