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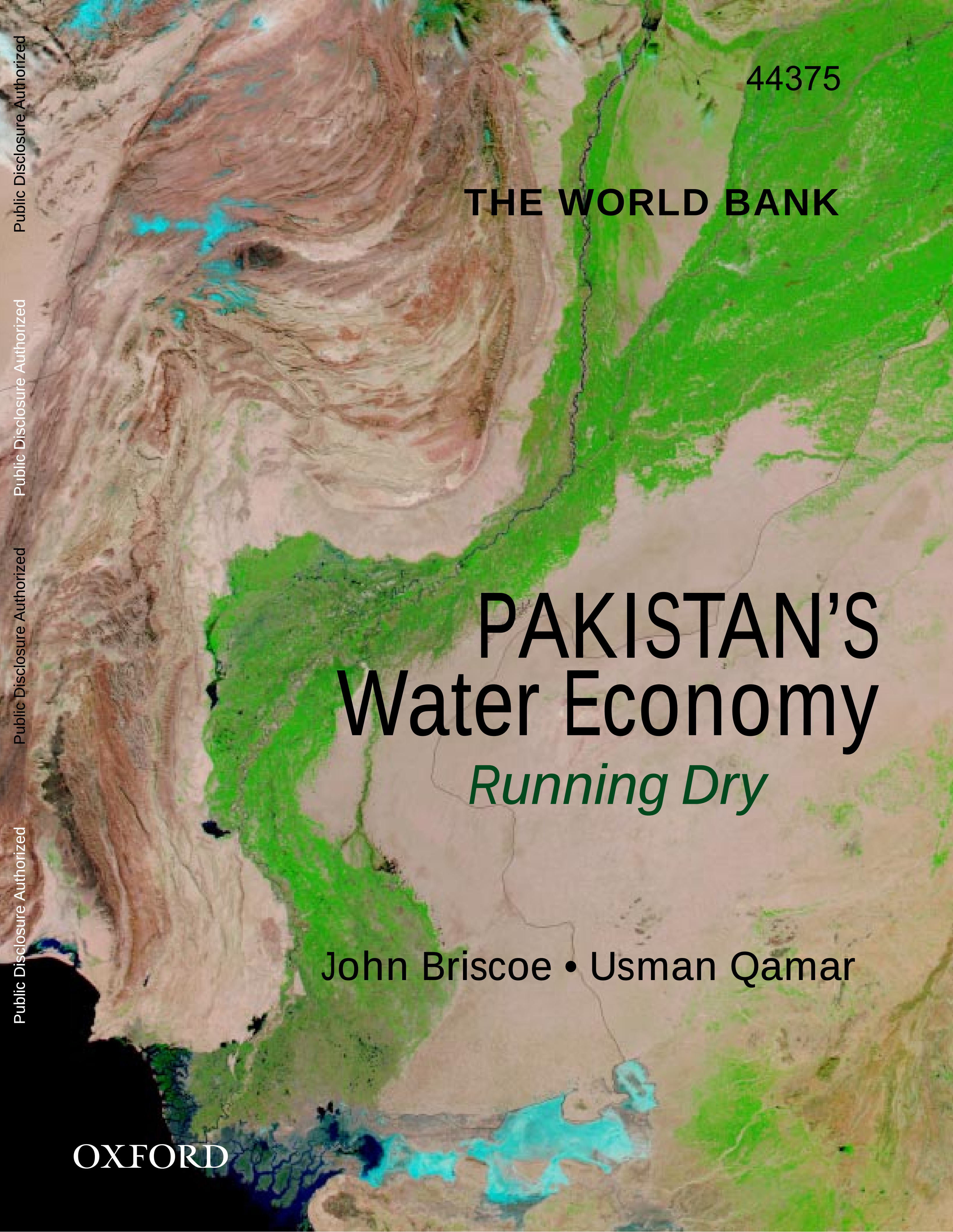

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THE WORLD BANK

PAKISTAN'S Water Economy

Running Dry

John Briscoe • Usman Qamar

OXFORD

Pakistan's Water Economy

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ABBREVIATIONS AND ACRONYMS

AJK	Azad Jammu and Kashmir
CAS	Country Assistance Strategy
COD	Chemical Oxygen Demand
DOs	Direct Outlets
FGW	Fresh Groundwater
FOs	Farmer Organizations
GDP	Gross Domestic Product
GoP	Government of Pakistan
HYV	High Yielding Varieties
IBDF	Indus Basin Development Fund
IBDP	Indus Basin Development Project
IBIS	Indus Basin Irrigation System
ICR	Implementation Completion Report
IPCC	Intergovernmental Panel on Climate Change
IRIS	Indus River System Authority
IWMI	International Water Management Institute
IWT	Indus Waters Treaty
KITE	Korangi Industrial and Trading Estate
KWSB	Karachi Water and Sewerage Board
LBOD	Left Bank Outfall Drain
LCC	Lower Chenab Canal
MAF	Million Acre Feet
MTIP	Medium Term Investment Plan
NDP	National Drainage Program
NWFP	North West Frontier Province
O&M	Operation and Maintenance
OED	Operations Evaluation Department
OFWM	On-Farm Water Management
OPP	Orangi Pilot Project
PARC	Pakistan Agriculture Research Council
PCR	Project Completion Report
PER	Public Expenditure Review
PID	Provincial Irrigation Department
PIDA	Punjab Irrigation and Drainage Authority
PIM	Participatory Irrigation Management
PMF	Probable Maximum Flood
PPAR	Project Performance Audit Report
SCARP	Salinity Control and Reclamation Project
SITE	Sindh Industrial Trading Estate
TDF	Tarbela Development Fund
TMA	Tehsil Municipal Administration
WAPDA	Water and Power Development Authority
WSS	Water Supply and Sanitation
WUA	Water Users' Associations

PREFACE

This Report is the product of eighteen months of intensive work by The World Bank staff and an eminent group of Pakistani and foreign consultants. The Bank team consisted of John Briscoe and Usman Qamar (World Bank Task Team Leaders), Manuel Contijoch (World Bank); Don Blackmore (former Chief Executive, Murray-Darling Commission), and Pervaiz Amir. The Report benefited greatly from formal reviews and comments by external reviewers (David Seckler, Richard Reidinger, Chris Perry, Saeed Rana, Shams-ul-Mulk, Frank van Steenbergen, Karin Astrid Siegman, Asif Kazi, Khalid Mohtadullah, Bert Smedema, Shamshad Gohar, Shahida Jamil, and M.N. Bhutta), and World Bank staff (Keith Pitman, Masood Ahmad, Abid Hasan, Shahzad Sharjeel, Dale Lautenbach, Vlado Vucetic, Adolfo Brizzi, Xiaokai Li, and Alain Locussol). John W. Wall, the Bank's Country Director for Pakistan, provided unstinting support in developing and disseminating the Report and ensuring that it resulted in practical actions by both the government and The World Bank.

The Report benefited enormously from the encouragement, guidance, and knowledge of senior officials of the Government of Pakistan (specifically from Ministry of Water and Power, Planning Commission, Economic Affairs Division, the provinces, and WAPDA).

The Report was reviewed in detail by The World Bank management, and the revised version endorsed by it. A final round of consultations was held in September 2005 with the multi-stakeholder group, including those who had advised during the early stages of this work. The release of the Report attracted extensive and high-level attention in Pakistan. Details can be found on www.worldbank/pakistan.

As usual, not all reviewers agreed with all that is written in the Report (nor did the authors agree with all that was suggested by the reviewers!). The product is entirely the responsibility of the authors and should not be attributed to the reviewers. The World Bank would like to acknowledge Oxford University Press India's help in editing the Report.

The financial support provided by Royal Netherlands Government for the preparation and printing of this Report through Bank-Netherlands Water Partnership Program and Bank-Netherlands Water Support Program for Pakistan is gratefully acknowledged.

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OVERVIEW AND EXECUTIVE SUMMARY

Pakistan is one of the world's most arid countries, with an average rainfall of under 240 mm a year. The population and the economy are heavily dependent on an annual influx into the Indus river system (including the Indus, Jhelum, Chenab, Ravi, Beas, and Sutlej rivers) of about 180 billion cubic meters of water, that emanates from the neighboring countries and is mostly derived from snow-melt in the Himalayas. Throughout history, people have adapted to the low and poorly distributed rainfall by either living along river banks or by careful husbanding and management of local water resources. One of the greatest of human civilizations—the Indus Valley Civilization (Harappa and Mohenjodaro)—flourished along the banks of the Indus.

This precarious, low-level balance between man and water was decisively shifted with the advent of large-scale irrigation technology in the nineteenth century. The Indus irrigation system became the largest contiguous irrigation system in the world. As shown in fig. 1, the desert literally bloomed, with irrigated agriculture providing the platform for the development of the modern economy of Pakistan. This hydraulic economy has faced and surmounted three massive challenges in the last half century.

The first challenge arose because the lines of partition of the Indo-Pak subcontinent severed the irrigated heartland of Punjab from the life-giving waters of the Ravi, Beas, and Sutlej rivers. In an unprecedented triumph of water diplomacy, Pakistani engineers, together with their Indian counterparts and The World Bank, negotiated the Indus Waters Treaty, giving Pakistan rights in perpetuity to the waters of the Indus, Jhelum, and Chenab rivers, which comprise 75 percent of the flow of the whole Indus system.

The second challenge was that there was now a mismatch between the location of Pakistan's water (in the western rivers) and the major irrigated area in the east. Again Pakistan's water engineers were up to the task, building the world's largest earth-fill dam, the Tarbela on the Indus, and link canals, which ran for hundreds of miles and carried flows ten times the flow of the river Thames (fig. 2). To a considerable degree (but not completely) the 'heroic stage' of water engineering in Pakistan was now over—the major challenges were now those of management. This is the case in all countries (fig. 3). But in the case of Pakistan, however, the 'heroic' era had involved particularly blunt affronts to the living organism that the river represents. The natural flow regime was dramatically altered: rivers which had previously meandered over wide plains were now confined within narrow channels; sediments which had previously nourished the

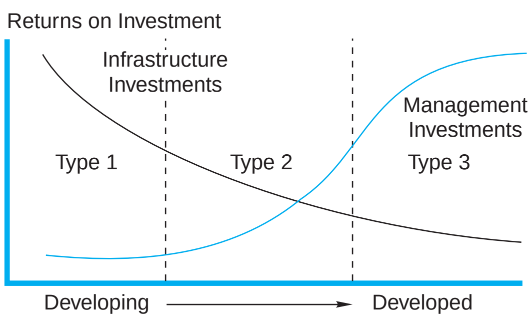
Fig. 1: Pakistan from space

Source: NASA, www.visibleearth.nasa.gov.

Fig. 2: The Indus Waters Treaty (1960)

Source: The World Bank.

Fig. 3: Rates of return on investment on infrastructure and management of water resources



Source: The World Bank, 2003.

delta were trapped; and vast quantities of water were disgorged onto deserts, substantial parts of which were of oceanic origin and highly saline. It was this last reality which gave rise to the third major challenge facing Pakistan shortly after Independence. Hundreds of billions of cubic meters of water were now stored in the naturally deep aquifers of Punjab alone. In many areas water tables had reached the level of the land, giving rise to the twin curse of waterlogging and salinity.

In the early 1960s it appeared that Pakistan was doomed, ironically, to a watery, salty grave.

With equal doses of good thinking, good planning, and good luck, this problem is now not beaten (nor will it ever be) but controlled and managed, to a degree that no one foresaw fifty years ago. The good thinking was the application of water science and economics by many of Pakistan's best and brightest in conjunction with many of the best water minds in the world. The 'solution' was not the obvious one of lining canals and putting less water on the land but of increasing the use of groundwater, thus both increasing evapotranspiration, drawing down the groundwater table and leaching much of the salts down and out of the root zone. The good thinking and good planning were classic 'public goods'. The 'good luck' driver of this revolution was the modest but transforming tubewell and diesel engine, bought and managed by millions of farmers for the simple reason that this decentralized 'on-demand' source of water enabled them to greatly increase their crop yields and incomes.

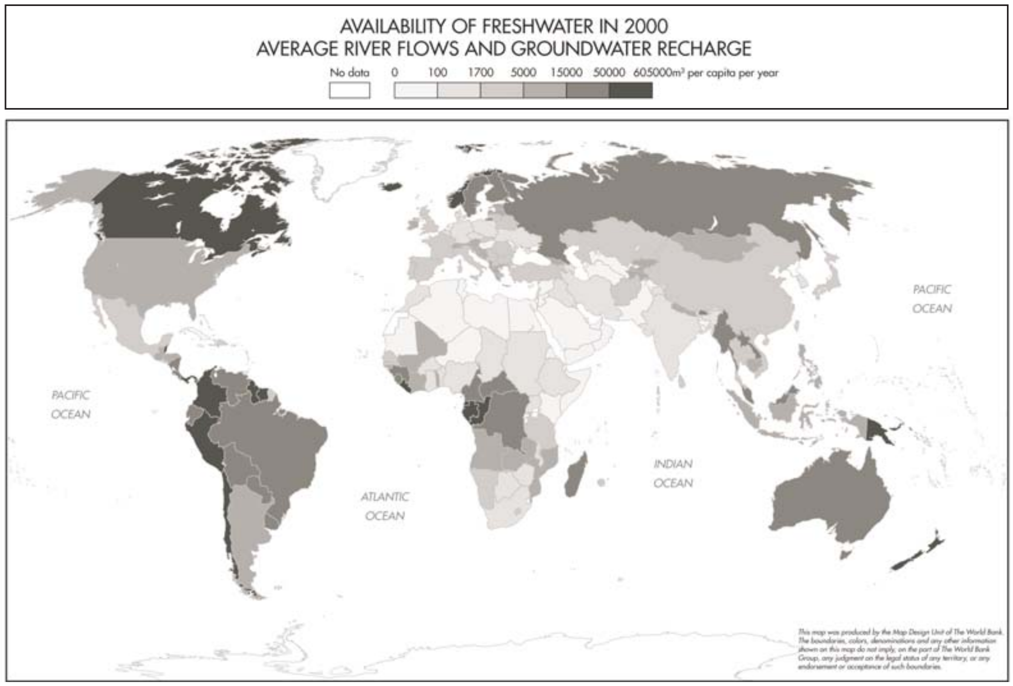
So the modern history of water development and management in Pakistan is one in which the glass can be seen as more than half full. But, as this Report will show, the glass can also be viewed as much more than half empty too. Once again, the survival of a modern and growing Pakistan is threatened by water.

The facts are stark.

Sobering Fact #1: *Water Stress.* Pakistan is already one of the most water-stressed countries in the world (fig. 4), a situation which is going to degrade into outright water scarcity (fig. 5) due to high population growth.

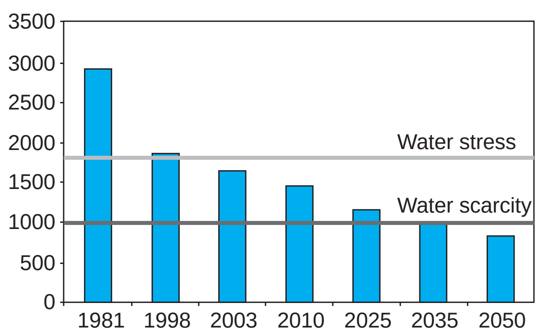
Sobering Fact #2: *There is no additional water to be injected into the system.* There is no feasible intervention which would enable Pakistan to mobilize appreciably more water than it now uses. Arguably, as shown graphically in fig. 6, overall use for irrigation needs to decline so that there are adequate flows into the degrading delta.

Fig. 4: World's most water-stressed countries



Source: www.UNEP.org.

Fig. 5: Declining per capita availability of water in Pakistan (cubic meters per capita per year)

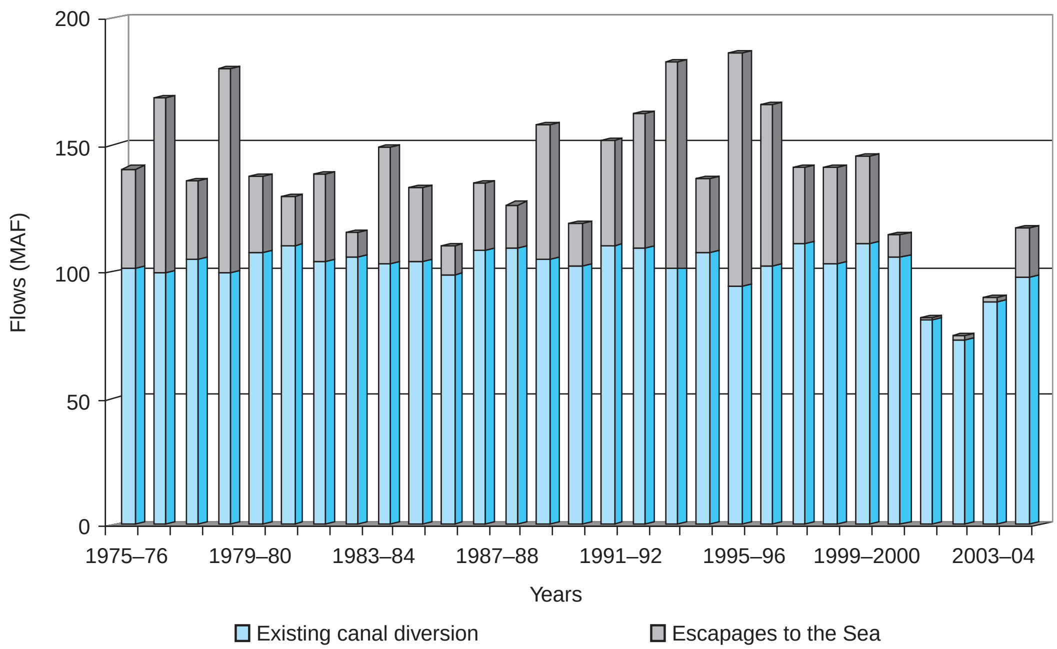


Source: Amir, 2005.

Sobering Fact #3: *A high risk water environment.* Pakistan's dependence on a single river system means it has little of the robustness that most countries enjoy by virtue of having a multiplicity of river basins and diversity of water resources. While India (for example) might be able to muddle through because it has many rivers and if something goes wrong in one place the effect is cushioned by opportunities in other places, this is a luxury which Pakistan does not have. If the water/sediment/salt system of the Indus Basin goes badly wrong, then it may prove disastrous. Hence, there is no latitude for error.

Sobering Fact #4: *Large-scale degradation of the resource base.* There is abundant evidence of wide-scale degradation of the natural resource base on which the people of Pakistan depend. Salinity remains a major problem, with some aspects partially controlled but others—including the fate of the approximately 15 million tons of salt which are accumulating in the Indus Basin every year, and the ingress of saline water into over-pumped freshwater aquifers—remain only dimly understood threats. And the delta, deprived of the water and

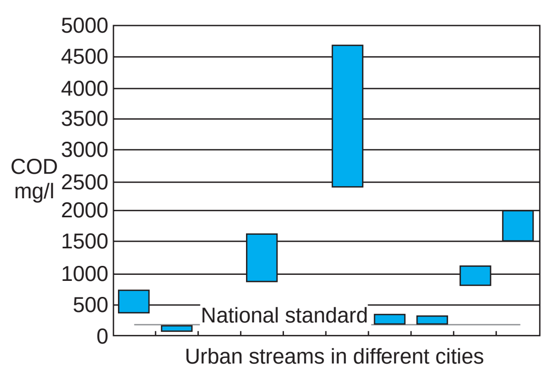
Fig. 6: Annual canal diversions and 'escapages to the sea'



Source: The World Bank, 2003.

silt which built and sustained it, is degrading rapidly, with large human and environmental consequences. Simultaneously, there is large-scale uncontrolled pollution of surface water and groundwater from the increasing quantities of pesticides and fertilizers used in agriculture and by rapidly growing cities and industries. Major cities have inadequate sewage treatment plants. Many are either nonfunctional or working poorly. And there is only one industrial common effluent treatment plant working in the whole of the country. The result, as illustrated in fig. 7, is the presence of heavily degraded surface water around all cities and towns.

Fig. 7: The quality (Chemical Oxygen Demand) of urban streams



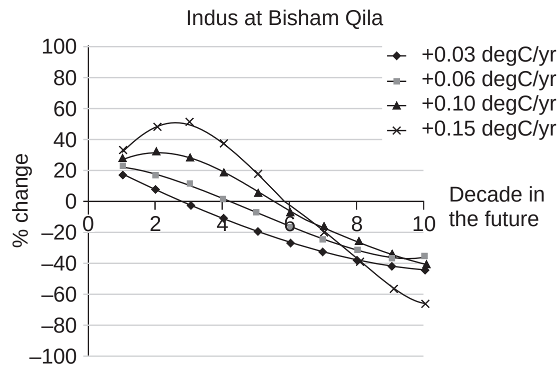
Source: Zakaria, 2005.

Sobering Fact #5: *Groundwater is now being overexploited in many areas, and its quality is deteriorating*. Over the past forty years, the exploitation of groundwater, mostly by private farmers, has brought enormous economic and environmental benefits. A laissez-faire approach could be appropriate during this era. Groundwater now accounts for almost half of all irrigation requirements. Now, although, there is clear evidence that groundwater is being over-exploited, yet tens of thousands of additional wells are being put into service every year. In the *barani* (rainfed) areas of Balochistan, farmers are pumping from depths of hundreds of meters and in the sweet water areas of the Indus Basin, depletion is now a fact in all canal commands. Furthermore, there are serious and growing problems with groundwater quality, a reality that is likely to get worse because there are 20 million tonnes of salt accumulating in the system every year. Pakistan has thus entered an era in which laissez-faire becomes an enemy rather than a friend. There is an urgent need to develop policies and approaches for bringing water withdrawals into balance with recharge, a difficult process which is going to require action by government and by informed and organized users. Since much groundwater recharge in the Indus Basin is from canals, this requires an integrated approach to surface water and groundwater. There is little evidence that government (or donors, including The World Bank) have re-engineered their capacity and funding to deal with this great challenge. And here delay is fatal, because the longer it takes to develop such actions, the greater would become the depth of the groundwater table, and the higher would be the costs of the 'equilibrium' solution.

Sobering Fact #6: *Flooding and drainage problems are going to get worse, especially in the lower Indus Basin.* The natural state of heavily-silt-laden rivers (like the Indus) is to meander. This is because as silt-builds up in their beds, the rivers seek lower lands and change their courses. This creates havoc with human settlements and so, throughout the world, such rivers have been trained and confined by embankments within relatively narrow beds. But as with everything watery, solving one problem gives rise to another. In this case, the bed keeps getting higher and higher, and soon the river is, as in the lower parts of Sindh, above the level of the land. (To some degree the trapping of silt in upstream reservoirs alleviates this particular environmental hazard.) Over time, the likelihood of embankment breaching increases, as do the problems of drainage from flooded lands. When this coincides with unfavorable tidal conditions, the consequences can be disastrous.

Sobering Fact #7: *Climate change*. The Indus Basin depends heavily on the glaciers of the western Himalayas which act as a reservoir, capturing snow and rain, holding the water and releasing it into the rivers which feed the plain. It is now clear that climate change is already affecting these western glaciers in a dramatic fashion (far more seriously, for example, than in the damper eastern Himalayas). While the science is still in its infancy, best estimates (fig. 8) are that there will be fifty years of glacial retreat, during which time river flows will increase. This—especially in combination with the predicted flashier rainfall—is likely to exacerbate the already serious problems of flooding and draining, especially in the lower parts of the basin, in the next few decades. But then the glacial reservoirs will be empty, and there are likely to be dramatic decreases in river flows—as shown in fig. 8, conceivably by a terrifying 30 percent to 40 percent in the Indus Basin in one hundred years time.

Fig. 8: Predicted changes in Indus flows just above Tarbela



Source: Rees, 2005.

Sobering Fact #8: *An inadequate knowledge base*. The Indus Basin is a single, massive, highly complex interconnected ecosystem, upon which man has left a huge footprint. When a dam or barrage is constructed the water and sediment cycles are changed dramatically. When water is diverted onto deserts, the water and salt balances seek new equilibriums. In a system so massive and complex, the generation and smart use of knowledge are the keys to adaptive management. But there has been very little investment in Pakistan in building this knowledge base and the accompanying institutional and human systems. The past twenty years should have been ones of massive investment in knowledge about this ecosystem. But the reverse has happened, and even the once-renowned Pakistan water planning capability has fallen into disrepair. The country is literally flying blind into a very hazardous future.

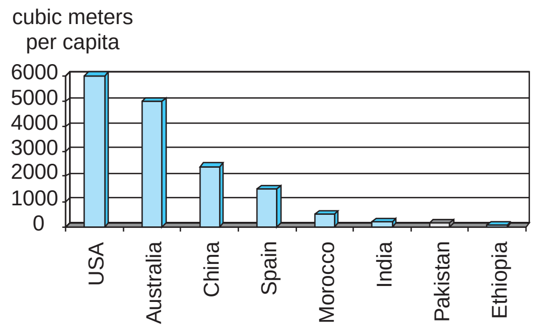
Sobering Fact #9: *Much of the water infrastructure is in poor repair*. Pakistan is extraordinarily dependent on its water infrastructure, and it has invested in it massively. Due to a combination of age and what has aptly been called the 'Build/ Neglect/Rebuild' philosophy of public works, much of the infrastructure is crumbling. This is true even for some of the major barrages, which serve millions of hectares and where failure would be catastrophic. There is no modern Asset Management Plan for any of the major infrastructure.

Sobering Fact #10: *The quality of project implementation is poor*. Pakistan is justifiably proud of its outstanding achievement in building the Indus Basin Replacement Works. In the intervening years, the quality of project implementation has declined substantially. Today, implementation of water sector projects in Pakistan is characterized by inefficiencies, completion delays, and time and cost overruns. Factors that affect implementation include: weak implementation planning and management, litigation related to land acquisition, non-compliance with agreed resettlement and rehabilitation programs, lack of attention to environmental issues, delays in procurement, delays in preparation of accounts and carrying out audits, and lack of preparation for transition from construction to operation.

Sobering Fact #11: *The system is not financially sustainable*. There are three basic questions relevant to the financing of infrastructure—who pays? how much is paid? and how is the money used? In terms of 'who pays', there are many reasons why a substantial portion of the costs of public works which provide individual services (such as irrigation water) should be paid for by those who get the service. But in Pakistan users of canal water pay a very small part of the bill, which is basically paid by the taxpayer. In terms of 'how much is paid', the answer is: much less than the presently configured institutions require for rehabilitation and maintenance of the assets and for operations. The result is that most infrastructure is in poor repair. In terms of 'how is the money used' the answer is that first call is for payment of heavily overstaffed bureaucracies, whose productivity is low and whose appetite leaves insufficient funds for system maintenance and operation. This reality gives rise to a vicious circle, in which users are not willing to pay for poor and unaccountable services, which means that insufficient funds are available for operations and maintenance, which results in the decline of service quality and whereupon users are even less willing to pay, and so on.

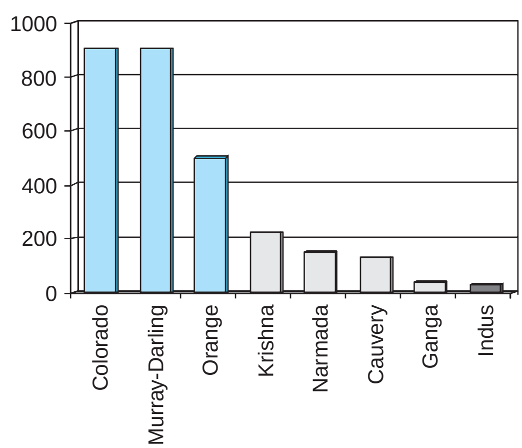
Sobering Fact #12: *Pakistan has to invest, and invest soon, in costly and contentious new large dams*. When river flow is variable, then storage is required so that the supply of water can more closely match water demands. Relative to other arid countries, Pakistan has very little water storage capacity. Figure 9 shows that whereas the United States and Australia have over 5000 cubic meters of storage capacity per inhabitant, and China has 2200 cubic meters, Pakistan has only 150 cubic meters of storage capacity per capita. And fig. 10 shows the storage capacity available in some of the major arid basins in the world. The dams of the Colorado and Murray-Darling rivers can hold 900 days of river runoff. South Africa can store 500 days in its Orange river, and India between 120 and 220 days in its major peninsular rivers. By contrast, Pakistan

Fig. 9: Storage per capita in different semi-arid countries



Source: The World Bank analysis of ICOLD data.

Fig. 10: Days of average flow which reservoirs in semi-arid countries can store in different basins



Source: The World Bank analysis of ICOLD and GDRC data.

can barely store 30 days of water in the Indus Basin.

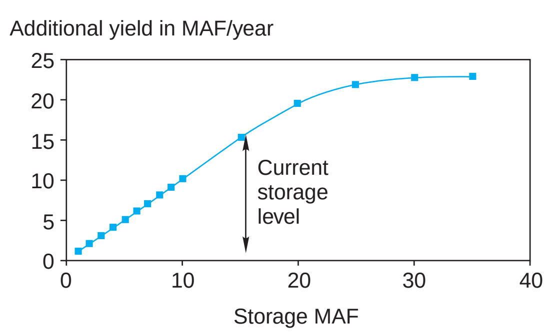
As shown in fig. 11, each million acre feet (MAF) of storage capacity lost means one MAF/year less water that can be supplied with a given level of reliability. And, as shown in fig. 12, there is an urgent need for storage just to replace the capacity that has (as predicted) been lost to sedimentation. Given the high silt loads from the young Himalayas, Pakistan's two large reservoirs are (as predicted at design) silting relatively rapidly.

Sobering Fact #13: *Poor governance and low trust.* Conceptually the simplest task for water managers in the Indus Basin is to move water in a predictable, timely manner to those who need it and have a right to it. Pakistan has among the best water engineers in the world. And yet this task is done less and less satisfactorily, less in the light of day and more behind an opaque curtain in which, as always, monopoly + discretion – accountability = corruption. The result is inequitable distribution of water, poor technical performance, and a pervasive environment of mistrust and conflict from the provincial level to the water course. The water bureaucracy has yet to make the vital mental transition (depicted in fig. 3) from builder to manager.

Sobering Fact #14: *Water productivity is low*. Large parts of Pakistan have good soils, abundant sunshine, and excellent farmers. And yet crop yields, both per hectare and per cubic meter of water, are much lower than international benchmarks, and much lower even than in neighboring areas of India (fig. 13). The quality of water service plays an important role in this: yields from reliable, self-provided groundwater are twice those of unreliable and inflexible canal supplies.

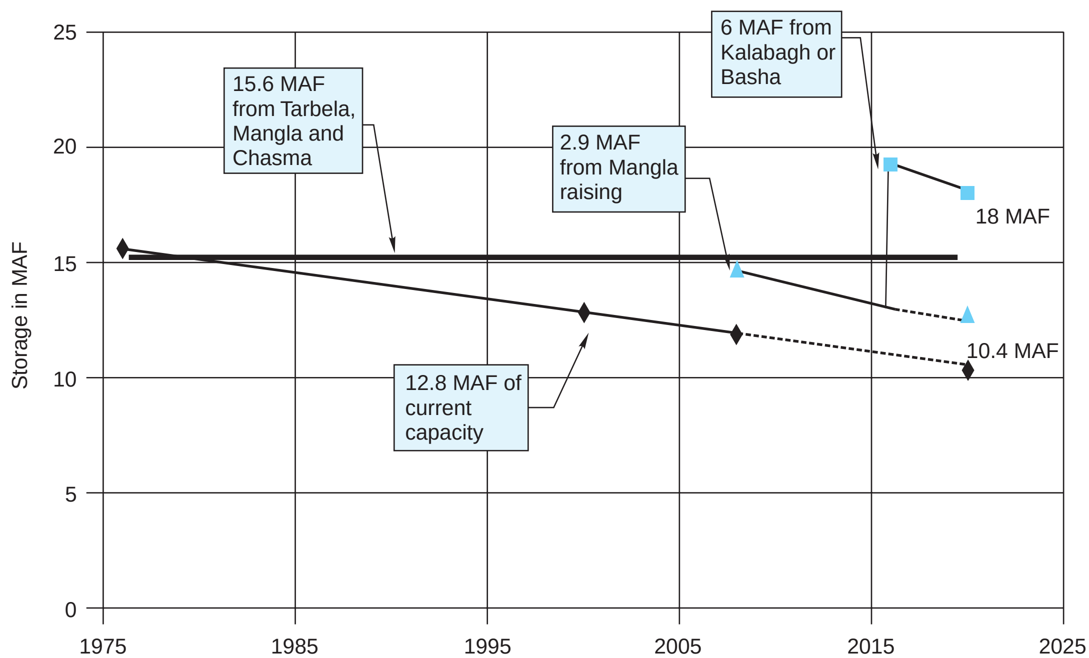
In water matters, the cup is always half empty, but it is also half, or, in the case of Pakistan, at least a quarter, full. In confronting these awesome challenges, Pakistan has considerable strengths, too.

Fig. 11: Storage-additional yield curve for the Indus



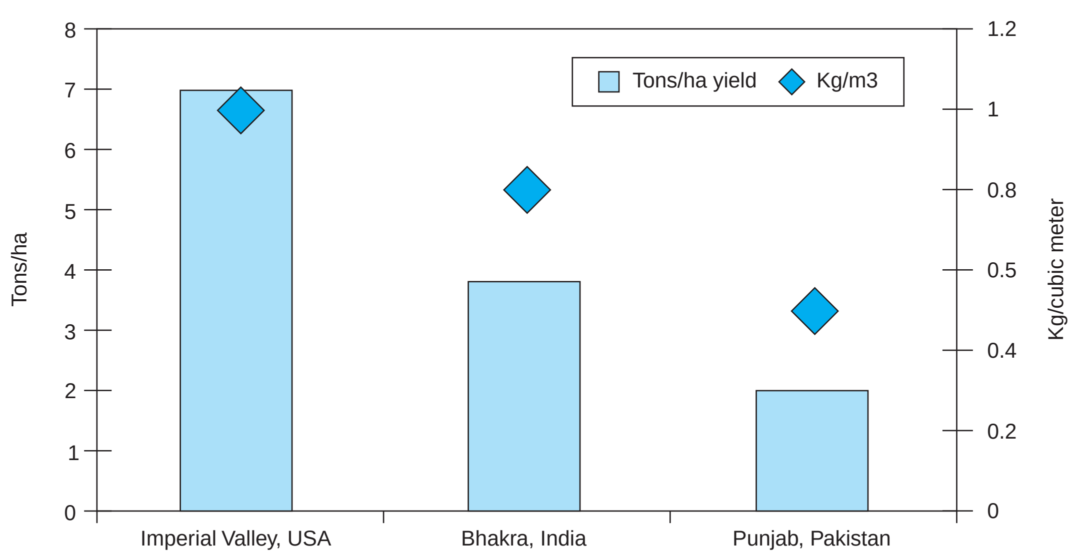
Source: Lieftinck, 1968.

Fig. 12: Sedimentation and storage capacity



Source: The World Bank, 2003.

Fig. 13: Wheat yields per unit of land and water



Source: Ahmad, 2005.

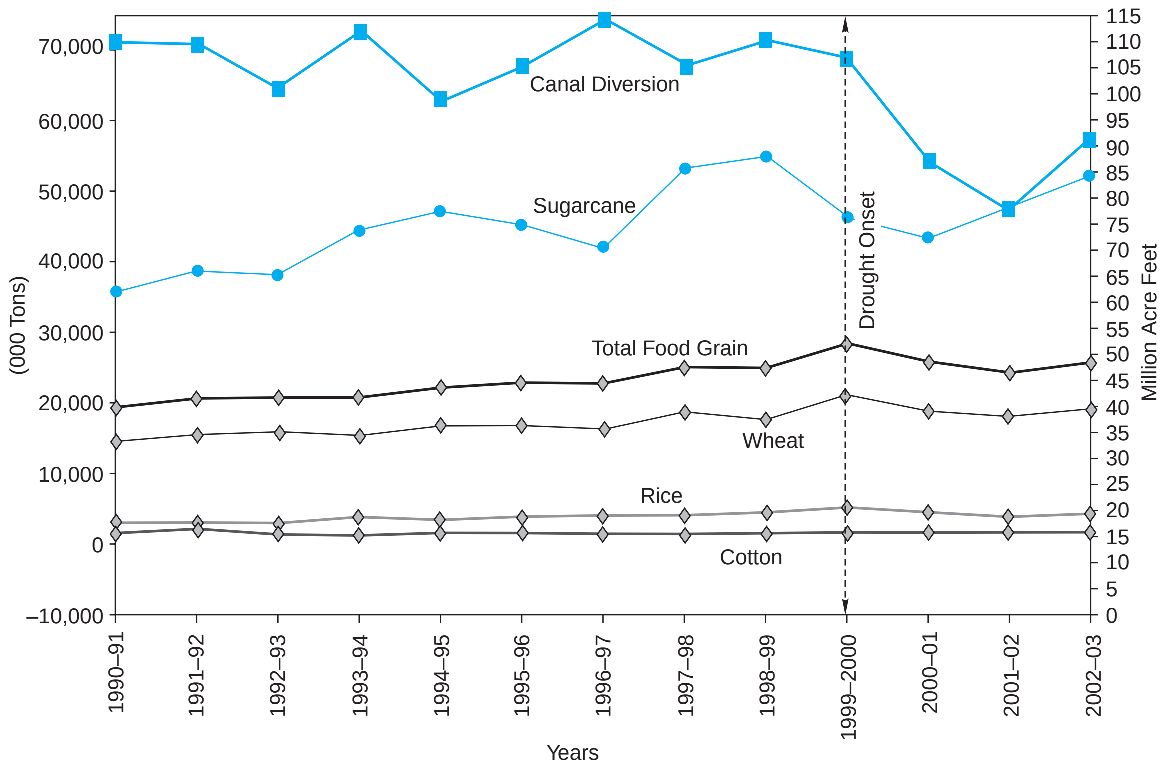
Hopeful Fact #1: *A well-established tradition and system of water entitlements*. Pakistan has an unusually long and well-established tradition of water entitlements. At the international level, Pakistan's rights to water from the Indus Basin system are unambiguously defined in the Indus Waters Treaty. The 1991 Water Accord is a major achievement, which establishes clear entitlements for each province to surface water. Implicit in the Water Accord, too, is a set of water entitlements at the canal command level (established on the basis of historic use). In large areas of the system, these entitlements serve as the basis for allocation of water among canal commands. There are also well-established rules for further distributing water to the distributary and outlet levels. Below the outlets, the *warabandi* is a proxy (appropriate in its era) to a water right, in which a farmer has a right to time, a surrogate for water. The existence of such well-established entitlements means that Pakistan can now focus on: putting in place a similar system for the surface systems that do not currently have such established entitlements; extending the entitlement system to cover any new water that might be mobilized; formalizing entitlements for environmental flows (including to the delta); and moving towards a similar definition of entitlements for groundwater, and, above all, administering this system in a more transparent, participatory manner.

Hopeful Fact #2: *Pakistan has largely avoided the trap of subsidizing electricity for groundwater pumping*. One of the obvious ways governments around the world address the problem of agricultural distress is to subsidize inputs. In many countries, electricity for irrigation pumping is heavily subsidized. This policy greatly exacerbates the underlying problem, which is making sure that groundwater pumping does not exceed recharge, and that the water table is not too deep. To date, this policy has been followed only in Balochistan, with disastrous effects both on the water table and on the financial state of the utility, and for pumping from public wells in Sindh. At present, the political pressure for 'free power' has been muted because the water table is shallow and most pumps are diesel-powered. The federal and provincial governments should be applauded for their stance to date, and should continue to strongly resist pressures to move towards free power for irrigation in the future.

Hopeful Fact #3: *There is much scope for increasing water productivity*. The flip side of current low water productivity is that Pakistan can get much more product—crop, jobs, and income—per drop of water. As shown in fig. 14, reduced water supplies in the irrigated areas have little detrimental impact on production (at least in the short run), in part because groundwater is available to make up the difference in the short run, in part because waterlogging and salinity are reduced, and in part because limited water supplies are used more carefully when there are shortages. But the bottom line is that this shows that it is quite possible to substantially increase production with existing supplies of water. A second, very important, factor is the emergence of a new class of progressive farmers, who are shifting to high-value crops (which produce far more income and jobs per unit of water), introducing new crops and agricultural technologies, and putting unprecedented pressures on the irrigation departments to become more accountable and efficient.

Hopeful Fact #4: *High returns from previous major water infrastructure*. Pakistan benefited immensely from the major water infrastructure built in the Indus Basin. As shown in fig. 15, the benefits from Tarbela substantially exceeded those which were predicted at the time of construction. Through forward and backward linkages in the economy, the total benefits were probably about twice those of the direct power and irrigation benefits. It is also certain that, as has been shown for the Bhakra project in Indian Punjab (fig. 15), it was the poor

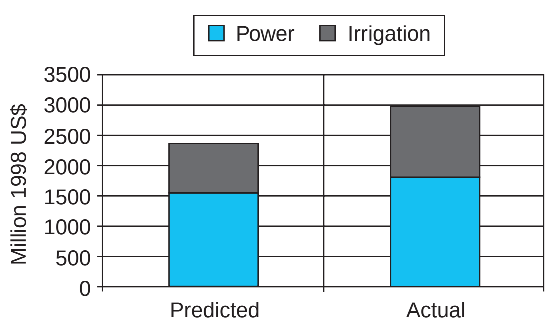
Fig. 14: Crop production and drought



Source: The World Bank, 2003.

who, through the operation of labor markets, were probably the greatest beneficiaries of these investments. It is important to note that although much of the discussion of such projects is in terms of agriculture, in fact it is the power benefits which are often greatest (fig. 15). And here, too, as shown in fig. 17, Pakistan lags behind its neighbors—86 percent of the 50,000 MW of Pakistan's economically viable hydropower potential has yet to be developed.

Fig. 15: Benefits from Tarbela (1975–98)



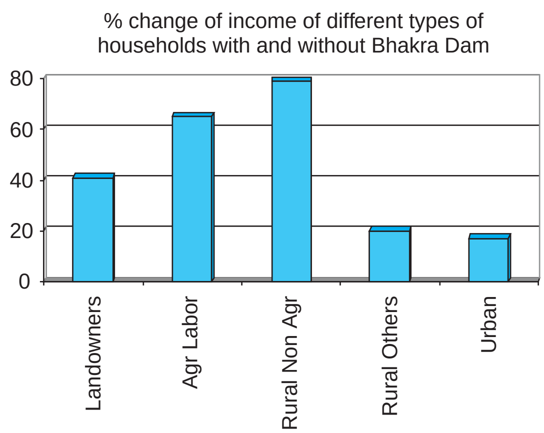
Source: WCD, 2000.

Hopeful Fact #5: *Pakistan has overcome major water challenges in the past.* Pakistan has a remarkable history of successfully confronting major water challenges. It has enormous human capacity to confront this next round of challenges, which can be pooled in four major categories.

> Challenge 1 is to develop a world-class knowledge-based capacity for adaptive resource management and service delivery.

The sustainable management of a huge, inter-linked, and very complex natural resource base is probably the

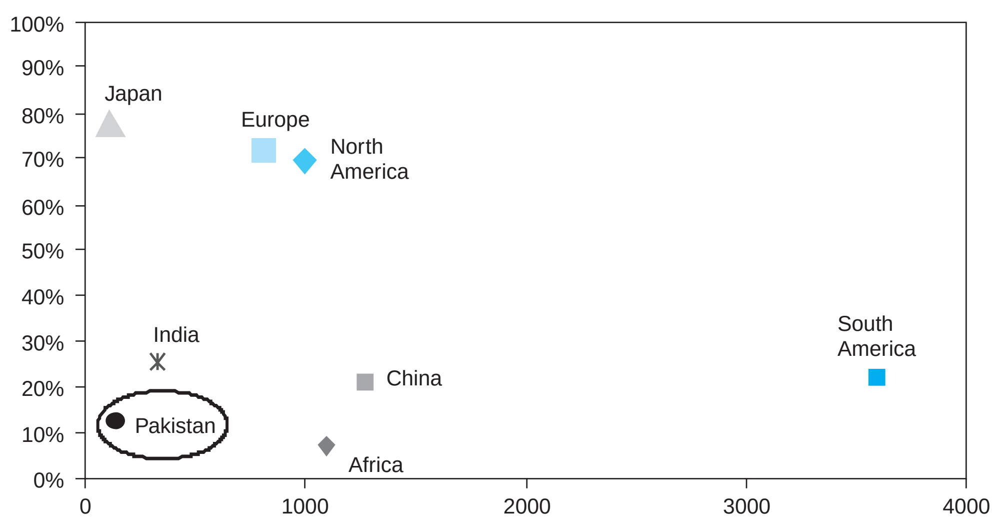
Fig. 16: The effect of Bhakra Dam on different social groups



Source: Bhatia, 2005.

single most challenging long-term task for Pakistan and requires the development of world-class capacity in three related areas. First are the natural sciences. Adaptive management of the Indus Basin system requires high levels of knowledge and understanding of a series of linked basic natural processes, the more important of which include: the behavior of the glaciers as climate change proceeds; the fate of the large amounts of salt being mobilized; the qualitative and quantitative dimensions of the aquifer systems in the Indus Basin and in the other parts of the country; the evolution and behavior of the ecosystems of the delta; and the impact of changed sediment loads on river morphology. Second are the engineering sciences. The plumbing for the world's largest contiguous irrigation system has underpinned much of Pakistan's development. Pakistan has long been a world leader in hydraulic engineering, and it is going to have to renew this capacity so that a new generation can maintain and modernize the water transmission and distribution systems. The third leg of the intellectual stool are the social sciences. Because at the end of the day government is going to have to design institutions and instruments, which will ensure that the actions of the millions of people who live in and off of the natural and engineered water systems are in consonance with the require-ments of those systems. Pakistan, accordingly, needs to build a strong, natural, engineering and social scientific

Fig. 17: The development of economically feasible hydropower potential in Pakistan in international context



Source: The World Bank, 2003.

cadre capable of working with all users in defining the problem, developing solutions, monitoring, assessing, and adjusting. This is a capacity which requires a wide range of disciplines—those necessary for understanding climate, river geomorphology, hydraulic structures, surface water and groundwater hydrology, limnology, water chemistry, sediment management, hydraulics, soil sciences, terrestrial and coastal ecosystems, agronomy, plant physiology, industrial organization, conflict management, politics, economics, and financing. In the past Pakistan has relied heavily on outside knowledge, especially in sciences. Now Pakistan needs to develop its indigenous capacity and make a major push to establish and nurture a new set of institutions that will provide the scientific, technical, and policy support for the management of increasingly scarce water. Experience in other countries shows that if this is not done there will be serious economic, social, and environmental consequences.

The water economy of Pakistan depends fundamentally on a gigantic and complex hydraulic infrastructure system. There are now a set of related challenges which have to be addressed—how to maintain what has been built, what major new system-wide infrastructure needs to be built, what infrastructure needs to be built for populations who have not been served and for environmental protection, and how to build institutions that will manage the resource effectively in the looming era of scarcity. First is rehabilitation and maintenance. Many elements of the vast hydraulic system are now reaching the end of their design lives, and have to be rebuilt. There is an enormous backlog of deferred maintenance. Most recent irrigation and water supply 'investments' from donors, including the World Bank, have been for the rehabilitation of poorly maintained systems. There is no systematic Asset Management Plan at either the federal or provincial levels which describes the condition of the assets, the requirements for replacement, rehabilitation (or retirement) and operations and maintenance and the associated costs, and the proposals for financing of these costs. Development of such plans is a high priority.

Challenge 2 is a financially feasible approach to maintaining and modernizing existing infrastructure and building needed new water infrastructure.

Second is the urgent need for construction of major new storage on the Indus. There is probably no more contentious an issue in Pakistan today. In part, this is for legitimate and necessary reasons (such as the resettlement of substantial numbers of people), partially for legitimate but resolvable reasons (lack of transparency about how this would affect the actual allocation of waters among the provinces and to the delta), and partially the discussion of dams has become a vehicle for a host of remotely or unrelated political grievances. A curiosity is that the most vehement opposition to new dams comes from Sindh, when in fact it is the downstream riparian who is typically the greatest beneficiary of the enhanced regulation which comes with new storage. (For this reason, in other countries lower riparians will often pay for upstream storage.) The requirements for government are obvious—there needs to be a totally transparent and verifiable implementation of the 1991 Water Accord, and reasonable quantities of water need to be guaranteed and delivered to the delta (as was discussed as part of the Indus Treaty negotiations). Equally important is a well-designed plan for paying for the costs of this storage, with the very large hydropower potential offering possibilities for raising substantial amounts of private financing.

Third, there is requirement for large investments in meeting the needs of those who do not have water and sanitation services in cities, towns, and villages.

Fourth, Pakistan has been accumulating an 'environmental debt' by not investing in municipal and industrial wastewater. It is clear that this has to change, and that it is going to take huge investment.

Fifth and finally, Pakistan has to walk on two legs—investing simultaneously in infrastructure, and in developing the institutions required for the sustainable management of increasingly scarce water.

The resource requirements for all of these priorities are very large. Government faces three essential tasks. First, to set priorities for the short and medium term. Second, to define the principles which will govern what proportions of the initial and recurrent costs are paid by taxpayers and by users. Third, government has to ensure that the limited financial resources are efficiently used. This is obviously not happening in the 'business-as-usual' model at present. It is going to mean exploring a whole set of mechanisms for introducing competition, for paying for output not inputs, and for increasing accountability.

The agrarian economy of Pakistan accounts for about 25 percent of GDP and employs about half of the labor force. While the transition to an urban and industrial economy can and must continue, agriculture will remain central for the well-being of large numbers of people. Better water management is a key constraint to improving agricultural productivity and generating jobs. Over the past several decades, farmers have largely taken the problem into their own hands, and 'solved it' by sinking hundreds of thousands of tubewells which provide just-in-time water for their crops. To a substantial degree the main function of the canal systems has been to recharge the groundwater—about 80 percent of groundwater abstractions in Punjab come from recharge from canals. The survival of the water economy over the last several decades has largely been despite rather than because of the state—it has been the tapping of the unmanaged groundwater by millions of farmers, by towns and villages and industries that have pulled the economy through. It is clear that this era of 'productive anarchy' is now coming to an end, since groundwater is now being over-tapped in many areas (including both the Indus Basin and Balochistan and other non-Indus areas). This poses two major challenges to the state. First, surface water supply systems are going to resume their previous high importance, and need to be managed much more accountably and effectively. Second, groundwater will have to be managed—for related reasons of quantity and quality—much more aggressively than has been the case in the past.

> Challenge 3 is to put in place a modern institutional framework, with the key task being the development and application of instruments which will motivate sustainable, flexible, and productive use of water.

It is also obvious that the needs for water are changing substantially, as a result of agricultural diversification, urbanization, industrialization, recognition of environmental needs, climate change, and the evolution of the natural resource base. Since there will be, if anything, less rather than more water, it means that the new water economy is going to have to be one which is much more flexible, in which a key will be the voluntary reallocation of water from those who need it less to those who need it more.

It is going to require a very different type of state machinery at both the federal and provincial levels to meet these challenges. In constructing this 'new water state', the focus must be primarily on instruments which govern the relationships of different users with water, and with each other. The logical organizational architecture then is that which is required to manage the instruments and order the relationships between the parties. Some of the key elements of the 'new water state' will be:

- Introducing accountability, efficiency, transparency, and competition into the surface water supply business. This will mean unbundling the business into bulk transmission and distribution enterprises, with relations among the parts governed by contracts which specify the rights and responsibilities of both parties. While it will not be easy to enforce such contracts, experience shows that this can stimulate improved accountability and service quality. This will mean moving away from a monolithic service model below the distributaries (with Farmers' Associations competing 'for the market' with the irrigation department) and into the canal commands (where a variety of forms of public-private partnerships can provide an alternative to the irrigation department). In many cases, professionals from the irrigation departments would be encouraged to form private businesses for the provision of such services, thus ensuring that their skills are not lost, and that they do not see the changes as purely a loss of security. The bulk business (operation of dams and barrages) would probably remain in state hands, but with many major functions (such as operation of power plants) concessioned out to private operators. A similar institutional architecture would pertain for the drainage infrastructure.

- In such a system (which would take place as a sequenced and prioritized process over many years) the government would, gradually, play a very different role. It would corporatize the state-owned operating units and develop new capacities to do the economic regulation. The government would also be far more active in groundwater management, where it has been largely absent. This would mean developing a new legal and regulatory framework for co-managing groundwater with user associations. It would mean developing the sophisticated natural resource management capacity required for managing water and land systems.
- A centerpiece of these systems, both surface water and groundwater, would be improving the administration of a well-established system of water entitlements. What is now needed is finalization of the agreement on environmental flows into the delta (a process that is underway) and then implementation of the Accord in a transparent manner, audited by an auditor who is, and is perceived to be, neutral. The same system then needs to be 'drilled down' to the canal commands within the provinces (where entitlements are mostly well established but not transparently administered). And so on down all the way to the users' associations and eventually to the farmers. There is broad agreement among most water professionals in Pakistan that this improved administration is quite feasible and that it would increase efficiency, allow flexibility in adapting to scarcity, reduce conflict, and install trust in the system.
- A similar, and even more difficult, process is essential for the management of groundwater quantity and quality, since groundwater reservoirs are already being mined in the barani and sweet water areas. Again, this will take a well thought-out, pragmatic, patient, and persistent strategy. The central elements will be heavy involvement of users, substantial investments in modern water and agricultural technology, and the state playing a vital role as developer of the enabling legislation, regulator, and provider of knowledge and decision support systems.

In the eyes of many the idea of such a modern, accountable 'Pakistan water system' is panglossian, given the deteriorating performance in recent decades and the broader challenges of governance. The glass is, of course, always half empty. But it is half full too. Pakistan has a stronger base for doing this than most other developing countries, and there are some important signs that the need for change is being understood, there are political leaders who are starting to grapple with these realities, and the

> Challenge 4 is to trace a principled and pragmatic path for implementing this reform agenda over the coming decades.

government and private sector leaders are taking the important first steps down this long and winding road.

Pakistan is fortunate, too, in that it is not the first country in the world to face this (daunting) set of challenges. The experiences of other countries suggest that there are a set of 'rules for reformers' in undertaking such a transition. These rules include:

- Initiate reform where there is a powerful need and demonstrated demand for change.
- Involve those affected, and address their concerns with effective and understandable information.
- If everything is a priority, nothing is a priority—hence develop a prioritized, sequenced list of reforms.
- Pick the low-hanging fruit first—nothing succeeds like success.
- Keep your eye on the ball—don't let the best become the enemy of the good.
- Be aware that there are no silver bullets.
- Don't throw the baby out with the bathwater.
- Treat reform as a dialectic, not mechanical, process.
- Understand that all water is local and each place is different—one size will not fit all.
- Be patient, persistent, and pragmatic.
- Ensure that reforms provide returns to politicians who are willing to make changes.

> Water is far from a simple commodity
> Water's a sociological oddity
> Water's pasture for science to forage in
> Water's a mark of our dubious origin
> Water's a link with a distant futurity
> Water's a symbol of ritual purity
> Water is politics, water's religion
> Water is just about anyone's pigeon
> Water is frightening, water's endearing
> Water's a lot more than mere engineering
> Water is tragical, water is comical
> Water is far from the Pure Economical
>
> —Kenneth Boulding

- Recognize that water, unlike electricity or telecommunications, is 'far from a simple commodity'.

How the World Bank might be a more effective development partner.

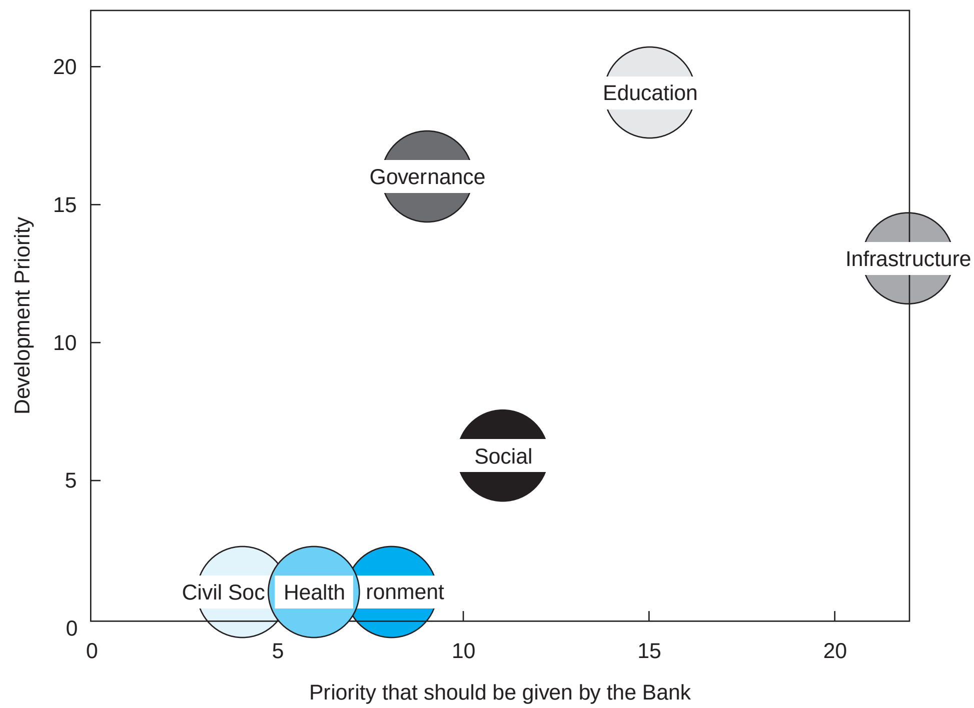
An important objective of this Report is to help define the water elements of the framework, known as the Country Assistance Strategy (CAS) which will govern the relationship between The World Bank and Pakistan for the period 2006–10. This is an iterative process, in which there have already been many discussions involving the federal and provincial governments, the Bank's country management and the Bank's Pakistan water team. While the final agreement on water will only be decided jointly with the other elements of the CAS, the contours of this agreement are already broadly clear.

The federal and provincial governments and the management of The World Bank all agree that water management is one of the central development challenges facing Pakistan, and that it is an area where the Bank has a long history and a strong comparative advantage. This is in broad agreement with the findings of a major poll of a wide variety of South Asian stakeholders (fig. 18), which concluded that infrastructure, education, and governance were the three areas which were both of high national importance and where the Bank was perceived to have a comparative advantage.

There is, therefore, a general agreement that there will be a major increase in Bank lending for water-related activities, with the indicative overall figures shown in fig. 19.

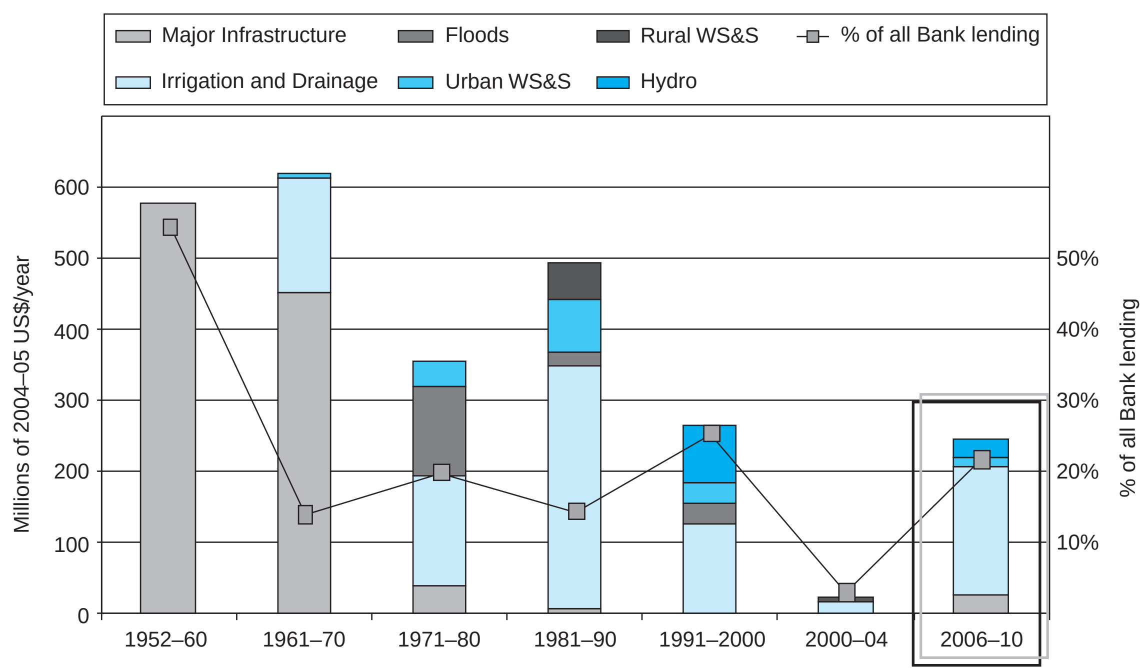
This would mean that water-related lending for Pakistan would increase about tenfold from the 2000–04 period, and account for about $1 billion in the coming four years. World Bank support would be based on 'principled pragmatism', recognizing that reforms and investments must proceed in parallel and the best should not be

Fig. 18: The 'global poll' results for South Asia



Source: The World Bank, 2002.

Fig. 19: World Bank lending to Pakistan for water-related sectors—past and prospective



Source: The World Bank, 2004.

allowed to become the enemy of the good. Broadly speaking, Bank assistance would support four pillars of the water sector, as described below:

Pillar 1: Asset Development and Management

Pakistan has a large endowment (with an estimated replacement value of US$60 to 70 billion) of water resources infrastructure, most owned and managed by the provinces, and much now quite old. Bank-funded projects will make major investments in rehabilitation of some critical assets (including barrages) and will help put in place Asset Management Plans which will set priorities for asset rehabilitation and maintenance, make explicit the requirements for public and user financing, and develop efficient institutional arrangements for rehabilitating and maintaining this infrastructure. The Bank will also continue its support for: developing and implementing a drainage and salt management strategy, other investments—including small dams, minor irrigation, and groundwater management—in barani areas outside the Indus Basin, as well as for improving livelihoods and safety in coastal areas.

One major issue that is likely to emerge in the 2006–10 CAS period is possible Bank engagement in developing and co-financing major new Indus Basin storage and hydro, if and when the government makes such a decision. The government is actively addressing some of the major issues which have been raised about a new dam on the Indus, including transparent implementation of the 1991 Water Accord and environmental flows into the delta. In discussions with the government it has been agreed that the Bank could be involved, with the usual provisions that any such project met the Bank's normal technical, economic, social, and environmental standards, and that these investments were part of an overall program which included institutional reforms and investments at federal, provincial, canal command, and farm levels to ensure better use of water.

Pillar 2: Water Resources Management

The Bank expects to support development of capacity at the provincial and federal levels for improving water and associated natural resource management. For surface water supplies, a major emphasis will be building on Pakistan's platform of defined water entitlements, making the administration of these more transparent and accountable, from the inter-provincial to the user levels. For groundwater, the Bank will support the development of the government's capacity for knowledge generation, policy generation, and management. A major emphasis will need to be on developing a better understanding of salinity and formulation of salt management strategies, groundwater recharge, and flood flows. For both surface water and groundwater there will be an emphasis on incorporating environmental issues (including water quality, wetlands, and environmental flows). An important element of Bank support will be training of a new generation of multidisciplinary water resources specialists, and support for multidisciplinary centers of excellence for water resources, and natural and social sciences.

Pillar 3: Service Delivery

The Bank expects to be heavily engaged in provincial- and city-level efforts to improve the quality, efficiency, and accountability with which water supply, sanitation, and irrigation services are delivered. The Bank will emphasize the development of frameworks which encourage the entry of new players (including community organizations, and the small- and large-scale private sector), the use of contracts which specify the rights and obligations of providers and users, and benchmarking for all water services. The Bank will emphasize the modernization of infrastructure—including canal re-modeling and the use of measuring devices, which are integral for moving to a more flexible, accountable, transparent, and monitorable service delivery paradigm.

Pillar 4: On-farm Productivity

The Bank will continue to invest in the on-farm services (land leveling, watercourse lining, and introduction of new technologies through private-public partnerships) which are essential for agricultural diversification and for improving the amount of crop, income, and jobs produced per drop of water.

The Bank anticipates providing such support through its various lending instruments, including budgetary support for policies and prior actions that address key issues (Development Policy Lending) as well as through specific investment lending for infrastructure and institutional reforms. Finally, given the major scientific, policy, and implementation challenges ahead, the Bank, with partial support from the Government of the Netherlands, will mount a major program for providing analytic and technical support to the federal and provincial governments.

Paraphrasing Akhter Hameed Khan, the great Pakistani reformer, it might be said that the Bank's involvement in water in Pakistan has been one in which the Bank 'has chased the rainbow of well-functioning institutions and dreaded the nightmare of further institutional decay… and that only the boldest among us can say that we may not be similarly engaged tomorrow'.[1]

1 Akhter Hameed Khan, 'A History of the Food Problem', The Agricultural Development Council, NY, 1973.

CHAPTER 1

THE PROCESS FOLLOWED

In 2003, the Board of Executive Directors (representing the 180 countries who own The World Bank) approved a new Water Resources Sector Strategy. Two important conclusions of the Strategy were that the general principles adopted needed to be adapted to the widely varying conditions pertaining in the Bank's borrowing countries, and that there needed to be more systematic and integrated incorporation of water-related issues into Country Assistance Strategies (the 'contract' between the government and the Bank which defines an indicative four-year package of investment and advisory services to be provided by The World Bank). Water management is a major issue for Pakistan, and an area where the Bank has a long history of engagement and a perceived comparative advantage. As part of the process of preparing a Pakistan Country Assistance Strategy for the period 2006–10 it was agreed that the Bank would do a Water CAS for Pakistan, following the logic shown in fig. 1.1. Generous support was provided by the Bank-Netherlands Water Partnership Program.

The Pakistan Water CAS process involved several related elements:

- extensive discussions with senior officials of the provincial and federal governments, including a major formal consultation on institutional issues
- a consultation with about 50 stakeholders from the private sector, academia, NGOs, professional associations, and the government
- commissioning of background papers (listed in table 1.1, and available in the enclosed compact disk) by prominent Pakistani practitioners and policy analysts.

Fig. 1.1: The Water CAS Process

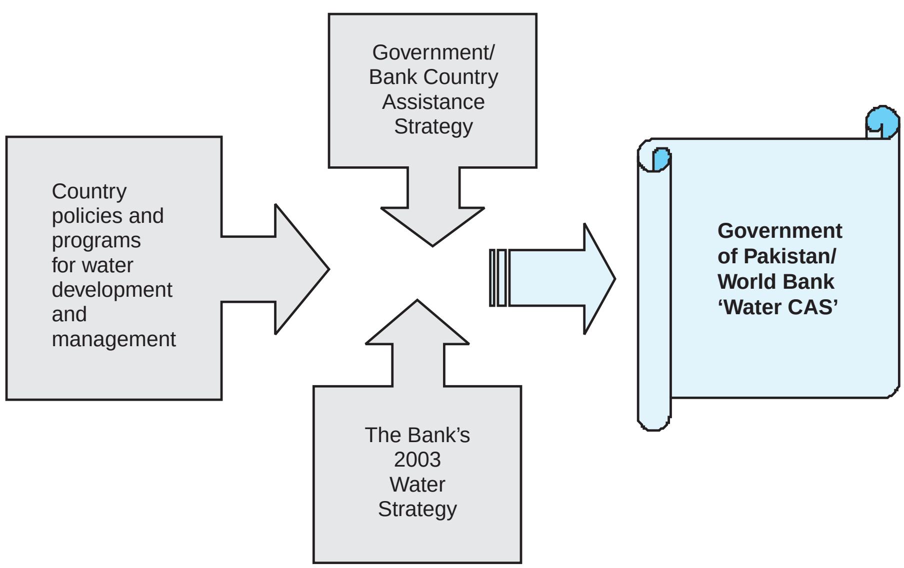


Table 1.1: List of background papers (available in the enclosed compact disc)

	Background Paper	Author(s)	Designation
1.	Water, growth, and poverty	Sarfraz Khan Qureshi	Former Director, Pakistan Institute of Development Studies
2.	Human and social dimensions	Karin Siegmann and Shafqat Shezad	Research Fellows, Sustainable Development Policy Institute
3.	Water and environmental sustainability	Vaqar Zakaria	Managing Director, Hagler Bailley
4.	Water and energy	Imitiaz Ali Qazilbash	Retired WAPDA official
5.	Water balances and evapotranspiration	Shahid Ahmad	Chief Scientific Officer, Water Natural Resources Division, Pakistan Agricultural Research Council
6.	Water rights and entitlements	Faizul Hasan	Chief Engineer, ACE (Pvt.) Ltd., and Project Coordinator, General Consultants for WAPDA
7.	Sustainable, accountable institutions	Sardar Muhammad Tariq and Shams-ul-Mulk	Former Member (Water), and Chairman, WAPDA, respectively
8.	Drinking water and sanitation	Khurram Shahid	Consultant
9.	The political economy of reform	Imran Ali	Professor, Lahore University of Management Sciences (LUMS)
10.	The role of large dams in the Indus System	Pervaiz Amir	Economist, Asianics Agro. Dev. International
11.	Groundwater development and management	Frank van Steenbergen and Shamshad Gohar	Metameta Research and Ground Water/ Water Quality Specialist, PCWSSP
12.	Modernization of agriculture	Pervaiz Amir	Economist, Asianics Agro. Dev. International
13.	The policies and prospective plans for development and management of water resources by the federal and provincial governments	Sardar Muhammad Tariq and Shams-ul-Mulk	Former Member (Water), and Chairman, WAPDA, respectively
14.	Flood control and management	Asif Kazi	Former Special Secretary, Ministry of Water and Power, and ex-Chairman, Federal Flood Commission
15.	Drainage and salinity management	M.N. Bhutta and Lambert Smedema	Director General International Water Logging and Salinity Research Institute (IWASRI)
16.	The evolution of Bank lending and non-lending for water in Pakistan	Usman Qamar	Senior Irrigation Engineer, The World Bank
17.	The evolution of Bank lending and non-lending for water supply and sanitation	Pervaiz Amir and Nadir Abbas	Economist, Asianics Senior Water Supply and Sanitation Specialist, The World Bank

CHAPTER 2

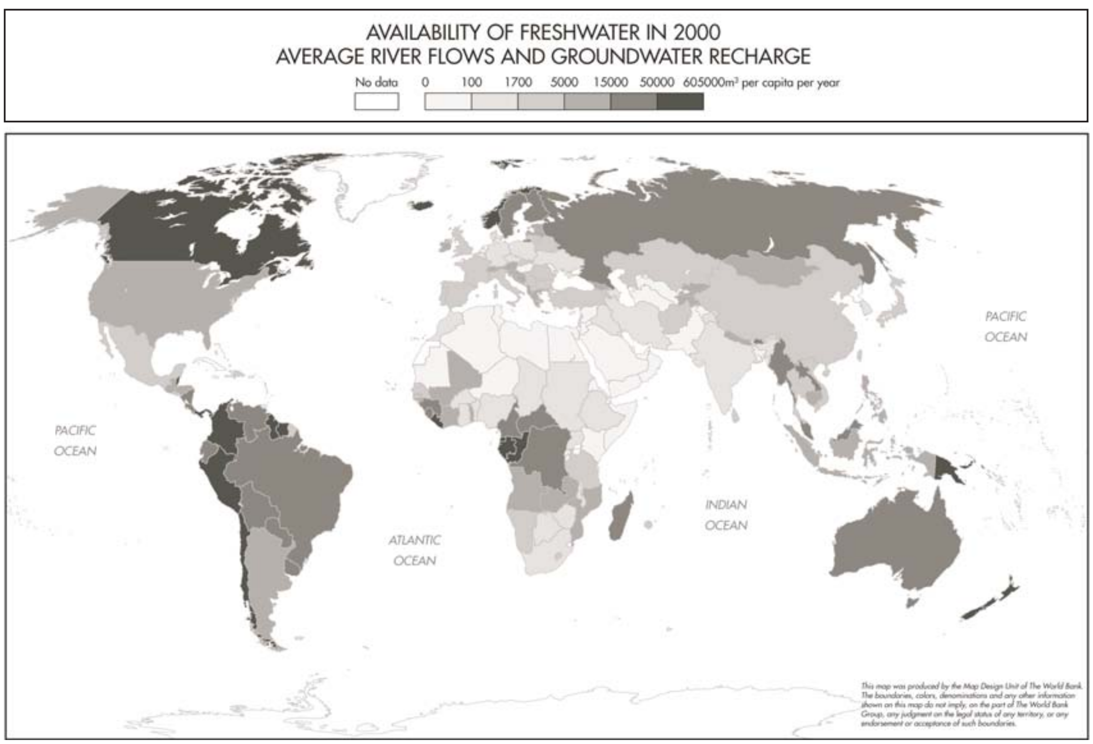
THE CHALLENGES AND ACHIEVEMENTS OF THE PAST

The Challenges

Pakistan is an arid country. The balance between population and available water already makes Pakistan one of the most water-stressed countries in the world (fig. 2.1); with rapid population growth it will soon enter a condition of absolute water scarcity (fig. 2.2).

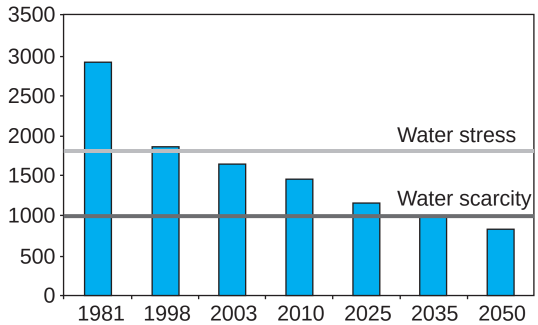
In the cultivable plains, rainfall ranges from about 500 mm a year along the Punjab border with India (which receives some rainfall from the summer monsoon) to only 100 mm a year in the western parts of Pakistan. These low precipitation levels mean that rain-fed or barani agriculture is not possible on a large scale in Pakistan. Throughout history people have adapted to the low and poorly distributed rainfall by either living along the banks of rivers, or by careful husbanding and management of local water resources. One of the greatest of human civilizations—the Indus Valley (Mohenjodaro and Harappa) Civilization flourished along the banks of the Indus. But under natural conditions population densities were necessarily low.

Fig. 2.1: World's most water-stressed countries



Source: www.UNEP.org.

Fig. 2.2: Declining per capita availability of water in Pakistan (cubic meters per capita per year)



Source: Amir, 2005.

With British rule everything changed. As analyzed in Deepak Lal's history of economic growth in the subcontinent,[1] the British understood that the marginal returns to water development were higher in regions of relatively low rainfall than in the higher rainfall areas, and thus emphasized hydraulic works which would 'make the deserts bloom'.[2] In many ways, the imperative was to 'go west, young man', including into the arid part of eastern Punjab.

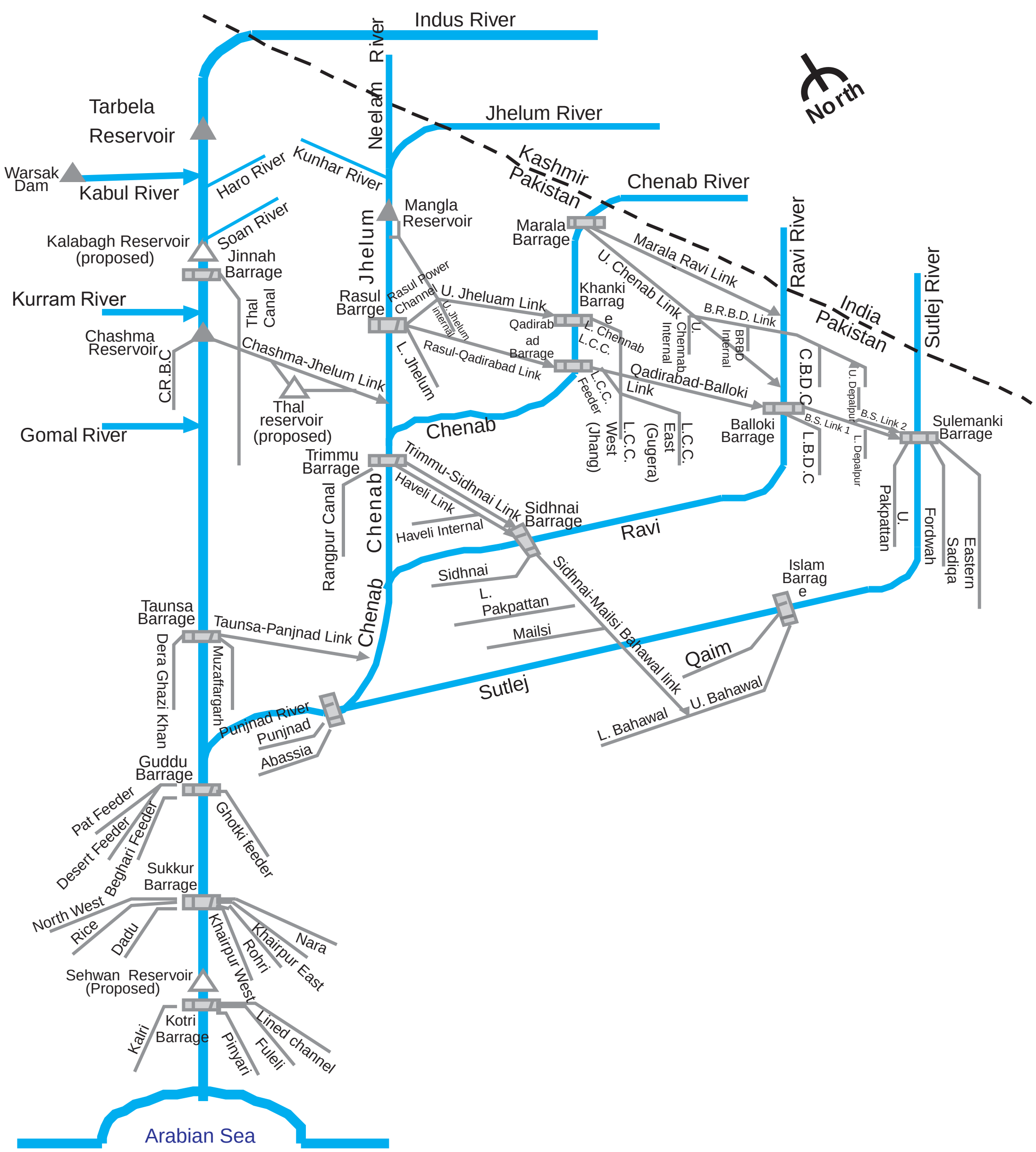
In any social endeavor of such ambition, the result varies depending on the interaction of the natural and human terrain as described brilliantly in Imran Ali's seminal book *The Punjab under Imperialism*[3] and in his background paper for this Report.[4] As the irrigation systems stretched further and further away from areas of reasonable rainfall, they dealt with quite different social realities on the ground and gave rise to different hydraulic civilizations. In UP and eastern Punjab canal irrigation occurred primarily on already settled lands, and irrigation was a supplement to relatively well-watered, rain-fed cultivation. In western Punjab, the part that would be in Pakistan, the situation was quite different. Irrigation here was onto pastoral lands, only a small fraction of which were private proprietary holdings. These extensive barren tracts were appropriated as state property and categorized as Crown or State Waste Land. Not only were the rights of the pastoral tribes to the land not recognized, but these tribes were also deemed to lack the agricultural traditions to make a success of cultivating new land. The British administration then embarked on a vast process of agricultural colonization, by essentially introducing colonists from other parts of the Punjab to these 'canal colony' lands.

A massive canal system (fig. 2.3 shows its extent today, and fig. 2.4 the architecture from the barrage to the field) was built, with the principle being to maximize the use of 'run-of-the-river' flows in the *kharif* season, and to allow equal distribution to all irrigators by use of the warabandi, a time-based roster allocation system. Since that time agriculture in the region has largely been synonymous with irrigation, with rainfall playing only a supplementary role both for the spring (*rabi*) and autumn (kharif) harvests.[5]

As population densities increased, especially in the areas adjacent to the rivers, so too did the vulnerability of people to the naturally meandering nature of heavily-silt-laden rivers, and to floods. As shown in fig. 2.5, floods have, with considerable regularity, inflicted large damages and caused many deaths. The nature of the flood protection and management challenge varies considerably across the country.[6] In NWFP and Balochistan and parts of the Punjab, the so-called 'hill torrents' are usually highly beneficial, sustaining a large

1 Deepak Lal, *Cultural Stability and Economic Stagnation: India 1500 BC–1980 AD*, Clarendon Press, 1988.
2 In the evocative phrase of Arthur Maass and Raymond L. Anderson, *And the Desert Shall Rejoice: Conflict, Growth, and Justice in Arid Environments*, MIT Press, 1978.
3 Imran Ali, *The Punjab under Imperialism, 1885–1947*, Princeton University Press, NJ: Princeton,1988.
4 Paper 9.
5 Ibid.
6 Paper 14.

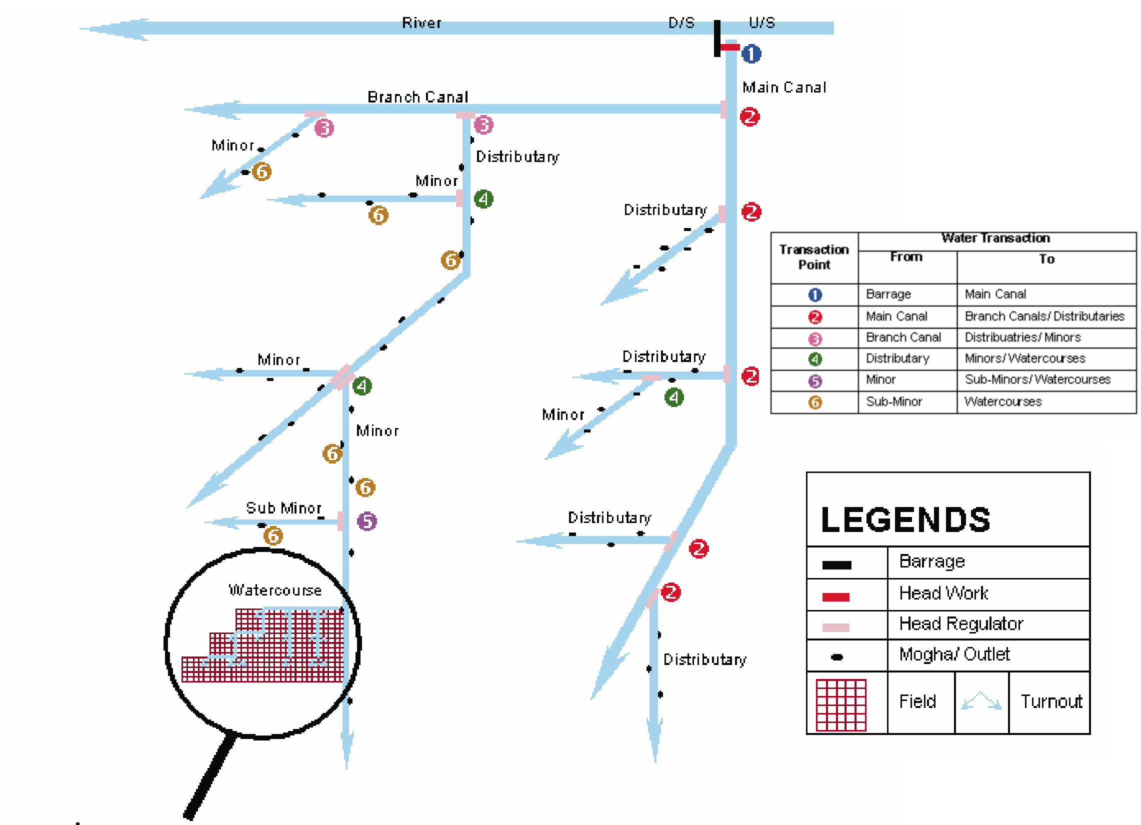
Fig. 2.3: Indus Basin irrigation system



Source: Hasan, 2005.

agricultural population. Occasionally, flash floods cause serious damage, as did the drought-ending floods in Balochistan in 2005. In the plains the problem is different. Punjab has problems both with inundation and land erosion, but intelligent use of the natural, south-west slope of the land has reduced the impact of flooding. In all river systems, and especially those with heavy silt loads, the greatest flooding problems are in the flat deltas. And so it is in Pakistan, where Sindh is basically a delta in which the Indus has meandered over millennia. As in all deltas, once silt is deposited in

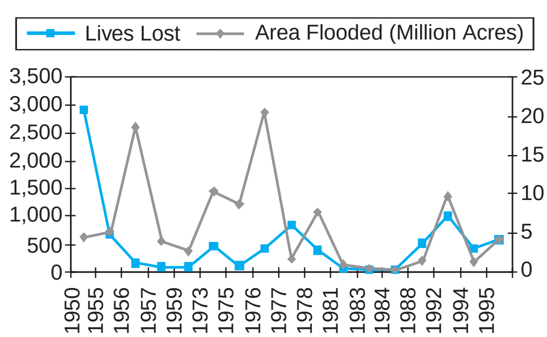
Fig. 2.4: A typical canal command in the Indus system



Source: Hasan, 2005.

one place, the river shifts to a lower-lying area. In times of flood these can be very dramatic and long-distance shifts. As larger populations inhabited the delta, however, this uncertainty was not acceptable and so, over the past one hundred and fifty years 'the Indus river has now been put in a straitjacket, thereby fixing its location'.[7] The result of this river training, as with so many other silt-laden rivers around the world, has meant that when silt is deposited the river now does not shift course horizontally, but vertically, giving rise to a situation where the river is higher than the surrounding land, and the choice is between two unsatisfactory

Fig. 2.5: Flood losses in Pakistan



Source: Kazi, 2005.

7 Paper 14.

and expensive options—dredging, and continuing to raise the side embankments. The inevitable consequence is that 'when a protection bund breaches in Sindh province, inundations are prolonged, and the floods not only damage summer crops but they also interfere with the sowing of subsequent winter crops. The potential for economic losses, and human sufferings for the poor inhabitants of relatively cheap flood-prone lands near the river, are the greatest. In addition to millions of acres of irrigated land that is subjected to flooding, country's major rail and roads are also sometimes affected by super flood events that keep the infrastructure out of service for long durations.'[8]

Transforming an arid and capricious environment into one in which large numbers of people could live peaceful and prosperous lives is, everywhere, a great gamble and even, in the eyes of some, a Faustian bargain. The natural flow regimes of the rivers were dramatically altered. Rivers which had previously meandered over wide plains were now confined within narrow channels. The large quantities of sediments which were washed off of the young Himalayas in the spring floods now no longer nourished the delta but were diverted onto land (and later partially trapped behind high dams). Vast quantities of water were disgorged onto deserts, substantial parts of which were of oceanic origin and highly saline. And areas which were previously habitable only by nomads were now transformed into dense 'canal colonies' of immigrant farmers.[9]

The area was, for better or worse, transformed into a hydraulic civilization which brought great returns but which also posed, and poses, massive political, hydraulic, and economic challenges in maintaining an acceptable balance between the natural system and man.

The first challenge for the nation of Pakistan was a political challenge which arose because the hastily drawn lines of Partition severed the irrigated heartland of Punjab from the life-giving waters of the Ravi, Beas, and Sutlej rivers (fig. 2.6).

The second challenge was hydraulic in nature, because there was now (fig. 2.6) a mismatch between the location of Pakistan's water (from the Indus, Jhelum, and Chenab, the so-called western rivers) with the areas that had previously been irrigated from the Ravi, Beas, and Sutlej (which were now 'India's rivers').

Fig. 2.6: The Indus water canal system at Partition in 1947

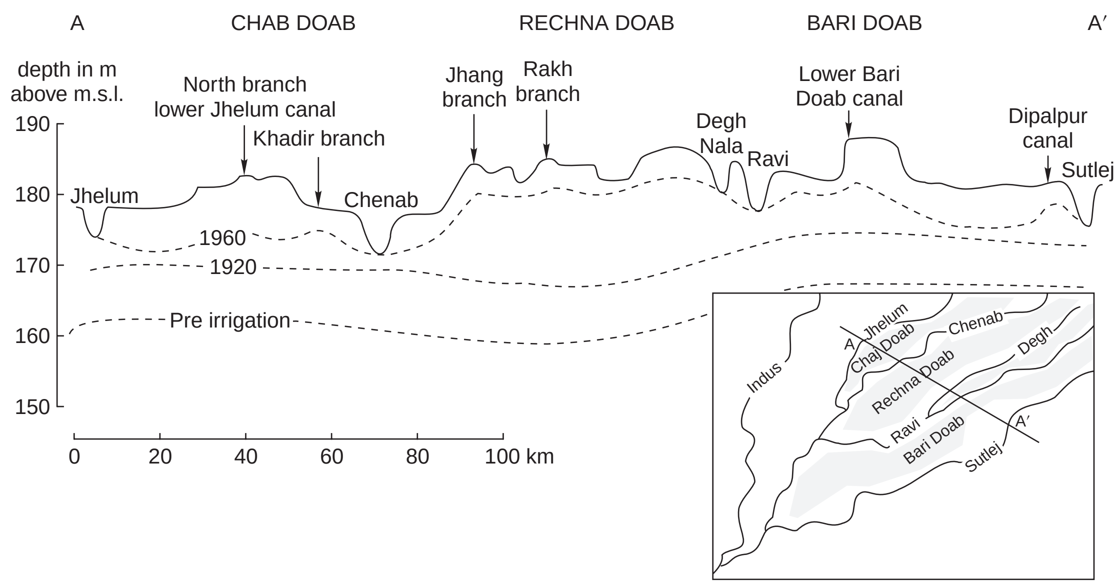
Source: The World Bank.

The third challenge was neither political nor hydraulic, but ecological. It was this last reality which gave rise to the third major water challenge which Pakistan had to face at and after Independence. Hundreds of billions of cubic meters of water were now stored in the naturally-deep aquifers of Punjab alone. The groundwater table rose dramatically (fig. 2.7), and in many areas water tables now reached the level of the land. And these waters were rich in salts which had been absorbed from the soil. After the water evaporated, the land was covered with a crispy layer of life-suppressing salt. In the early 1960s it appeared that Pakistan was doomed, ironically, to a watery, salty grave.

8 Paper 14.

9 Imran Ali, *The Punjab under Imperialism, 1885–1947*, Princeton University Press, NJ: Princeton, 1988.

Fig. 2.7: The change in groundwater levels



Source: Bhutta and Smedema, 2005.

The Response— Public Infrastructure

The Partition both created Pakistan and did it in such a way that the very survival of the country was put in jeopardy. Almost 90 percent of the irrigated area in the Indus Basin was now in Pakistan,[10] but the rivers which nourished these lands had their origins in India (and, to a minor degree, in remote and sparsely inhabited parts of China).

Over the next decade, teams from Pakistan and India worked together with a team from The World Bank (whose offer of its 'good offices' was accepted by both countries) to fashion a solution which would be acceptable to both sides and would be durable. There were great difficulties and many dead ends. The first proposal (framed by David Lilienthal, former Chairman of the Tennessee Valley Authority and the person who got the ball rolling on the Indus Treaty) was of a single, integrated basin authority. This was rapidly rejected as being impractical. The broad outlines of the agreement were that Pakistan was (with minor exceptions for existing uses in Kashmir) assigned full use of the waters of the Indus, Jhelum, and Chenab rivers, which accounted for 75 percent of the waters of the system. The unique feature of the negotiating process was that it was agreed that the process should not be driven by legal principles but that, instead, principles of water engineering and economics were to be the basic considerations.[11] This meant that, Pakistan's considerable misgivings notwithstanding, India was to be permitted (under very carefully specified conditions which took two years to negotiate) to tap the considerable hydropower potential of

10 N.D. Gulhati, *Indus Waters Treaty: An Exercise in International Mediation*, Allied Publishers, Bombay, 1973.
11 N.D. Gulhati, *Indus Waters Treaty: An Exercise in International Mediation*, Allied Publishers, Bombay, 1973, and Undula Alam, 'Water Rationality: Mediating the Indus Waters Treaty', Ph.D. dissertation, Durham University, 1998.

Pakistan's three rivers before they entered Pakistan.[12]

The Indus Waters Treaty (IWT) was not a first-best for either side. Then there were conflicting principles put on the table—'no appreciable harm' versus 'equitable utilization'. As in most other cases, 'international water law is used by riparians less to resolve disputes than to dignify positions based on individual state interest.'[13] And so too was the way in which the IWT was (and sometimes still is) perceived. From the Indian side the fact that Pakistan got 75 percent of the water represented a fundamental violation of the principle of 'equitable utilization' (the favorite of the International Law Association). 'The Treaty came under heavy fire in the Indian parliament and was subjected to trenchant criticism by most of the speakers who participated in the Lok Sabha debate on the subject on 30 November 1960. They blamed the Government of India for a policy of appeasement and surrender to Pakistan and said that Indian interests had been let down…'.[14] From the Pakistani side the fact that they were allocated 'only' 75 percent of the water when they had 90 percent of the irrigated land represented a violation of the principle of 'appreciable harm' (the favorite of the International Law Commission). A solomonic judgment (to which we return several times in this Report in other contexts) was that of President Ayub Khan: '…we have been able to get the best that was possible….very often the best is the enemy of the good and in this case we have accepted the good after careful and realistic appreciation of our entire overall situation.... The basis of this agreement is realism and pragmatism….'[15] The wisdom of this perspective has been vindicated many times over the past forty-five years, with the Indus Treaty recently again being declared 'sacrosanct' by the Presidents of both countries.

A central element of the Indus Waters Treaty was the construction of the infrastructure which would enable Pakistan to both supply those areas which would no longer be irrigated from the Ravi, Beas, or Sutlej ('India's rivers'), and to increase the overall area under irrigation. The Indus Basin Development Fund (with contributions from several western governments, a payment from India, and loans from The World Bank) was used to re-plumb the system, as shown in fig. 2.8. This included the building of massive 'link canals' from the western rivers to the east, and the two main storage dams (Tarbela, the then biggest rockfill dam in the world, on the Indus; and Mangla on the Jhelum) on which the re-configured system would depend.

Fig. 2.8: The Indus Waters Treaty (1960)

12 N.D. Gulhati, *Indus Waters Treaty: An Exercise in International Mediation*, Allied Publishers, Bombay, 1973, and Undula Alam, 'Water Rationality: Mediation the Indus Waters Treaty', Ph.D. dissertation, Durham University, 1998.

13 Shapland in Undula Alam, 'Water Rationality: Mediating the Indus Waters Treaty', Ph.D. dissertation, Durham University, 1998.

14 N.D. Gulhati, *Indus Waters Treaty: An Exercise in International Mediation*, Allied Publishers, Bombay, 1973.

15 Ayub Khan in N.D. Gulhati, *Indus Waters Treaty: An Exercise in International Mediation*, Allied Publishers, Bombay, 1973 .

This was a massive engineering challenge that faced, as do all challenges in life, times when failure seemed imminent. But with great skill and commitment Pakistan's engineers and their collaborators from around the world did it.

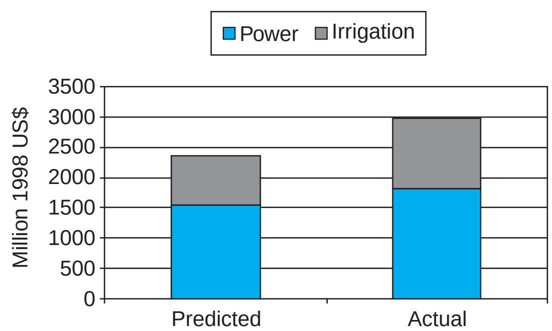
The Indus Waters Treaty brought a fundamental and unprecedented change in Pakistan's options and approach towards its water development and management. With the loss of the three eastern rivers, Pakistan had no choice but to rely on storage for meeting its existing demands (Mangla), and for future extension of the irrigated area (Tarbela). In short, the development and sustainability of water resources development in Pakistan became, and continues to be, dependent on storage and dams.

What was the social and economic impact of this infrastructure? First, it secured the future of a young and vulnerable country. (It is relevant to note that, despite the fact that it was funded by The World Bank, there was no economic analysis done of Mangla Dam—it was an investment that was self-evidently necessary for the pure survival of Punjab in Pakistan.) Second, it—especially Tarbela—facilitated the expansion of irrigated area and the production of clean and renewable hydropower. In a major study done for the World Commission on Dams, Pervaiz Amir and colleagues did an ex-post assessment of the impact of Tarbela.

The impact was and is massive. In the mid-1970s The World Bank did an ex-post assessment of the economic impact of Mangla and the link canals. While recognizing that the indirect benefits were large, the assessment focused only on direct benefits, and concluded that these exceeded 10 percent.

Tarbela has a massive impact on the economy of Pakistan. It is estimated[16] that about 40 percent of the population presently benefits from water that is regulated by Tarbela. Tarbela (along with the derivative Ghazi Barotha project below it) represents over 30 percent of Pakistan's installed generation capacity. The actual direct power and irrigation benefits were about 25 percent higher than those predicted at appraisal (fig. 2.9).

Fig. 2.9: Benefits from Tarbela (1975–98)



Source: WCD, 2000.

As noted in the Tarbela study for the World Commission on Dams, important as these direct effects are, they tell only part of the story of the impact of major infrastructure. The irrigation and hydropower are the 'direct benefits', which in turn generate both inter-industry linkage impacts and consumption-induced impacts on the regional and national economy. Water released from a multipurpose dam provides irrigation that results in the increased output of agricultural commodities. Changes in the output of these commodities require inputs from other sectors such as seeds, fertilizers, pump sets, diesel engines, electric motors, tractors, fuels, and electricity. Furthermore, increased output of some agricultural commodities encourages setting up of food processing (sugar factories, oil mills, rice mills, bakeries, etc.) and other industrial units. Similarly, hydropower produced from a multipurpose dam provides electricity for households in urban and rural areas, and for increased output of industrial products (including fertilizers, chemicals, and machinery). Changes in the output of these

16 Paper 2.

industrial commodities require inputs from other sectors such as steel, energy, and chemicals. Thus, both increased output of electricity and irrigation from a dam result in significant backward linkages (that is, demand for higher input supplies) and forward linkages (that is, providing inputs for further processing). In addition, as incomes rise, there is a further feedback loop deriving from increased demands for goods and services.

There have been two major studies in the sub-continent which have examined these indirect impacts. A study by the International Food Policy Research Institute of the impact of Green Revolution[17] showed that:

- the multiplier was large—each rupee increase in value added in agriculture stimulated an additional rupee of value added in the region's non-farm economy
- about half of the indirect income gain was due to agriculture's demands for inputs and marketing and processing services, and the rest due to increased consumer demands as a consequence of higher incomes
- the multipliers for basic productive infra-structure were much higher than for social spending and other sectors

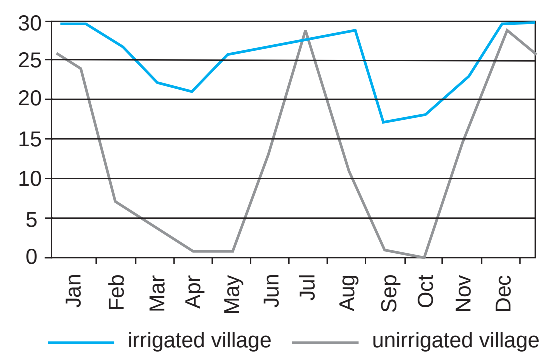
As pointed out by Pervaiz Amir,[18] the indirect impacts of major dams in Pakistan are likely to be quite similar to those emanating from the similar-sized Bhakra Dam in the Indian Punjab, for which there has been a major recent assessment.[19] The study found that the direct benefits were higher than anticipated when the dam was built and that the dam did, indeed, serve to transform this region. For every 100 rupees of direct benefits, Bhakra generated 90 rupees of indirect benefits for the regional economy and ripples well beyond the region.

These investments were done in the name of national survival, food security, and economic growth: how do they fare when judged by the contemporary criterion on poverty reduction?

The single most important finding from research shows that the central issue for poverty reduction is not who gets the water, but how that water transforms the demand for labor (which is provided primarily by the landless and marginal farmers). The fundamental driver is that the demand for agricultural labor is 50 percent to 100 percent higher on irrigated land.[20] As Robert Chambers has shown through village-level work (fig. 2.10), irrigation has meant higher and much more stable employment, with the poor the major beneficiaries.

Two recent, much more sophisticated analyses (which used input-output matrices and Social

Fig. 2.10: Average number of employment for adult casual laborers each month



Source: Chambers, 1988.

17 Hazell, Peter, and C. Ramasamy, *The Green Revolution Reconsidered: The Impact of High Yielding Varieties in South India*, The Johns Hopkins University Press, Baltimore, 1991.

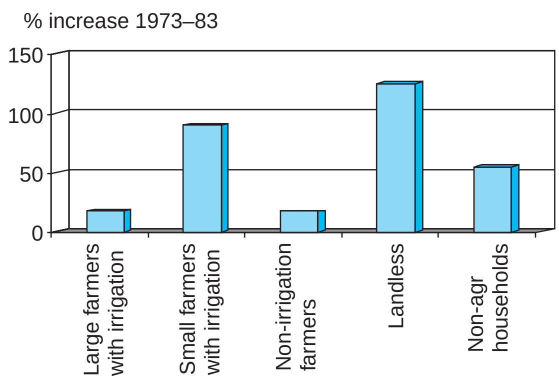
18 Paper 10.

19 Ramesh Bhatia, 'Economic Benefits and Synergy Effects of the Bhakra Multipurpose Dam, India: A case study', The World Bank, 2005 (draft).

20 Ramesh Bhatia, 'Water and Growth', Background Paper Report, 2005.

Accounting Matrix methods) have shown similar results. The study by the International Food Policy Research Institute of the impact of Green Revolution[21] showed (fig. 2.11) that the biggest winners were the landless, whose incomes increased by 125 percent as a result of the large increase in demand for their labor.

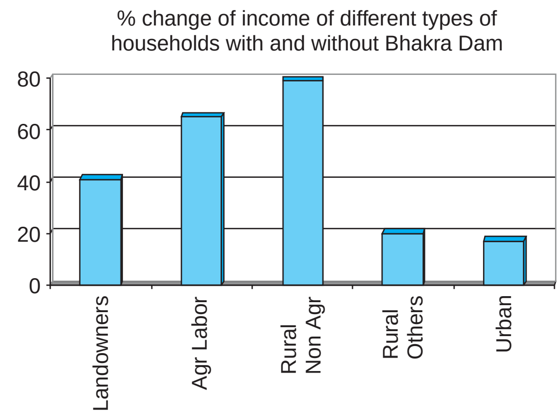
Fig. 2.11: The effect of irrigation and green revolution on income



Source: Hazell *et al.*, 1991.

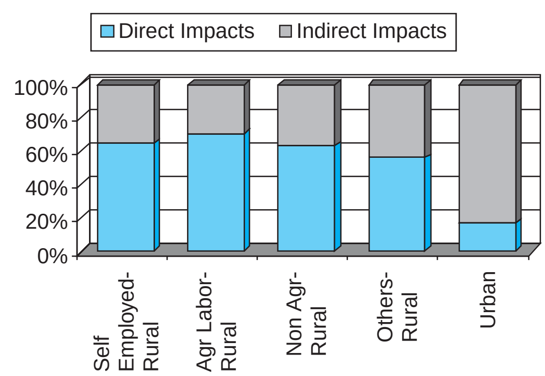
And the major study by Bhatia and colleagues of the effect of Bhakra,[22] again (fig. 2.12) shows that the rural poor have benefited hugely from the project, and (fig. 2.13) that it was the indirect effects of the dam which had the major impact on urban areas (and therefore on urban poverty reduction). (There are, of course, a number of important differences between landholding size and agricultural productivity in the Indian and Pakistani Punjabs, which would mean that the distribution of direct benefits, which accrue to those with land, would be somewhat different. But there is unlikely to be much difference in terms of the forward and backward linkages which determine the magnitude of the indirect effects, or of the effects on the poor, since labor markets operate quite similarly on both sides of the border.)

Fig. 2.12: The effect of Bhakra Dam on different social groups



Source: Bhatia, 2005.

Fig. 2.13: Income gains from directly and indirectly impacted sectors—Bhakra Dam



Source: Malik, 2005.

With the certainty—or so it seems—of retrospective wisdom, it has been claimed that

21 Hazell, Peter, and C. Ramasamy, *The Green Revolution Reconsidered: The Impact of High Yielding Varieties in South India*, The Johns Hopkins University Press, Baltimore, 1991.

22 Ramesh Bhatia, 'Economic Benefits and Synergy Effects of the Bhakra Multipurpose Dam, India: A case study', The World Bank, 2005 (draft).

these interventions did nothing for the poor, because it were the rich farmers who benefited from the infrastructure.[23] These studies show the limits of such a reductionist view (which has never been one taken by governments with responsibility anywhere in the world). At the end of the day it does not matter (a) whether such projects are justified in terms of poverty reduction, or (b) whether the primary recipients of the 'first-round benefits' are those with land. Because the record is overwhelmingly clear—investments in water infrastructure in the subcontinent have resulted in massive reductions in poverty, and it is actually the poor and landless who have been the biggest beneficiaries. The appropriate (water!) metaphor (as in other water projects around the world) is not 'trickle down', but 'a rising tide lifts (almost) all boats'.

Finally, all pubic infrastructure was not for irrigation. Settling large numbers of people in an arid and capricious environment means facing not only the constant threat of famine, but the constant threat of variability's other face, occasional but very damaging floods. 'Floods are detrimental not only in financial terms, but also in their ability to severely undermine the productive system that has to be reasonably free from uncertainties and frequent disruptions.'[24] As also pointed out by Asif Kazi, there can be no such thing as full protection from floods. In terms of infrastructure, the challenges (and the responses) are quite different in different parts of the country. In addition to the major dams (which provided some protection from floods), and the multitude of small check dams in the hills, there were also substantial investments in flood control infrastructure, with about 6,000 kilometers of embankments constructed along the major rivers and their tributaries.[25] There have also been investments in watershed protection (above Mangla, for example)[26] which have probably had a modest effect on the uncontrollable sediment loads from the young mountains, and have and could have (accepted wisdom notwithstanding) little effect on large-scale flooding.[27] Pakistan's approach to flood management has also emphasized other non-structural elements, 'including permanent and temporary relocation of potential flood affectees, review of reservoir operation regulations to attenuate flood peaks, land-use regulations for hazardous areas, and an extended and reliable Flood Forecasting and Timely Warning Network.'[28]

The Response—Private Infrastructure

The large investments in surface irrigation transformed not only the economy and landscape of Pakistan, but had a huge impact on groundwater. The vast, leaky, irrigation system disgorged hundreds of billions of cubic meters[29] of water into the aquifers of the Indus Basin at the same time as when natural drainage channels were impeded. The result was a fundamental change in the water balance, with subterranean and surface flows out of the aquifers and into the rivers, and eventually the ocean no longer capable of draining the much larger quantities of water

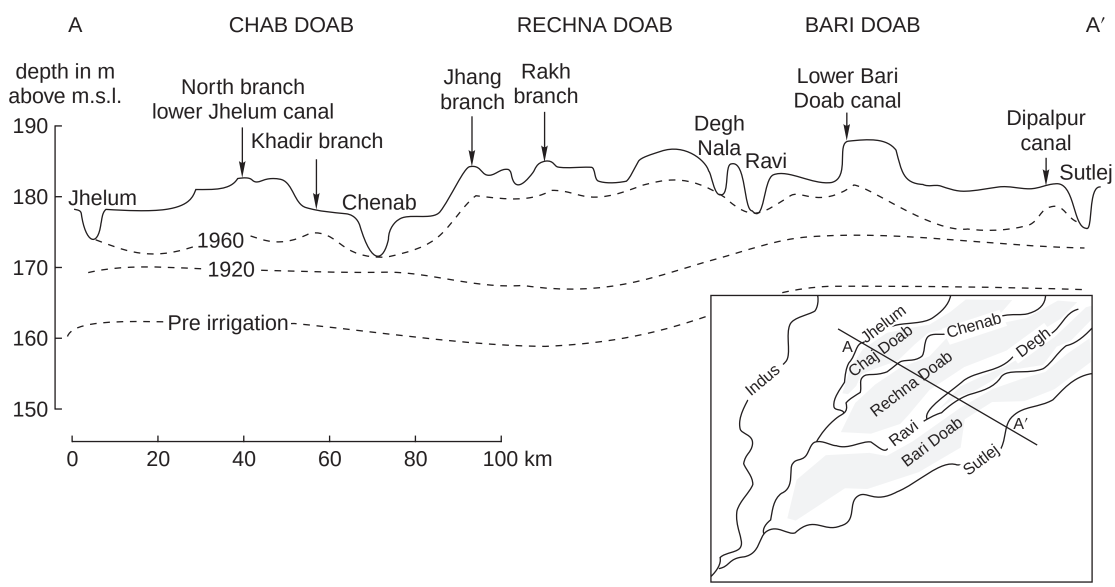
23 Jack Pelliquen, *India: Evaluating Bank Assistance for Agriculture and Rural Development*, OED, The World Bank, 2002, and Shripad Dharmadhikary, *Unraveling Bhakra*, Badwani, Madhya Pradesh, 2005.
24 Paper 14.
25 Ibid.
26 Ibid.
27 Calder, Ian, and David Kaimowitz, 'A flood of evidence', *The Economist*, 7 October 2004.
28 Paper 14.
29 Assuming an area of roughly 200 km x 300 km, a change of depth of 15 meters, and a storage coefficient of 0.3.

which were poured into the aquifers. The result was an inexorable and relatively rapid rise in the water table, as shown for a cross-section between the Punjab canals (fig. 2.14), and on an average basis for a longer period in fig. 2.15.

There were two pronounced and curiously entangled consequences of the high water table.

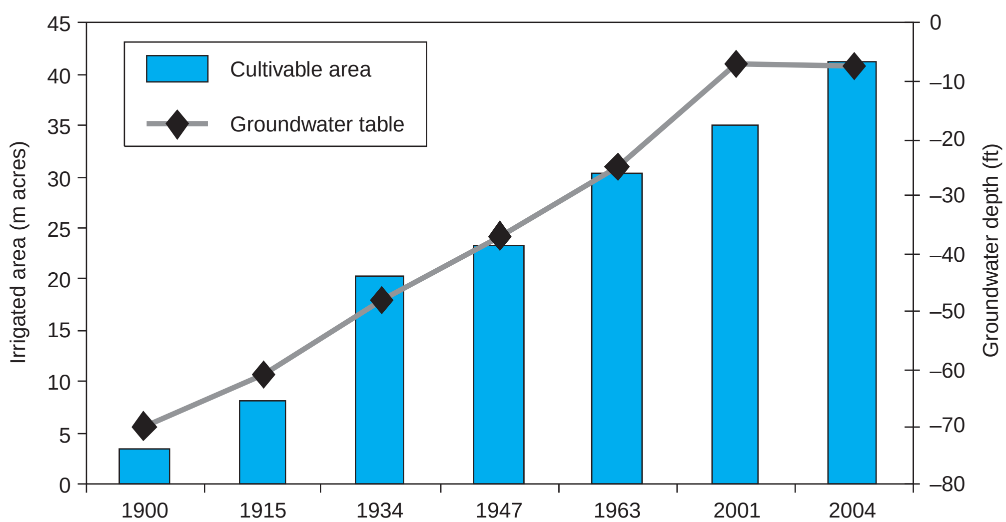
The first consequence was a revolution in the use of groundwater. At the time of Independence, groundwater use in the country was very

Fig. 2.14: The rise in groundwater levels (1860–1960)



Source: Bhutta and Smedema, 2005.

Fig. 2.15: Irrigation expansion and groundwater levels



Source: IWASRI/WAPDA, 2004.

limited—mainly through Persian wheels in the riverine aquifers, and the remarkable *karezes* (horizontal community wells) in Balochistan. This changed dramatically from the mid-1960s onwards as a result of several converging factors. As Green Revolution took hold, farmers needed much more reliable supplies of 'just-in-time' water. The canal system, however, with few hydraulic controls and rigid, predetermined schedules was derived for another, less precise type of irrigation and no longer met the more demanding needs of farmers.

Green Revolution was not just about seeds and fertilizers, a central part was also the emergence of the new modular pump plus diesel engine technology which offered every farmer an 'exit option', or at least one in which he could ensure that he had water when he needed it if the canal irrigation system failed. As emphasized by IWMI's Tushaar Shah:[30] 'we need to recognize that self-provision of water is the best indicator of the failure of public water supply systems. Tubewells proliferate in canal commands because public irrigation managers are unable to deliver irrigation on demand'. In addition, starting in the 1960s there were new forms of government support: credit and soft loan programs for pump sets and tubewells, and subsidies for electricity (with agricultural rates 40 percent less than normal rates in Punjab and Sindh, and 60 percent less in Balochistan and NWFP).[31]

The second consequence of the rapid rise in the groundwater table was much less benign. In its travel down and back up the soil profile, the water had absorbed the salts—sometimes very abundant where the sediments were of oceanic origin, as in large parts of Sindh—which were present in the soil. When the water evaporated the salts stayed behind, covering large areas of once-fertile fields with a sterile crust. The low-lying areas were now effectively barren, due to the combined effect of salt and sodden root zones. In the early 1960s, it appeared that the blessing of bringing water to the desert had ended up as a curse, with 4 million hectares of Pakistan affected by waterlogging and salinity, and apparently doomed to a watery, salty grave.

But just as there are unforeseen ecological consequences when man intervenes with nature on such a massive scale, so, too, is the power of human ingenuity also often unimaginable. So when President Ayub Khan visited Washington in 1962, he told President Kennedy of the curse of waterlogging and salinity. And thus started another chapter, for that conversation led to a major scientific enquiry by teams of natural and social scientists from Harvard University and their Pakistani colleagues into the causes of the problem, and the policy options for containing the damage. Intuition said that the balance needed to be restored by reducing the flows into the aquifers, by lining the canals. But the scientists said otherwise—the way to establish a new, not-so-close-to-the-surface water balance was to increase the amount of evapotranspiration (more crops), and to increase the circulation of water so that the salts would not accumulate in the root zone.

And so it proved, although not quite in the way that the scientists thought and advised. For that was an era of naïve faith in the capacity of governments to plan and implement, and of little confidence in the actions of individual peasant farmers. And so the proposed solution was large-scale installation of public tubewells, which would recycle groundwater back into the canals for subsequent use on the fields in the sweet water areas, and pump saline water out into drains in the saline areas. And so almost 20,000 high capacity (50–150 liters per second) government-run tubewells were installed from the 1960s onwards under the Salinity Control and Reclamation Project (SCARP).[32] In many of the worst affected areas, the SCARP formula worked wonders—converting

30 Tushaar Shah, 'Accountable institutions', Background Paper Report, 2005.
31 Robert Johnson, 'Private Tubewell Development in Pakistan's Punjab', IIMI, Lahore, 1989.
32 Ibid.

a saline wasteland back into a productive area. In fresh groundwater areas, the SCARP drainage tubewells doubled up as an additional source of irrigation. In saline groundwater areas the problem of disposing the highly saline effluent made the deep tubewell program far more complicated and the impact more limited.

As we have seen earlier, the farmers knew one thing better—they did not need larger supplies of unreliable water, but much more precise supplies which they could control. And so the great attack on waterlogging and salinity followed the compass of the scientists, but not their road map. The large SCARP tubewells were installed and did play a role; but it was the unfettered action of millions of farmers with their individual tubewells and their intensifying agriculture which reversed the rising tide of water and salt, and restored a still-uneasy balance.

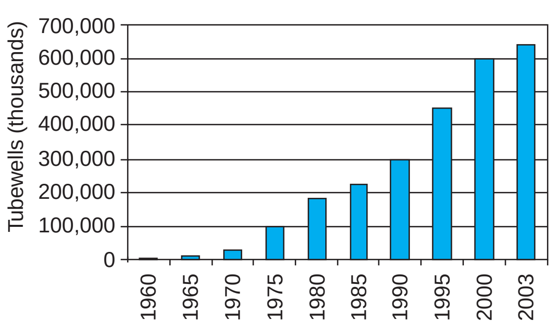
The net result of this interplay of supply- and demand-side factors was (fig. 2.16) an explosive increase in the number of tubewells for irrigation, primarily in the sweet water areas far from the ocean and nearer the mountains. (The investment on these private tubewells is of the order of 30–40 billion rupees.) In addition, many industries rely for their water supply on relatively 'clean' groundwater.[33]

In 1960, groundwater accounted for only 8 percent of the farm gate water supplies in Punjab. Twenty-five years later this figure was 40 percent, and at present groundwater use for agriculture accounts for more than 60 percent of the water at the farm gate in Punjab.[34] It is estimated that 75 percent of the increase in water supplies in the last twenty-five years is due to groundwater exploitation.[35] In the process, the great canal system became less of a water delivery mechanism, and more of a groundwater recharge mechanism. In Punjab, for example, 80 percent of the groundwater recharge is from the canal system.

Finally, it is instructive to consider the source of irrigation water by both quantity and value, in part because it shows the centrality of conjunctive use, and the fallacy of a Cartesian view, namely that 'groundwater is more important than surface water'. Figure 2.17 shows:

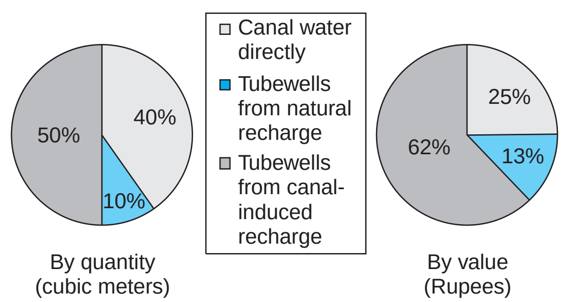
- that surface water is very important, accounting for 90 percent use for irrigation in Punjab (40 percent directly, and 50 percent indirectly). The massive infusions

Fig. 2.16: The growth in use of tubewells



Source: Steenbergen and Gohar, 2005.

Fig. 2.17: Quantities and values of irrigation supplies in Punjab, by source



Source: Steenbergen and Gohar, background paper.

33 Paper 11.
34 Ibid.
35 Ibid.

of surface water remain as important as ever. However, primarily because of the inability of the surface system to directly meet the just-in-time demands of modern agriculture, the delivery is through the circuitous (and costly in many ways) groundwater system

- that groundwater is very important, accounting for 60 percent of the water delivered at the farm gate and 75 percent of the value of water delivered

In summary, the last forty years witnessed an extraordinary demonstration of man's ability to think and act his way out of apparent dead ends. With equal doses of good thinking, good planning, and good luck, the people and government of Pakistan have addressed the twin challenges of producing more while simultaneously dealing with a fundamental threat to the natural resource base. The good thinking was the application of water science and economics by many of Pakistan's best and brightest in conjunction with many of the best water minds in the world. The 'solution' was not the obvious one of lining canals and putting less water on the land, but of increasing the use of groundwater, thus increasing evapotranspiration, drawing down the groundwater table, and leaching much of the salts down and out of the root zone. The good thinking and good planning were classic 'public goods'. The 'good luck' driver of this revolution was the modest but transforming tubewell and diesel engine, bought and managed by millions of farmers for the simple reason that this decentralized 'on-demand' source of water enabled them to greatly increase their crop yields and incomes.

The Response—Institutions

As described earlier, the hydraulic civilization of the Indus Valley in Pakistan was a very particular construction, cut from quite a different cloth from its apparently similar Indian cousin to the east. To the east, irrigation was a service provided to existing farmers who had long been engaged in settled agriculture. To the west, in the 'to-be-Pakistan' areas there were only pastoralists. There the role of the state was not only to lay out the physical infrastructure, but also to construct an entirely new colonial social structure.[36]

All of history is path-dependent, but in few places is the import of the initial decisions as profound and as clear as it is in this case, as dissected with extraordinary clarity by Imran Ali.[37] For the British, especially after the armed struggle of 1857, the Punjabis were the favored people of the subcontinent. It was only Punjabis—and not any of the other ethnic groups in future Pakistan—who were given land in the canal colonies in both present Punjab and Sindh, laying the basis for still-simmering perceptions of preferential treatment by the state. Furthermore, the colonial administration almost universally confined the selection of grantees to the 'upper' segments of village society (the lineages that controlled land and power at the local level) and excluded the lower status 'service' castes. And here another path-defining brick was laid, for these same landholding castes monopolized recruitment into the colonial military, with Punjabis comprising half of the entire British army. The military thus became a major actor in the emerging hydraulic society, through substantial land grants to military personnel, military farms, extensive horse-breeding schemes and stud farms, and remount depots for the cavalry. After 1900, the selection process worked within the framework of the Punjab Alienation of Lands Act, which listed hereditary landholding castes in each district, and forbade land transfers from 'agricultural' to 'non-agricultural' castes. Finally, those who were rewarded with land in the new canal colonies were

36 Paper 9.
37 Ibid.

primarily non-Muslim Punjabis from the east, laying the seeds for the massive problems of return migration in 1947.

The hydraulic state in Pakistan, then, created not just infrastructure, but social fabric, and it was a state which evolved in close association with the military. The hallmark of the Pakistani water bureaucracy at Partition was one of discipline, order, and the unquestioned supremacy of the state.

As described earlier, the pressing water challenges of Pakistan in the first decade after Independence were to build the infrastructure necessary for water and energy security. Given the dominance of the single trans-provincial Indus Basin and the need for basin-wide solutions, the logical response was WAPDA, a parastatal given a mandate of planning and building this infrastructure, and given the human and financial resources to do so. WAPDA proved to be very successful, developing a global reputation for world-class expertise in planning, construction, and operation.

Building institutions, however, is not a one-shot business. Trade-offs which were made quite sensibly at one particular stage of development, may not be appropriate as opportunities and values change. The key test is whether the physical and institutional systems are able to evolve as circumstances change. The very success of one endeavor gives rise to new challenges, and often challenges which are fundamentally different from those just mastered. It is now generally agreed that in recent decades the major water institutions—irrigation departments, WAPDA—have ossified, and not evolved in the face of changing circumstances, incentives, and demands.

Like all institutions, they were designed to meet a specific need at a particular historic juncture. In the case of the irrigation departments, the challenge of the nineteenth century was to put in place a low-cost extensive unlined canal system which could spread the then-abundant water onto a very large area at minimal cost for the production of foodgrains. The reasonable result was a system which had little ability to regulate flows within the channel systems or for flow measurement at either the main, branch, or distributary levels, and which ensured that pain was equally spread through an inflexible time-based allocation system. Some defects were cumulative and became apparent and important over time. The rigid and simple warabandi rules had many virtues, but also—like all human endeavors—vices. A major issue was that a time-based distribution system which did not take account of large canal losses ended up heavily discriminating against tail-enders. The 'take it when we give it; and use it or lose it' philosophy of warabandi also meant that the system became less aligned with the needs of irrigators as water became scarce, and as farmers shifted to varieties and crops which were more sensitive to the timing of water inputs. Farmers, as everywhere, adapted in ways that they could—by trading warabandi turns in the distributaries, and, eventually, by becoming heavily reliant on groundwater which they could control much better.

This 'involution' (to use Clifford Geertz's cultural anthropological construct)[38] meant that the irrigation departments slowly but surely shifted their focus from being a good service provider to being concerned substantially with ways in which the departments could serve the needs of the people in it. A greater and greater amount of the real attention of the irrigation departments was paid to the employment provided, and the opportunities for rent which could be extracted at all levels. The iron equation of rent seeking (monopoly + discretion – accountability = corruption) was at work even in colonial times: 'The subordinate bureaucracy was involved extensively in perquisites from agricultural owners.

38 Clifford Geertz, *Agricultural Involution: The Processes of Ecological Change in Indonesia*, University of California Press, 1963.

The larger and more powerful the latter, the more concessions they could obtain from corruption. This occurred in essentially two features: first, greater and inordinate access to irrigation water; and second, underassessment of water rates. This situation was exacerbated in Sindh, with more land under large landowners.'[39]

After Independence, this process was deepened and strengthened. The irrigation departments (a) maintained (to this day) their *monopoly* status; (b) developed ever-higher levels of *discretion* (so that at each level in each of the systems there are just a few people—sometimes one—who decide exactly how and why water is distributed to the various canals in the ways it is), and ensured that the water records remained (and remain) internal rather than public records; and (c) concurred with the cumulative tipping of the 'who pays' balance away from the user and towards the budget, thus creating a larger and larger discrepancy between the cost and value of water (and thus a larger and larger space for arbitrage) and less and less *accountability* to users. The end results are somewhat different in different areas, and always there are good people at various levels who push to hold the incentive structure at bay. But the systemic result is clear. The original discipline of the warabandi is severely damaged, with 'direct outlets' constituting up to 30 percent of flows in some canal commands. The rents extracted are huge: at the top of the feeding chain in some provinces crores of rupees allegedly are paid by officials for positions; at the executive engineer level offers of 'clean jobs at four times the salary' are rejected because of the major loss of income (formal and mostly informal) this would entail. Put all of this on top of a system where inequality (the so-called 'feudal problem') was built in from the start, and it is not surprising that the single most striking feature to experienced outsiders is the very high level of mistrust in the water management system of Pakistan. The contemporary situation is summarized well by Imran Ali: '...with declining administrative efficiencies, overstretched organizational resources, degraded service delivery, and unchecked corruption, there appears to be a glaring failure of centralized irrigation management.'[40]

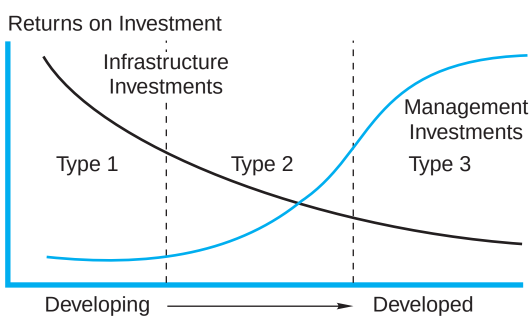
WAPDA has a shorter history driven by the original planning and construction of major infrastructure mission. It performed this heroically, in many respects, with an organization of high morale and competence building Mangla and Tarbela, and, in the process overcoming enormous technical challenges which threatened the integrity of structures which have served the country so well. With the imminent completion of Indus Basin Project and Tarbela Dam, the country's emphasis shifted to addressing waterlogging and salinity problems, both of which were included in WAPDA's founding Act. In 1973, the federal government launched an 'accelerated program' of waterlogging and salinity control (SCARP). WAPDA, which had skimmed off the cream of the technical expertise earlier available in the irrigation departments, was the natural choice to play the lead role in the construction of SCARPs as well as new canals that cross provincial boundaries. While federal resources for SCARP were allocated to the provinces, they were obliged to use WAPDA as the 'contractor'. Completed works were 'handed over' to the irrigation departments, who took over O&M responsibility, invariably with reluctance and reservations. Besides operating and maintaining the existing three major reservoirs, WAPDA continues to perform some of these new responsibilities to date, even though this takes opportunities for the irrigation departments to develop their own capacity. With the ongoing reforms of WAPDA's Power Wing and the advent of the drought and emerging water shortages, WAPDA has once again been

39 Paper 9.
40 Ibid.

thrust into the limelight. The residual Water Wing of WAPDA has shifted its focus towards developing water resources envisaged in its ambitious 'Vision 2025'. WAPDA is constructing several medium-size reservoirs as well as major irrigation extension projects (Greater Thal and Kachi Canals), while planning for and advocating major new reservoirs.

In many ways, these key institutions of the hydraulic state of Pakistan resembled and in some cases were modeled after similar institutions in developed countries which had used water infrastructure as the platform for growth in arid lands. And as with all such countries—including USA, Mexico, Brazil, South Africa, Egypt, India, Thailand, Australia, and China—the process of institutional change has been protracted, fitful, difficult, and incomplete. In the process of a similar review with The World Bank in China, the Government of China developed a useful schematic representation (fig. 2.18) of the institutional challenge in moving from an era 'Stage 1', in which building infrastructure is the dominant challenge, to 'Stage 2', where infrastructure still had to be built, but maintenance and management of existing infrastructure and resources become the primary challenge.

Fig. 2.18: Rates of return on investment on infrastructure and management of water resources



Source: The World Bank, 2003.

Long as the distance is to go, Pakistan has made important progress in some critical areas.

Institutions are not just organizations, but the 'rules of the game' which govern relationships among organizations and people.[41]

The most fundamental of the instruments which affect water management are those which define who is entitled to do what with water. At the apex level there is the Indus Waters Treaty which defines, unambiguously and in perpetuity, the water that belongs to Pakistan. One of the great virtues of the Treaty was that by the clarity of definition, and the permanent nature of the rights so established, it motivated India and Pakistan to focus on how they would use the water that was theirs (and not on endless distracting haggling about what water they should have). Recent differences on 'differences' which have arisen in the interpretation of the Indus Waters Treaty have confirmed the foresightedness of the framers of the Treaty (who set up well-defined mechanisms for dealing with these), but have also suggested that there is room for modernizing the bilateral dispute resolution mechanism so that questions can be resolved in a more predictable and time-bound manner by the Indus Waters Commission.

In a set-up where most depend on a single river system, clarity on entitlements at the next level down—between provinces—was equally important and, in many ways, equally disputatious. Starting in 1935, there were a series of high-level commissions constituted first by the British and then Pakistani governments to try to get a lasting agreement on the division of the Indus system waters among the provinces. After many failed attempts, in 1991, agreement was reached on the provincial entitlements to waters of the Indus Basin (see box 2.1).[42] The Water Accord is a great

41 Douglass North, *Institutions, Institutional Change and Economic Performance*, Cambridge University Press, 1990.
42 Paper 6.

achievement since it defines, unambiguously and in perpetuity, the shares of available water which can be used by each of the provinces. It is worth recounting the bases for the Accord.

- The basis for entitlements was prior existing use of water: 'the record of actual average system uses for the period 1977–1982 would form the guideline for developing a future irrigation pattern. These ten daily uses would be adjusted pro-rata to correspond the indicated seasonal allocations of the different canal systems and would form the basis for sharing shortages and surpluses.' This meant that 'the existing uses of water supplies to the provinces, which they have so far been getting as ad hoc allocations, remain untouched'.
- The Accord specifies an automatic process for adjusting entitlements depending on availability. 'These ten daily uses would be adjusted pro-rata to correspond the indicated seasonal allocations of the different canal systems and would form the basis for sharing shortages and surpluses.'
- In case a province was not in a position, for the time being, to make full use of its allocation, that surplus may be used by another province without acquiring a right to it.
- The provinces were, in law, given freedom by the Accord to use their allocation in any way that they want: 'there would be no restrictions on the provinces to undertake new projects within their agreed shares', and 'the provinces will have the freedom within their allocations to modify system-wide and period-wise uses'. In practice, however, the fact that provincial entitlements were explained as aggregates of specified historical uses in different canal commands meant that the Accord was thus implicitly specifying the distribution of the provincial shares to each of the existing canal commands, allocations which, in Punjab at least, are followed to this day. Similarly, the historic allocations within each canal command among the distributaries is also defined historically and followed, and similarly down to the outlet level, below which the warabandi system specifies shares.
- What this implies is that in major parts of the Indus Basin irrigation system there are, in fact, well-defined entitlements at all levels, from the international, through the inter-provincial, down to canal commands, distributaries, outlets, and ultimately to each farmer on a water course.

This well-established set of water entitlements is a tremendous institutional asset for Pakistan as it moves towards modern water management. That said, the entitlements have not been implemented, at any level, with transparency and accountability. This has bred widespread belief that the discretion, which is always present when there is no transparency, is widely abused. The extent of actual abuse remains unclear—officials will, in one breath, say that administration is 'by the book' at all levels, and then say that a move towards transparency will be opposed because it will reduce the discretion which officials have been used to exercise at all levels. If existing entitlements at all levels were publicized, along with actual flows, and if this was done in a way such that the information was easily accessible, and comprehensible to lay people, then a great deal of the discretion, corruption, and mistrust would evaporate. In addition, farmers equipped with reliable information on what they would get each season, and confidence that it would actually be delivered, would be able to improve substantially the returns to the crops they grow. And, of course, there would be much greater pressure on the irrigation departments for actually providing that to which users are entitled.

The installation of a telemetry system at all barrages and headworks of canals is a vital first step in this process. With periodic, credible calibration,

Box 2.1: The Water Accord of 1991

There was an agreement that the issue relating to apportionment of the waters of the Indus river system should be settled as quickly as possible. In the light of the accepted water distributional principles, the following apportionment (in MAF) was agreed to:

	Kharif	Rabi	Total
Punjab	37.07	18.87	55.94
Sindh*	33.94	14.82	48.76
NWFP	3.48	2.30	5.78
Balochistan	2.85	1.02	3.87
Civil Canals** (NWFP)	1.80	1.20	3.00
Grand Total	79.14	38.21	117.35

* Including already sanctioned urban and industrial uses for metropolitan Karachi.
** Ungauged civil canals above rim stations.

Under Section 14 (b), the record of actual average system uses for the period 1977–82 would form the guideline for developing future regulation pattern. These ten daily uses would be adjusted pro-rata to correspond to the indicated seasonal allocations of the different canal systems and would form the basis for sharing shortages and surpluses on all-Pakistan basis.

Balance river supplies, including flood supplies and future storages, shall be distributed as 37 percent each to Punjab and Sindh, 12 percent to Balochistan, and 14 percent to NWFP.

The need for certain minimum escapage to sea below Kotri to check sea intrusion was recognized. Sindh held the views that the optimum level was 10 MAF which was discussed at length, while other studies indicated lower/higher figures. It was, therefore, decided that further studies would be undertaken to establish the minimal escapage needs downstream Kotri.

All efforts would be made to avoid wastages. Any surplus used by provinces would not establish a right to such uses.

Source: Abstract from Water Accord 1991.

and public access to the data on the Internet, this will substantially improve public confidence in the implementation of the Water Accord. We return to this theme, and the exciting possibilities for progress, in Chapter 3 of this Report.

Finally, a profound institutional change over the last thirty years throughout the subcontinent has been the de-formalization of the water economy. Recall that over the past twenty years, 75 percent of the expansion of irrigated area has been 'outside of the formal system', and driven by the individual decisions and investments of millions of farmers. In many ways this de-formalization has been a great success. But nothing lasts forever, and now it is clear that the laissez-faire attitude to groundwater exploitation, which worked so well in recent decades, will not work now that the challenge has changed from underexploitation to incipient overexploitation of many aquifers. The formal institutions have not been doing very well in their 'home territory' (providing services and maintaining their infrastructure); now they will not only have to improve greatly there, but also gear up for the new and very difficult task of conjunctive use of surface water and groundwater, and co-managing these in collaboration with the users (discussed in detail in Chapter 3).

CHAPTER 3

THE CHALLENGES OF THE PRESENT AND THE NECESSARY RESPONSES

There has been much deliberation in Pakistan in recent years on how to reorient the state to meet the massive water development and management challenges. At the national level, this includes deliberations reflected in the Ten Year Perspective Plan (Planning Commission, 2001), the National Water Policy (Ministry of Water and Power, Draft 2002) and the latest of October 2002, the Pakistan Water Sector Strategy Study by the Ministry of Water and Power, which includes three main documents: the National Water Sector Profile, which summarizes and details all aspects of the water availability and utilization as they exist today; the National Water Sector Strategy, which identifies the key issues and objectives for the water sector and proposals for planning, development, and management of water resources and their use in all water sub-sectors; and the Medium Term Investment Plan (MTIP), which identifies the key programs and projects which should be undertaken by 2011, and which are designed to achieve the initial objectives of the Strategy.

As summarized in the background paper by Sardar Tariq and Shams-ul-Mulk, two of Pakistan's most eminent water practitioners, the core issues emerging from these documents are:

- the desirability of attaining financial sustainability
- defining clearly the water rights and entitlements both for surface water and groundwater
- creating trust and transparency in equitable water distribution and improving services
- rationalizing water charges and increasing productivity
- clearing huge backlog of maintenance and modernizing the existing infrastructure
- developing additional infrastructure for storage, distribution, and delivery

It is to these and related challenges, and the responses they demand, that we now turn our attention.

Adjusting to the Needs of a Changing Pakistan

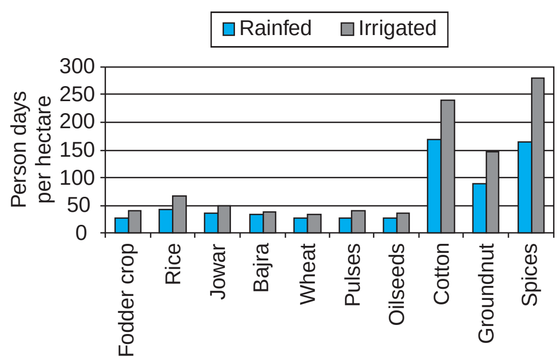
Pakistan is in the throes of profound demographic and economic changes, which have major implications for water management.

First, there are major changes within agriculture and rural areas. Until relatively recently, as described by Shahid Ahmad,[1] 'agriculture was characterized by low cropping intensity and production dominated by low-water requirement crops like food grain (wheat, maize, sorghum, and millets, pulses, and oilseeds)…. During the last decade, however, the pressure on water has drastically increased, with more competition for quantity and quality of irrigation water within the irrigation sector.' There is now the emergence of a class of farmers known as 'progressive farmers', who are growing high-value crops for both domestic and export markets, and who have leapfrogged out of the old 'brute force' type of agriculture into 'precision agriculture', in which water plays a central role not just in evapotranspiration, but as a mechanism for delivering fertilizers and pesticides to crops. Incipient as it is, there is already evidence that this agricultural diversification is

[1] Paper 5.

transforming the countryside in many ways. As in other parts of the world, this agricultural diversification transforms rural life (and water management) in many ways. High-value crops produce many more jobs per drop of water and per unit of land than traditional crops (fig. 3.1). And they have deeper ripple effects into the rural

Fig. 3.1: Employment generation by crop



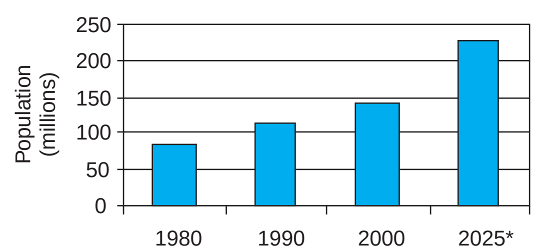
Source: Bhatia, 2005.

economy, both backward (since they demand more inputs) and forward (since they give rise to a variety of off-farm processing activities). These changes are spurring substantial employment challenges within rural areas, with about 30 percent of people in rural areas already dependent on non-agricultural sources of income.[2] 'Contract farming', often led by progressive farmers, is likely (as it has in other countries)[3] to be an important mechanism for bringing unified packages of technology, services, and marketing, in making the transition to high-valued agriculture, and in lifting large numbers of people—both those who stay in agriculture and those who move into the associated service sectors—out of poverty.

In short, rural areas in many parts of Pakistan are changing in fundamental ways, captured in vivid prose by Akhter Hameed Khan, the great observer and social activist: '(In the) rural areas of Pakistan…the subsistence economy has given way to a cash economy. Education has changed people's attitudes. New professions, business and commerce have created new relationships and the "culture of poverty" is dead or dying. Government inputs, however inadequate and badly implemented, have changed the physical and social environment. …the changes that have taken place, have created a new society and a new culture…'[4]

Second, there are major demographic and economic changes taking place. Population growth (fig. 3.2) is very high—from 80 million people in 1980, the population will be 230 million in 2025.

Fig. 3.2: Population growth in Pakistan

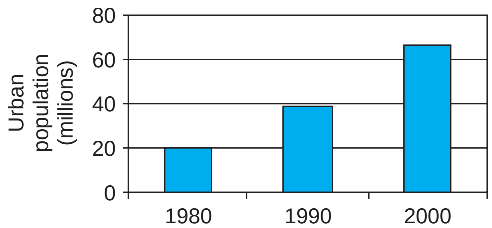


Source: Siegmann and Shezad, 2005.

This means that aggregate water demands have increased sharply and will continue to do so. Simultaneously, Pakistan is urbanizing rapidly—the percent of the population which lives in urban areas has doubled over the past twenty years, and the absolute size of the urban population has increased by a factor of 3.5, going from 20 million in 1980 to 70 million in 2000 (fig. 3.3). Associated with this urbanization is a rapid increase in the role of manufacturing (fig. 3.4) which now contributes about the same as agriculture to the GDP of Pakistan. Poverty declined during the 1980s but has stagnated until recently (fig. 3.5).

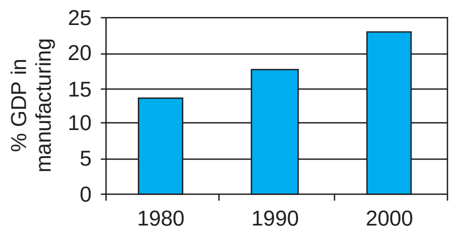
2 Edward Luce, 'Cure for India's rural woes lies in ability to escape the farm', *Financial Times*, 7 December 2004.
3 For example Brazil, as documented in World Bank Water Resources Sector Strategy, 2003.
4 Arif Hasan, in John Briscoe, 'Two decades of change in a Bangladeshi village', *EPW*, Vol. XXXVI, No. 40, 26 October 2001.

Fig. 3.3: Urban population growth in absolute numbers



Source: Siegmann and Shezad, 2005.

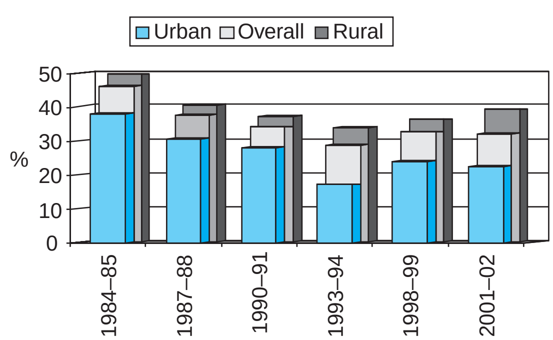
Fig. 3.4: Proportion of GDP in manufacturing



Source: Siegmann and Shezad, 2005.

These changes of scale, location, and composition have profound implications for water management in the future. Most obviously they will mean a Malthusian arithmetic, in which growing demands will put unprecedented pressure on a limited quantity of available water. But it also means that demands that could once comfortably be met at a local level will start having regional implications, and thus implications for other sectors. All major cities of Pakistan, with the exception of Islamabad and Karachi, depend on tubewells which tap local aquifers for their raw water supplies. Lahore, for example, has 300 wells that supply the city with water. This arrangement functioned well as long as the cities were small and the aquifers were not contaminated. But now the explosive growth in demand—which is expected to grow from 4 percent to 15 percent of aggregate water demand in the next twenty years[5]—has meant that local aquifers are being drawn down very fast. And more ominously, large quantities of untreated, often highly toxic municipal and industrial wastes are being dumped in open drains, and are leaching down into the aquifers. As discussed in more detail in the section on the environment later in this Report, more than 90 percent of municipal and industrial wastes are simply dumped, untreated, into the local aquatic environment with major consequences for the environment and human health now, and since natural aquifer cleansing takes place over decades or even centuries, for very long periods into the future.

Fig. 3.5: Prevalence of poverty in Pakistan



Source: Qureshi, 2005.

Finally, there is a growing understanding that there are major environmental needs for water—in sustaining rivers, wetlands, and coastal areas, including the Indus Delta (discussed in the later section on the environment). As understanding and income grow, so these needs (still often described as 'wastage', as in 'wastage to the sea') will become important claimants on the ever-scarcer resources of the country.

In summary, then, in the past water resources management in Pakistan was largely synonymous with management of water for irrigation. While irrigation will continue to use the majority of water in the foreseeable future, management of water resources in Pakistan will become a much more multisectoral affair. Water use for towns and industries will become a major local and regional

5 Paper 2.

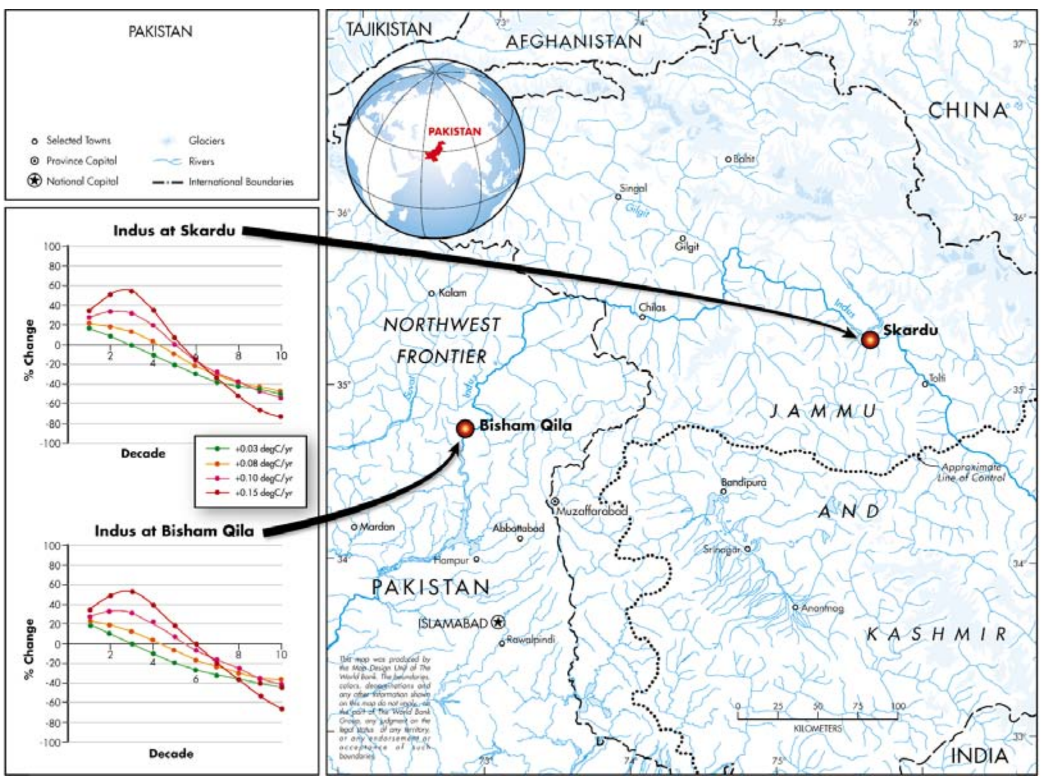
issue, and the use of water for environmental purposes will demand more water and more attention. And issues of water quality will grow to be as important as issues of quantity. Water managers in Pakistan should, like their counterparts in India, be bracing for a turbulent future.[6]

Preparing for Climate Change

There are strong indications that climate change is likely to affect Pakistan in a number of ways. There is much uncertainty about some, and little uncertainty about other of these impacts.

The Indus Basin depends heavily on the glaciers of the western Himalayas which act as a reservoir, capturing snow and rain, holding the water and releasing it into the rivers which feed the plain. It is now clear that climate change is already affecting these western glaciers in a dramatic fashion (far more seriously, for example, than in the damper eastern Himalayas). While the science is still in its infancy, best estimates[7] (fig. 3.6) are that there will be fifty years of glacial retreat, during which time river flows will increase. This—especially in combination with predicted more flashier rainfall—is likely to exacerbate already serious problems of flooding and draining, especially in

Fig. 3.6: Accumulated effects of deglaciation on Indus river flows over ten decades



Source: Rees *et al.*, 2005.

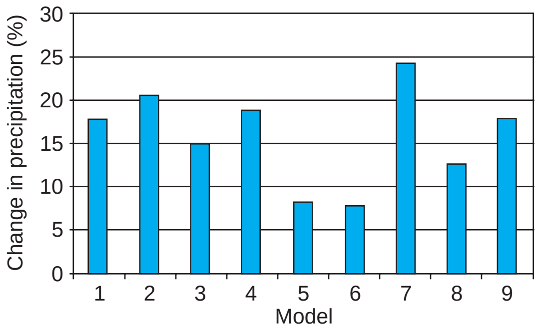
6 Briscoe, John, and R.P.S. Malik, *India's Water Economy: Bracing for a Turbulent Future*, Oxford University Press, New Delhi, 2006.

7 Rees, Gwyn, and David Callins, 'An assessment of the potential impacts of the Himalayas', Draft Report, HR Wallingford, April 2004.

the lower parts of the basin, in the next few decades. But then the glacial reservoirs will be empty, and there are likely to be dramatic decreases in river flows—as shown in fig. 3.6, conceivably by a terrifying 30 percent to 40 percent in the Indus Basin.

Deglaciation is, of course, not the only way in which climate change is likely to affect the availability and timing of runoff in the sub-continent. The Intergovernmental Panel on Climate Change (IPCC) uses ten General Circulation models, nine of which project that precipitation during the summer monsoon will increase substantially (fig. 3.7).

Fig. 3.7: Change in South Asia summer rainfall predicted by nine General Circulation Climate Models



Source: IPCC, 2004.

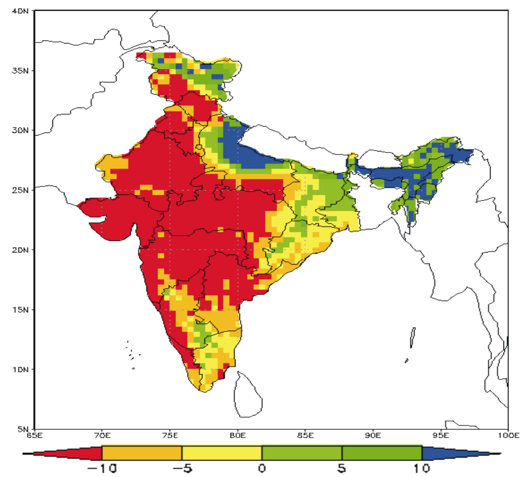
The IPCC has used a regional model (curiously based on the one global model which showed reduced precipitation) to explore possible changes in the number of rainy days and in extreme rainfall in India (with obvious extrapolations to Pakistan). This model predicted a decrease in the number of rainy days (fig. 3.8) but substantial increases in extreme precipitation events (fig. 3.9).

What does seem likely is that climate change will increase the variability of already highly variable rainfall patterns, requiring greater investments in managing both scarcity and floods.

From this fog of information the following conclusions emerge very clearly:

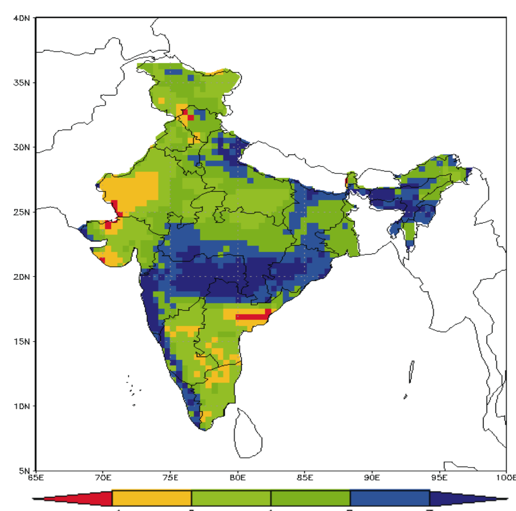
- Deglaciation is going to result in inadvertent 'mining' of the water banks of the Himalayas. This is going to result in increased runoff (and silt loads) for a few decades, to be followed by major, permanent reductions in runoff.

Fig. 3.8: Predicted change in number of rainy days from the 'decreased rainfall' IPCC model



Source: IPCC.

Fig. 3.9: Predicted change in rainfall intensity (in mm per day) from the 'decreased rainfall' IPCC model



Source: IPCC.

- Climate change is likely to substantially increase overall monsoonal rainfall in Pakistan, but this is likely to be poorly distributed in the sense that much of the additional rainfall is likely to be in high-intensity storm events.
- The area affected by flooding is likely to increase substantially in the coming decades as the glaciers melt and as rainfall intensity increases.
- Water scarcity is forecast to become widespread in Pakistan in a future which is, given the fact that changing water use habits takes decades to effect, just around the corner. The next several decades offer a window of opportunity, in which there is likely to be more water, to prepare for a future in which the quantity of water available is likely to be substantially reduced.

What, then, are the implications of these changes? Despite the many uncertainties, they include: a need for large investments in water storage. As described earlier, Pakistan actually has relatively little capacity to store water. For example, whereas there is about 900 days of storage capacity on the Colorado and Murray-Darling rivers, there is only about 30 days of storage capacity in the Indus Basin. Accordingly, major investments need to be made to increase capacity to store water, in both surface water and groundwater reservoirs, in projects small (such as local rainwater harvesting) and big (such as large dams). In so doing, however, there is a need for concomitant adoption of quite different development and management strategies. It must be understood that storage projects should primarily be for improving the reliability of supplying existing demands and for meeting historically deprived environmental uses, and not for creating and serving new demands (which simultaneously inevitably means curtailing existing downstream uses.)

The melting of the glaciers offers Pakistan a window of opportunity, first, to make productive use of this 'windfall', but also to understand that this window should be used to prepare for the very hard days, with substantial flow reductions in the Himalayan region, which lie ahead.

While the exact shape of the future climate regime is uncertain, it is very likely that there will be greater variability—both of droughts and floods. As was shown in a detailed examination by the National Atmospheric and Oceans Administration of US water practices, the best preparation for managing unpredictable future changes is to put in place a water resource infrastructure and management system which is driven to a much greater degree by knowledge (including but not limited to hydrologic knowledge), and which is designed and operated to be much more flexible and adaptive.

Flooding, which already affects substantial areas of Pakistan (including areas in and outside of the Indus Basin), has yet to be effectively addressed. Pakistan is only now starting to explore the combinations of 'hard' interventions (to protect high-value infrastructure) and 'soft' interventions (smart adaptation to living with floods, including changing land use patterns and cropping patterns, and construction of emergency shelters for people and animals), which have been used to considerable effect in countries as diverse as the United States[8] and Bangladesh,[9] and are globally-accepted best practice.

Adapting to Scarcity: An Imminent 'Water Gap'

Pakistan is close to using all of its available water resources in most years. Shahid Ahmad[10] has

8 Miller, Barbara A., A. Whitlock, and R.C. Hughes, 'Flood Management—the TVA experience', Tennessee Valley Authority, Oak Ridge, 1998.
9 Ainun Nishat, powerpoint presentation on flood management in Bangladesh, World Bank Water Week, 2005.
10 Paper 5.

summarized the situation as follows: 'The long-term sustainable average annual net inflow of the Indus Basin is 175 billion m^3. Canal diversions over the same period have averaged 128 billion m^3, with an average of 35 billion m^3 flowing downstream of Kotri Barrage to the sea…'. In a system with little storage and considerable variability, however, averages can be deceptive—fig. 3.10 shows, again in Ahmad's words, that 'Pakistan is now essentially at the limit of its surface water resources.'

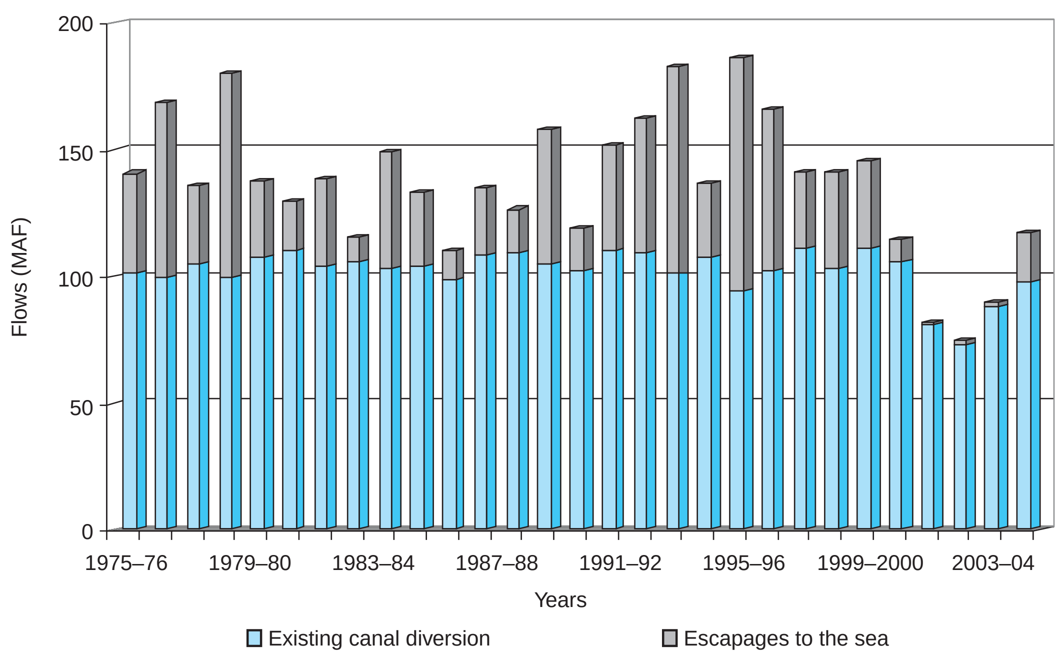
Similarly, on groundwater:[11] 'Estimates of groundwater availability have been made in several studies, and average around 63 billion m^3. Abstraction of groundwater for irrigation and for urban and rural drinking water supplies is estimated as about 52 billion m^3. While these figures may suggest some potential for further exploitation, they are based on very little actual monitoring of the resources or the abstraction and should be treated with caution. Other evidence, such as increasing salinity of groundwater due to redistribution of salts in the aquifer and declining water levels, suggests that there is little, if any, further potential for groundwater exploitation.'

The bottom line is clear—Pakistan is currently close to using all of the available surface water and groundwater, yet it is projected that over 30 percent more water will be needed over the next twenty years to meet increased agricultural, domestic, and industrial demands (fig. 3.11).

Getting more Product per Drop: The 'Performance Gap'

There are several corollaries to the fact of looming water scarcity in Pakistan: the focus of attention

Fig. 3.10: Annual canal diversions and 'escapages to the sea'



Source: The World Bank analysis.

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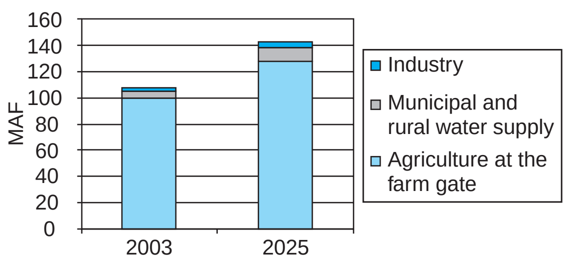
Fig. 3.11: Projected demand for water

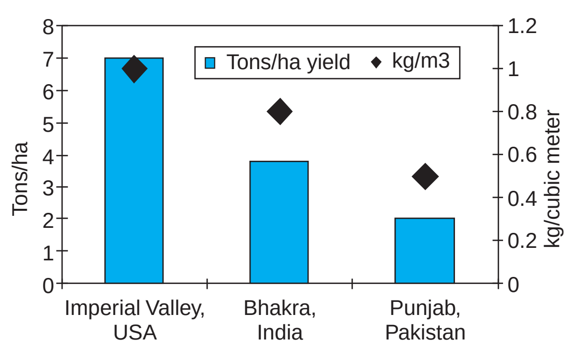


Source: Hasan, 2005.

will have to shift from productivity per unit of land to productivity per unit of water, and the major challenge will be to get more from less—more crops, more income, more jobs per unit of water.

A basic point of departure is that there is abundant evidence that irrigated agriculture in Pakistan is not efficient. As shown in fig. 3.12, a comparison of wheat yields in California (USA),

Fig. 3.12: Wheat yields per unit of land and water

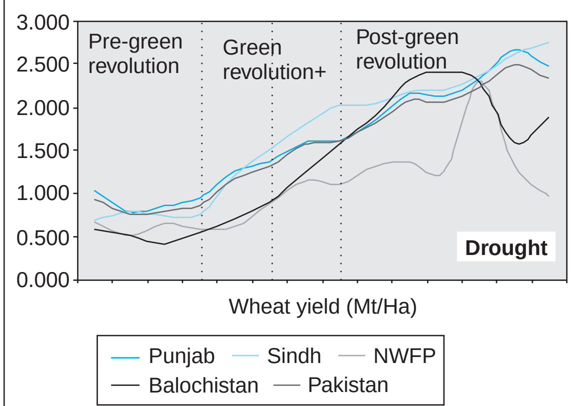


Source: Ahmad, 2005.

the Indian Punjab, and the Pakistani Punjab shows that productivity in Pakistan relative to India and California is about 3:6:10 per unit of land, and about 5:8:10 per unit of water.

A second important macro perspective emerges from data analyzing the relationship between overall water availability and production. As shown in fig. 3.13, drought has a dramatic impact on production in non-irrigated areas, but remarkably

Fig. 3.13: Drought effect on yields



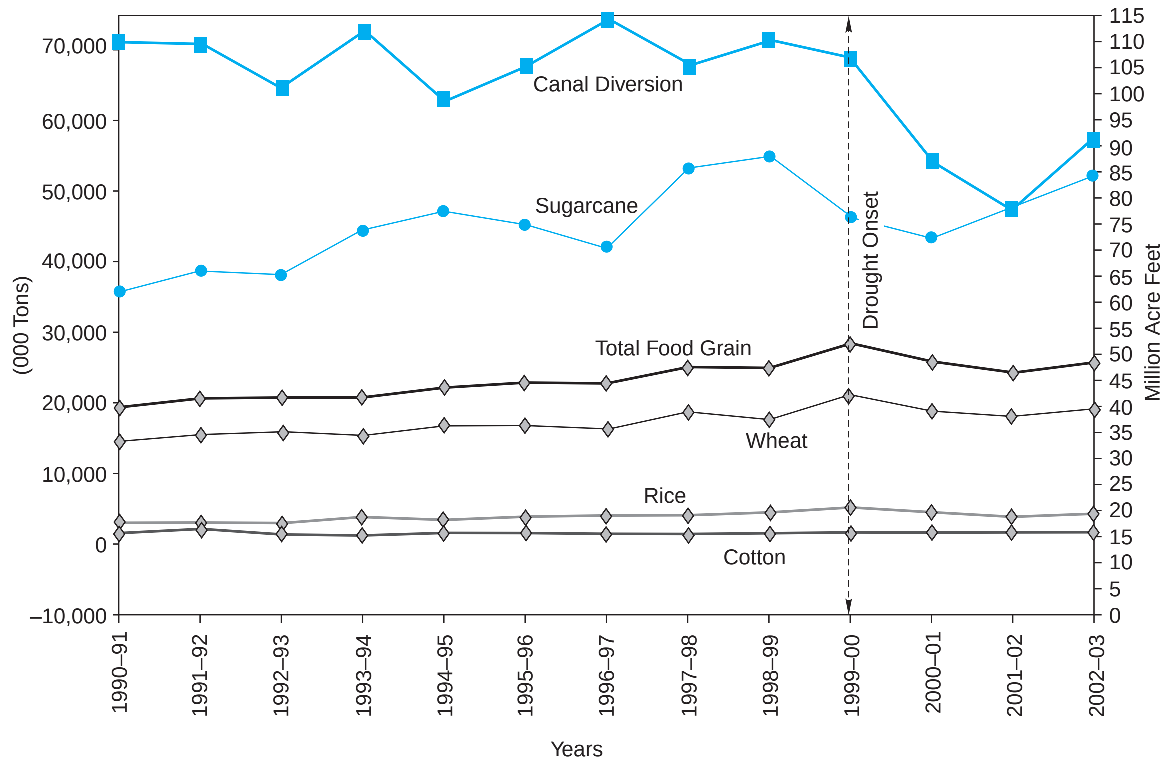
Source: The World Bank, 2003.

little impact in irrigated areas. This is confirmed in fig. 3.14, which shows the very modest impact of drought on irrigated crops and, indeed, by the production figures for April 2005. Despite an unusually dry monsoon season (with Tarbela not filling for the first time) and despite some drastic prognostications of production levels as low as 12 million tonnes, Pakistan has had a bumper wheat crop: overall production was 22 million tonnes, 10 percent higher than the government's target.[12] These data suggest that irrigation is obviously vital for high and stable levels of crop production, and that a lot more efficiency ('crop per drop') can be squeezed out of the system.

As pointed out by Shahid Ahmad,[13] 'the most important basic principle in irrigation is to deliver a reliable supply of water. In an uncertain environment, farmers will not invest in seeds, fertilizers, and land preparation, and consequently yields and water productivity will suffer. A second basic principle has to do with timing. At various times in a crop's growth cycle, water stress can be particularly damaging'. In principle water

12 'Minding the wheat market', Editorial, *Dawn*, 14 April 2005.
13 Paper 5.

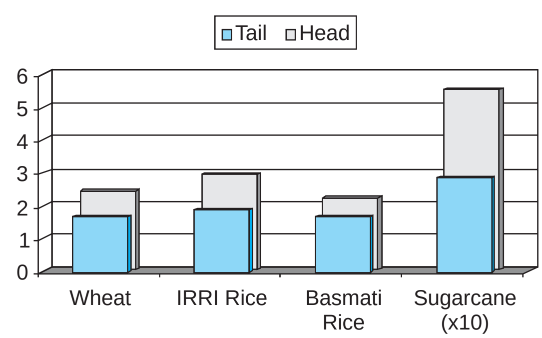
Fig. 3.14: Crop production and drought



Source: The World Bank, 2003.

entitlements for all users of an outlet are equal under the warabandi system; in fact numerous studies have shown that there is a high degree of maldistribution which favors head-enders and discriminates against tail-enders, with serious implications for equity and productivity. Within watercourses, tail-enders typically get about 20 percent less water than those in the middle, who in turn get about 20 percent less than head-enders.[14] Figure 3.15 shows how head-enders systematically do much better than tail-enders, and fig. 3.16 shows that there could be major overall production gains by re-distribution of water currently used in excess by head-enders.

Fig. 3.15: Crop yields for head- and tail-enders



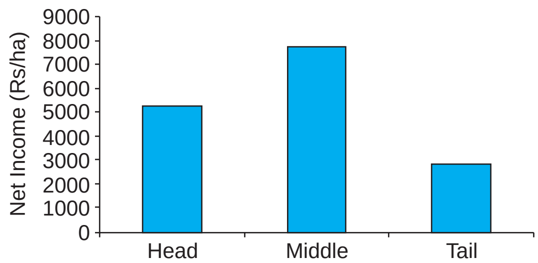
Source: Qureshi, 2005.

A detailed analysis by IWMI[15] (fig. 3.17) shows that inequity in water distribution in the Pakistani Punjab is substantially worse than it is in the Indian Punjab. At the high productivity end, farmers in

14 Paper 2.

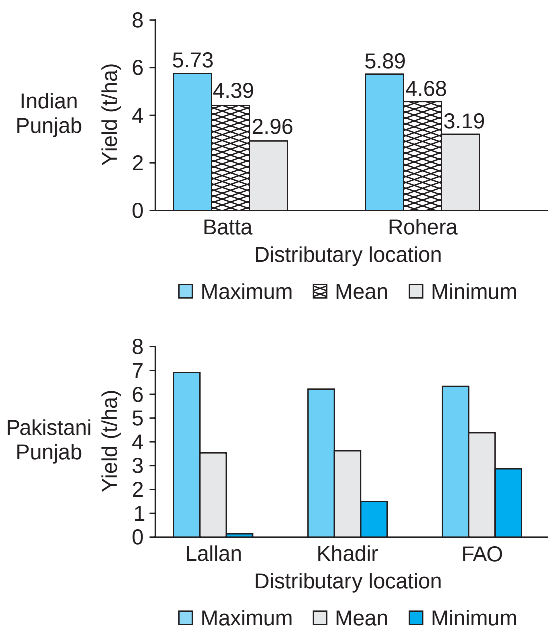
15 International Water Management Institute Research Report No. 65.

Fig. 3.16: Returns to irrigation location in a canal



Source: Bhatia, 2005.

Fig. 3.17: Differences in wheat yields across distributaries



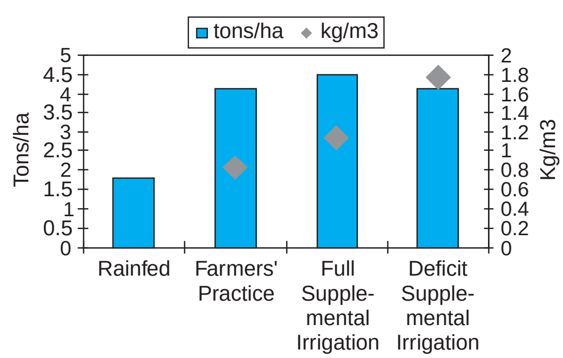
Source: IWMI, 2003.

Pakistan are doing at least as well as farmers in India, but the spread between high- and low-yields is much greater in Pakistan, due in part to more unequal water distribution. These inequalities play an important role in the explanation of the lower productivity of Pakistan's irrigation systems. When these supply uncertainties are resolved, the impacts on productivity can be very large: the productivity of water from tubewells (available on demand) is twice that of canal water.[16]

For these reasons, there is broad agreement that 'the most promising intervention is to provide equitable water distribution to the head- and tail-end reaches',[17] with the issues of transparent administration of water entitlements, and accountable, efficient provision of irrigation services again being key elements.

There is also growing evidence that different water application regimes could greatly increase the amount of 'crop per drop'. Studies conducted by PARC and IWMI indicated that extensification rather than intensification could greatly increase productivity. As shown in fig. 3.18, deficit and supplemental irrigation produce much higher returns per unit of water compared to complete irrigation under farmers' practices and rainfed farming systems. The deficit and supplemental irrigation had increased the water productivity two- to three-folds compared to rainfed systems.[18]

Fig. 3.18: Yield and water productivity of wheat under different irrigation scheduling strategies



Source: Ahmad, 2005.

16 Paper 5.
17 Ibid.
18 Ibid.

In situations of water scarcity, however, it is important to look at productivity not just in terms of units of water applied, but to take into account that return flows to sweetwater aquifers are not 'losses', but water that is still available for other uses and users. (This is a concept that has long been applied in the subcontinent—for example, in the 1950s Indus Waters Treaty discussions of the net effects of upstream abstractions in Kashmir on the availability of water from the Jhelum and Chenab.[19])

Consider the basic arithmetic of local water balances under equilibrium as shown in the equation below:

Applied water = consumed water + non-consumed water

Consumed water = beneficial evapotranspiration + non-beneficial evapotranspiration

Non-consumed water = water recharging the aquifer + water returning to streams

Now consider three issues of productivity—water productivity, energy productivity, and economic productivity.

(a) Water productivity: In simplified terms the basic objective of increasing productivity of water is:

- in sweetwater areas—the measure of water productivity is to maximize the proportion of consumed water which goes to beneficial evapotransipration (Et) (and minimize the proportion due to non-beneficial Et.)
- in saline areas—here water which goes to the aquifer is no longer of any use, and therefore the objective is to reduce the sum of water lost to non-beneficial evapotranspiration and water which is added to the saline aquifer.

(b) Energy productivity: Canal water which infiltrates into sweetwater aquifers is not lost, but it takes energy to lift the water again. And therefore it is not appropriate to consider very leaky systems to be 'fine', especially as aquifer depths increase.

(c) Economic productivity: If 'the prices—including those relating to externalities—and incentives are right' then the summation of all costs—water, energy, and those of greater precision in the application of these and other inputs—are all summed up in the economic value of a crop and it is thus the 'economic return' criterion which is the appropriate one in assessing the efficiency of different regimes.

Shahid Ahmad's background paper[20] looks at the issue of water productivity from the Et perspective. The major findings include:

- There is considerable loss of water due to inefficient irrigation application at the field level. Because of poor surface irrigation hydraulics and unleveled fields, farmers apply enough water to cover the highest spot in the field. The result is not only excessive non-beneficial Et, but also loss of nutrients especially nitrates, and pollution of the groundwater with these excess applications of agricultural chemicals. This is a particular problem in the canal commands which have high Authorized Canal Water Allowances.
- There is much non-beneficial Et due to weeds, shrubs, and plants that grow along the waterways, weeds in fallow fields, and vegetation in wastelands. As the weed infestation is very high in the Indus Basin, it is expected that almost 20–30 percent of water is consumed by weeds and thus regarded as non-beneficial Et.
- Watercourses are the main source of weed seeds to the fields. Weeds grown along the watercourse shed seeds which ultimately reach the field through the irrigation water. Weeds in cropped fields not only reduce crop yield but also consume water. All weeds

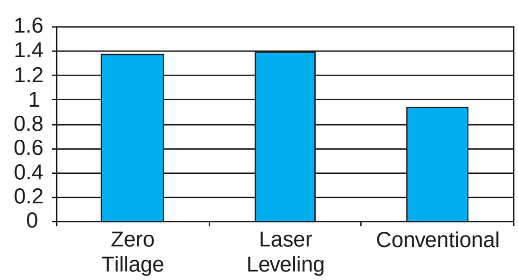
19 N.D. Gulhati, *Indus Waters Treaty: An Exercise in International Mediation*, Allied Publishers, Bombay, 1973.
20 Paper 5.

should be regularly eradicated as part of the watercourse maintenance activity, something that will be substantially improved as part of the major national program for watercourse lining.

- Et studies were conducted by IWMI and PARC using remote sensing techniques in areas where drought had positive impacts in reducing waterlogging and increasing productivity. These studies showed that over-irrigation is a common practice in southern Punjab and Sindh. Evaporation from fallow fields and waterlogged areas increases non-beneficial Et and contributes to accumulation of salts in the surface soil.
- The major implications are that there can be major reductions in non-beneficial Et by:
  - reducing evaporation from water applied to irrigated fields through improved irrigation technologies such as precision land leveling and furrow irrigation in the IBIS, and drip irrigation in areas where water is at premium, and, as shown in fig. 3.19, introduction of modern agronomic practices such as residue farming using zero-till planting, mulching of fruit plants, or changing crop planting dates to match periods of less evaporative demand
  - reducing evaporation from fallow land by decreasing area of free water surfaces, decreasing non-beneficial or less-beneficial vegetation, and controlling weeds
  - minimizing salinization of return flows—by minimizing flows through saline soils or through saline ground-water to reduce pollution caused by the movement of salts into recoverable irrigation return flows
  - shunting polluted water to sinks—to avoid the need to dilute with fresh water, saline or otherwise polluted water should be shunted directly to sinks
  - reusing return flows—by integrating crops, forest plants, forages, and aquaculture into land use to utilize different qualities of water in a sustainable manner

There is agreement among agronomic and water professionals that the overall productivity of the IBIS could be improved by reallocating water from areas where production per unit of water loss is high. As pointed out by Shahid Ahmad: 'reallocation will generally be difficult between the provinces as the water apportionment and rights are well defined. However, there is a possibility that each province looks into Authorized Canal Water Allocations of various canal commands and reallocates water allowance based on evapotranspiration, cropping pattern, and cropping intensity to have sustainability on long-term basis. This will dramatically increase the economic productivity of water, both under the deficit and excess canal commands.' As discussed elsewhere in this Report, the use of such technocratic discretion would fly in the face of the single-most important need in the system, namely to reduce discretion and to put in place systems which make entitlements inviolable, and which reduce the application of administrative discretion. Fortunately, there is another way of moving towards the desired goal of greater productivity.

Fig. 3.19: Production (kg/cubic meter of water) under different agricultural practices



Source: Amir, 2005.

Pervaiz Amir, in his background paper on agriculture,[21] has outlined the appropriate way to encourage such efficiency gains. Entitlements (based on historic use) are, to a large degree, established for the major parts of the Indus Basin system. There should be no command-and-control overriding these entitlements, even in the case of greater productivity. What there should be, instead, is an aggressive effort to make clear to both those who have too much water and those who have too little, how reallocation (perhaps initially as a lease and eventually as permanent transfers) might benefit both parties, and then encourage water trades (with willing buyers paying willing sellers). Such trades would logically start within specific canal commands, but then expand to trades between canal commands, and eventually trades between provinces.

Finally, crop productivity obviously depends on much more than just the supply of water. Box 3.1 describes the ways in which distortions in public subsidies can give rise to absurd water use patterns (in this case in the sugar industry).

It is apparent that water (not land) is the main constraint, and there is growing attention to the quite different water requirements of different crops (fig. 3.20). An acre of sugarcane, for example, consumes as much as eight times the water needed by wheat. Increased attention is accordingly now being given to producing crops that can yield more with less water, withstand water-scarce and drought conditions, and thrive on low quality (saline/alkaline) water,[23] and to the effect of different agronomic practices on water productivity.

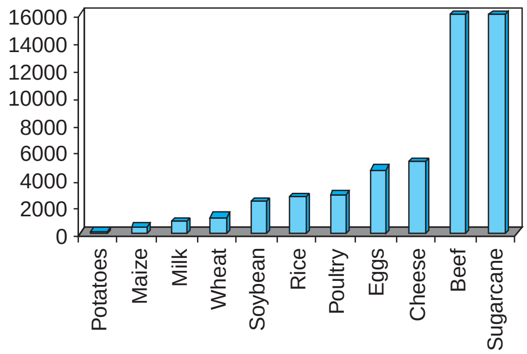
Successful reforms in the water sector need, therefore, to be accompanied by simultaneous improvements on the agricultural side, in production techniques, marketing efficiencies, and in research, education, and extension.[24] There is a

Box 3.1: How other distortions affect the water economy—the case of sugarcane (from the background paper by Imran Ali[22])

'The linkages between industrial needs and impacts and water quality and supply can be seen in the case of the sugarcane. Starting with one sugar mill in 1947, Pakistan now has over 80. Sugar mills are often a reward for political services and support. A large number are owned by politically important elements and owe their existence to political gratification. Also, in the 1990s the Nawaz Sharif government induced financial institutions to extend loans for sugar mills, to which Sharif's Ittefaq Foundries was a capital goods supplier. Sugar also seemed a relatively uncomplicated form of earning industrial rents. The Pakistani consumer had to subsidize the processor, since international sugar prices traditionally remained below domestic prices. However, beyond a low percentage of total cropped area, sugarcane production is not ecologically suited to an arid region like the Indus Basin. Now, farmers need, or want, to grow enough sugarcane to feed 80 mills, creating excessive demand on both surface and tubewell water. Areas with critically low groundwater levels have large standing crops of sugarcane (as well as rice, the other water intensive crop). Shortfalls in sugarcane supply would create a crisis in the sugar industry, which has the second highest capitalization in the Pakistani stock market, as well as politically eminent stakeholders. Additionally, effluents from sugar mills are a significant source of water pollution, which is affecting human and livestock health. Clearly, on specific issues there are complex options facing the administration, involving trade-offs between environmental, hydraulic, social, agronomic and industrial priorities.'

21 Paper 12.
22 Paper 9.
23 Paper 5.
24 Paper 9.

Fig. 3.20: Cubic meters of water to produce a ton of produce



Source: Hoefstra, 2003.

vital public sector role in the production of these 'public goods'. But experience in other countries which have undergone recent agricultural diversification (such as Chile, Brazil, and Mexico) has shown that the private sector can play an equally important role. As Pervaiz Amir has described: 'an important driver for higher water efficiency and farm productivity will be establishment of hi-tech modern farms with international cooperation that show the modern way. Exposing industry leaders to opportunities of joint partnership can help bring new biotechnology, efficiency based systems thinking and international marketing perspective to a larger segment of the farm community.'

In summary, improving the productivity of water used in agriculture is a central challenge facing a water-scarce Pakistan. (As pointed out by Shahid Ahmad, since the water required to grow enough food for one person—between 3,000 and 5,000 cubic meters a year—is about 100 times the amount required for household purposes [100 lpd or about 35 cubic meters a year], urban demands are important locally but not at a national scale.) Confronting this challenge will require actions on multiple fronts, not least of which is changing the water supply system so that it meets the predictability, transparency, and flexibility required for a modern and much more productive agricultural system.

Narrowing the 'Trust Gap'

One of the defining issues in contemporary Pakistan water management is the pervasive lack of trust, at all levels.[25]

It is, again, useful to start with the Indus Basin treaty, both because of its direct importance to Pakistan, but also because of the model it provides in reducing mistrust. The Indus Waters Treaty shows very clearly that a well-defined set of entitlements, which are monitored by both stakeholders, and which have clear enforcement mechanisms, can provide a high (not perfect) level of trust, even when the parties involved have literally gone to war several times. The IWT is a great example of how 'good fences make good neighbors'.

Now consider the parallel issue between provinces in Pakistan. As described earlier, the 1991 Water Accord is an enormously important achievement. There remain a number of important issues on which agreement needs to be reached, including how to share flows under drought conditions, how much water to allocate to the delta, and how to manage the demands from some provinces. There is also a need for putting in place a modern conflict resolution mechanism. These caveats notwithstanding, the Accord is basically sound and should be implemented in its present form. But what has happened?

Fifteen years after the Accord was signed there is still not a sound organization equipped with the right instruments that would give all parties confidence that the Accord is being implemented transparently. This is a deplorable missed opportunity, because it has caused mistrust to

25 Described in many of the background papers done for this study.

fester and to corrode a host of water-related and other issues between the provinces. The irony is that, with the Accord in place, this is so easy to fix!

Similar accords in other countries—the Colorado Compact in the US and the Murray-Darling Agreement in Australia—show that once there is a clear agreement, there are three fundamental implementation requirements. First, that a rigorous, calibrated system for measuring water inflows, storages, and outflows be put in place. Second, that the measurement system be audited by a party which is not only scrupulously independent and impartial but is seen to be so by all parties. (In the case of the Colorado the Federal Department of the Interior is the 'river master'; in the Murray-Darling system, an individual from Western Australia is retained as the water auditor.) Third, reporting must be totally transparent and available in real time for all parties to scrutinize.

The great frustration in Pakistan is that, given the Accord, this is so easy to do and yet it has not yet been done. The central function of IRSA (see box 3.2) is to be this auditor and 'river master', but it acts more like a political body and does not do this task. For years now a telemetric system for automatic measurement of flows into and out of the main barrages and control structures has been 'under implementation', but there is always something that does not work (further fueling belief that the lack of transparency in the system is being manipulated for nefarious purposes). There is no higher priority for water management in Pakistan than to move aggressively in putting

Box 3.2: The Indus River System Authority (1992)

The Water Accord necessitated the creation of an Indus River System Authority (IRSA) for its implementation. The Authority was established in December 1992. It consists of 5 members, one each to be nominated by each province and the federal government from amongst engineers in irrigation or related fields. The first Chairman was the member nominated by the Government of Balochistan, to be followed by the nominees of the Governments of NWFP, Punjab, and Sindh, and the federal government, and thereafter in the same order. The term of office of the Chairman is one year. The functions of the Authority are as follows:

- Lay down the basis for the regulation and distribution of surface waters amongst the provinces according to the allocations and policies spelt out in the Water Accord;
- Review and specify river and reservoir operation patterns, and periodically review the system of each operation;
- Coordinate and regulate the activities of WAPDA in exchange of data between the provinces in connection with the gauging and recording of surface water flows;
- Determine priorities with reference to sub-clause © of clause 14 of the Water Accord for river and reservoir operations for irrigation and hydropower requirements;
- Compile and review canal withdrawal indents as received from the provinces on 5-daily or, as the case may be, on 10-daily basis and issue consolidated operational directives to WAPDA for making such releases from reservoirs as the Authority may consider appropriate or consistent with the Water Accord;
- Settle any question that may arise between two or more provinces in respect of distribution of river and reservoir waters; and
- Consider and make recommendations on the availability of water against the allocated shares of provinces within three months of receipt of fully substantiated water accounts for all new projects for the assistance of the Executive Committee of National Economic Council (ECNEC).

Source: Paper 6.

in place a totally transparent, impartial system for implementation of the Accord.

This situation is mirrored within the provinces. As described earlier, one hugely important part of the Accord was that it formalized the entitlements for the 24 canal commands in Punjab, the 3 major barrages in Sindh, the 2 barrages serving Balochistan, the 5 canals serving NWFP.[26] Consider the case of Punjab as an example. The allocations to the 24 canal commands are specified for 10-daily periods in both the kharif and rabi seasons in the annex to the Accord (fig. 3.21).[27] And the administrators of the allocation system in Punjab apparently respect these, for the most part. The irrigation department keeps detailed records of the entitlements for each season of the amounts of water actually delivered, and of the 'balances' for each canal command. (For example, as can be seen in the first few entries for the current season, a number of canal commands did not wish to receive their full shares, but they get 'credit' for this, and can use these saved amounts later in the season.) This system is very close to something that would be ideal. The one big missing piece is the transparent and verified implementation of the allocations. And here, again, lack of transparency means that there is discretion, discretion which corrodes belief in the fairness of the system. Many

Fig. 3.21: Punjab canal entitlements from the 1991 Water Accord

10-Day Seasonal Systemwise Adjusted Allocations
(Excluding Flood Flows & Future Storages)

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Punjab–Kharif

Period		F.I.C.	M.R. INT	CBOC	S.Y.C. (Upper)	S.V.C (Lower)	Trimmu	Panjnad	Thal	Taunsa	CABC	Greater Thal	Total (1000 × Cs)
Apr	1.	24.2	0.1	1.8	8.3	3.9	2.9	4.3	6.0	4.9	1.3	2.6	60.3
	2.	24.7	0.3	1.8	10.8	3.7	3.4	5.1	6.4	4.3	0.18	3.4	64.7
	3.	28.1	1.1	2.0	13.3	5.5	5.5	7.3	6.4	7.9	0.5	4.9	82.5
May	1.	30.1	1.3	2.1	16.0	8.0	5.9	7.6	6.6	10.0	0.7	5.4	93.7
	2.	30.8	2.0	2.1	17.2	8.7	6.1	9.0	6.8	11.5	1.1	5.5	100.8
	3.	31.6	2.4	2.2	18.1	9.2	6.3	9.5	6.8	11.9	1.3	5.5	104.8
Jun	1.	32.3	2.6	2.3	18.5	9.4	6.6	10.5	6.8	13.0	1.7	5.4	109.1
	2.	33.2	3.6	2.2	18.7	9.7	6.7	10.4	6.9	13.5	1.8	5.5	112.2
	3.	34.0	4.0	2.2	19.2	9.6	6.7	10.7	6.7	14.0	1.8	5.7	114.6
Jul	1.	32.7	5.4	2.2	19.2	9.9	6.6	10.4	6.6	14.3	1.7	5.8	114.8
	2.	29.6	6.0	2.0	17.9	8.7	5.7	0.0	6.3	12.5	1.7	5.1	104.4
	3.	27.8	6.1	1.8	16.8	8.7	5.1	9.6	6.8	11.8	1.8	4.7	100.0
Aug	1.	28.2	5.8	1.7	17.4	8.2	5.3	9.6	6.0	11.5	1.8	4.8	100.0
	2.	31.5	6.1	1.8	19.3	9.3	6.3	10.6	6.3	11.3	1.8	5.4	109.7
	3.	34.6	4.9	2.0	20.6	10.1	6.8	11.1	6.6	13.9	1.8	5.9	118.3
Sep	1.	33.9	4.4	2.1	21.0	10.0	6.8	11.1	6.8	14.4	1.8	5.9	118.2
	2.	33.9	3.7	2.1	20.6	9.8	6.8	10.8	6.8	14.0	1.8	5.8	116.1
	3.	33.1	2.3	2.2	19.6	9.9	6.9	11.0	6.8	13.0	1.8	5.5	112.0
Total MAF		**11.18**	**1.24**	**0.74**	**6.31**	**3.07**	**2.15**	**3.40**	**2.37**	**4.19**	**0.55**	**1.87**	**37.07**

Source: Government of Pakistan, 1991.

26 Indus River System Authority, 'Apportionment of Waters of Indus River System between the Provinces of Pakistan: Agreement 1991 (A chronological expose)', undated.

27 Ibid.

officials, including those at senior levels, honestly try to implement the water according to entitlements. But they are under a variety of murky and non-transparent pressures to tweak the system, to use discretion for a variety of opaque reasons. These officials are the strongest advocates for moving to verification and transparency at all levels.

In some cases, however, what is happening is not 'tweaking' but wholesale destruction of the discipline on which the system fundamentally depends. In his background paper Sarfraz Qureshi[28] describes the existence of a large number of uncontrolled direct outlets (DOs) in the Nara Canal in Sindh. 'These are outlets which draw water directly from the main canals that often have no outlet control (gates for example, and where these exist they are not easily controlled by the ID). These types of outlets are illegal under the 1873 Irrigation Act, but have been permitted and a majority has been accorded official sanction over the years. The cumulative effect of the steady increase in these DOs has been to increase the command area of the Nara Canal by more than 30 percent making it impossible to distribute water to large areas in the tail portion of the canal command area without a major increase in diversion and a change to a rotational method of water distribution among the distributaries since outlet discharges become unreliable if the flow in the canal is outside the range of about 70–110 percent of design discharge.' It is common knowledge that large amounts of money change hands for the sanctioning of these direct outlets.

This paradox of a basically sound allocation system being administered without transparency and accountability is replicated down below the canal commands and into the distributaries, outlets, and watercourses. As described in the background paper by Faizul Hasan: 'Lack of trust among various users, especially mistrust of small farmers on the large farmers and mistrust of the farmers on the state agencies, is at the heart of the water rights issues in Pakistan. All disputes stem from the crisis of confidence. The small and medium farmers have the apprehension over the large farmers of using more water. The small and medium farmers have an understanding that the irrigation department is not equitably distributing the water, therefore, providing more water to the influential farmers. Therefore, there is a need to develop the confidence building measures at all the levels. Delays in justice and poor accountability have also shaken the confidence of the farmers on the state agencies.'

It is obvious that Pakistan faces a series of serious natural challenges in managing its water resources. As described by Siegmann and Shezad, it is, in fact, the human-induced uncertainties that are of greatest concern to common farmers: 'the availability of water for irrigation often varies during the season (despite efforts to improve forecasts, there are no guarantees), but this variability and uncertainty does not seem to be the primary issue with farmers—transparency and timely information, participation in decisions about what to do when there are shortages, and delivery on whatever is agreed, are the more important issues.' Or in the words of Faizul Hasan: 'Farmers generally understand the natural variability of their main source of water supply, the Indus River, but want to know what their share is and when it will be delivered—with this information they can make good or at least informed and lower risk decisions on how best to use both the water and their land (and possibly respond more appropriately to incentives).'

The overall situation and some of its ramifications are summarized by Pervaiz Amir in his background paper: 'The lack of transparency in information sharing and hiding data that should be in the public domain has created an environment of distrust and despair. Unless the grievances in relation to water entitlements,

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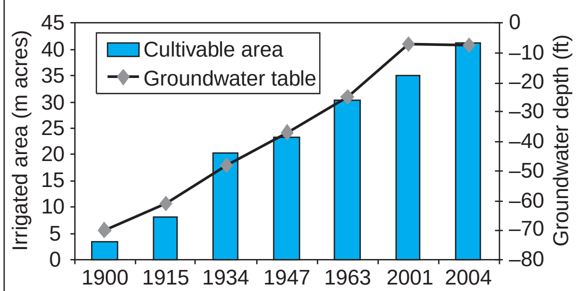
distribution, and governance are addressed in a comprehensive manner, dams or even other large scale water infrastructure projects will be blamed for all the shortcomings in water sector.'

In the shadows of discretion and lack of accountability, of course, lurk all sorts of interests—of powerful people who manipulate the system for their ends, and of those in the bureaucracies who serve them and are rewarded for this service. The amounts of money that circulate in service of these distortions are very large, and those who benefit from it will not easily acquiesce to changes. But there is a widespread sense in Pakistan that this has now gone too far for too long, and there would unquestionably be massive support for politicians who ensured that entitlements were made public, and that there was unimpeachable information publicly available on who is getting what. Modern measurement and computer technology makes it much easier to do this today. In the words of an astute observer of similar problems in India: 'an entire range of activities which normally incubate corruption can be made transparent through the intervention of technology… The government must concentrate on enabling technology to overarch human venality, and empower the ordinary person to access and monitor the availability of services directly'.[29]

Maintaining the Resource Base—Groundwater

As described earlier, the initiation of large-scale irrigation in the Indus plains started a large, and still on-going transformation in the hydrogeology of the basin. First there was the injection of hundreds of billions of cubic meters of water into the aquifers, quantities of recharge which far exceeded the subsurface horizontal drainage capacity of the aquifer system. This led to an inexorable rise of the water table (from an average of about 80 feet in 1900 to 10 feet a century later, shown in fig. 3.22) and the mobilization of large amounts of salt, as hundreds of billions of cubic

Fig. 3.22: Irrigation expansion and groundwater levels



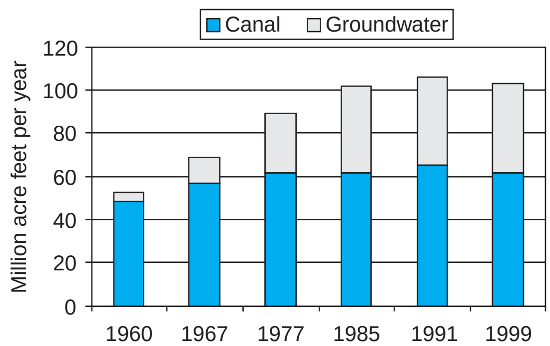
Source: IWASRI/WAPDA, 2004.

meters of surface water were stored in the aquifers. The result was large-scale waterlogging and salinity, but also the ready availability of large amounts of groundwater which could be used to supplement canal water supplies. And so in the 1960s extensive groundwater exploitation got under way, a process which has continued unabated until the present.

The 1960s saw the start of the era of large-scale groundwater exploitation. As described in the background paper by van Steenbergen and Gohar,[30] over 600,000 private tubewells have been sunk. It is estimated that 75 percent of the increase in water supplies in the last twenty-five years is to be attributed to public and private groundwater exploitation (fig. 3.23). The investment on these private tubewells is of the order of 30–40 billion rupees, whereas the annual benefits in the form of agricultural production are estimated at 200 billion rupees, roughly equivalent to 5 percent of GDP. In addition, most towns and many industries rely for their water supply on groundwater. To a large degree this groundwater system has become

29 Pavan K. Varma, *Being Indian*, Penguin, 2004.
30 Paper 11.

Fig. 3.23: The growing role of groundwater irrigation



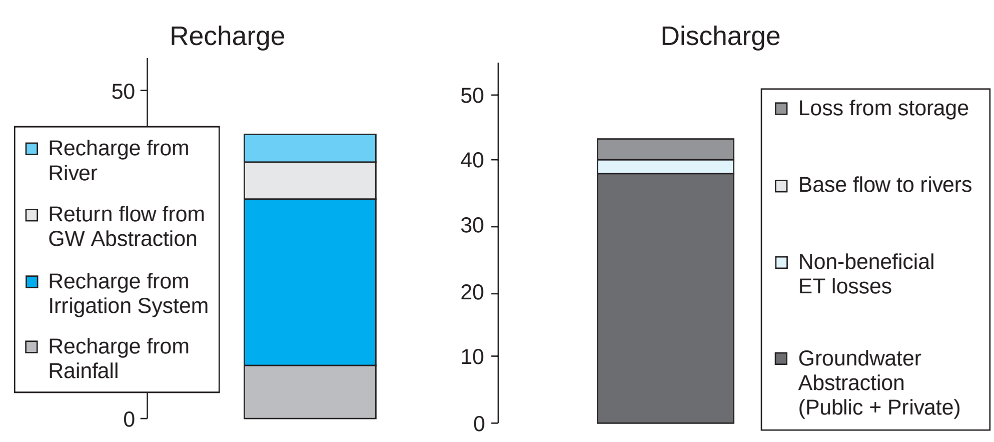
Source: Steenbergen and Gohar, 2005.

the primary storage mechanism used to distribute available water between the monsoon (Kharif) and dry season (Rabi).[31]

It is useful to consider the history of groundwater development in Pakistan in three stages. Stage 1 was the pre-canal era of deep and stable water levels, in which only small and local use was made of groundwater. The main feature of Stage 2, starting in the nineteenth century, was the injection of massive amounts of seepage into the aquifers, but still of very little use of groundwater. Stage 3 started in the 1960s, and involved the application of new technologies on a massive scale for the exploitation of groundwater. Stage 4 started some years back in the barani areas (where recharge is much smaller), and is now starting in the main Indus Basin. It is a stage in which the primary challenge becomes preserving the resource base—the groundwater—on which so much life and wealth now depends. As shown for the Punjab in figs. 3.24 and 3.25, groundwater is in balance in the kharif season, but now systematically negative in the rabi season, meaning that groundwater is being mined and water tables must fall. And the levels are indeed falling (fig. 3.26)

The management challenge is to stabilize the groundwater table at levels where the cost of pumping is not prohibitive (see fig. 3.27) and in which primary attention is given to understanding and managing the quality—and especially the salinity—of the aquifers. Although groundwater levels are already very deep in some barani areas

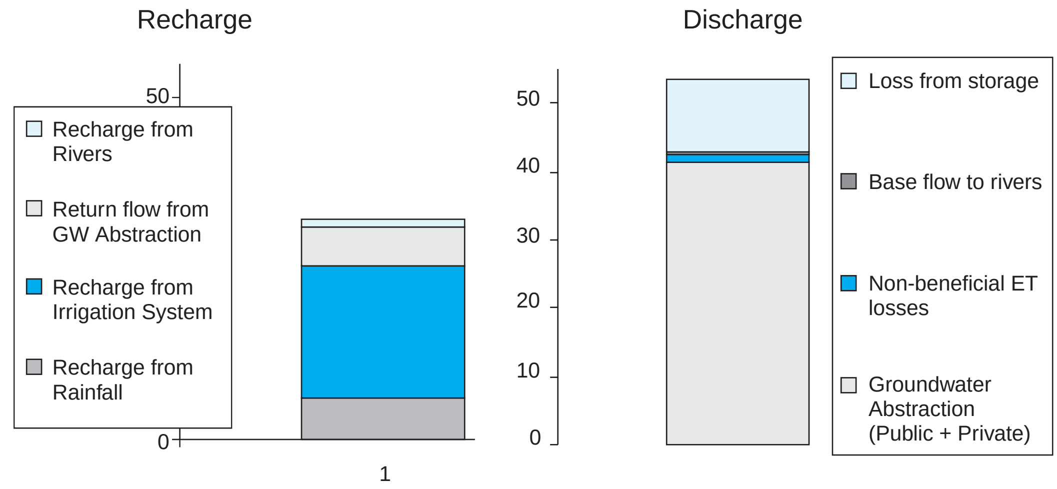
Fig. 3.24: Punjab water balance: normal year (MAF)



Source: Steenbergen and Gohar, 2005.

31 Paper 5.

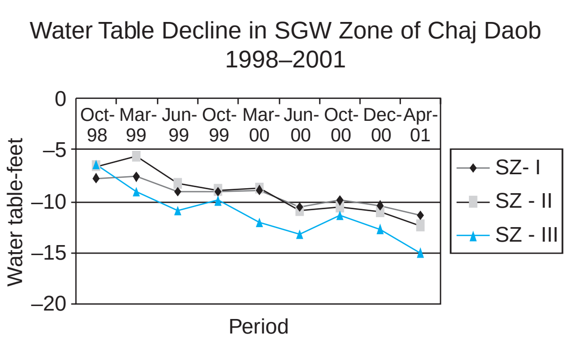
Fig. 3.25: Punjab water balance: drought year (MAF)



Source: Steenbergen and Gohar, 2005.

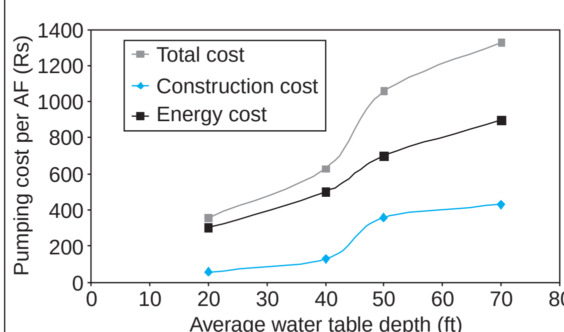
(farmers are drilling wells to 1,000 feet in the fruit-growing Pishin district of Balochistan), in the plains groundwater tables are still fairly shallow (fig. 3.28), something which good management would aim to preserve. In none of the past stages have conscious management played any role in the fate of the aquifer. In Stage 4 it is precisely the ability to consciously manage the aquifer which constitutes a huge and quite new challenge to the people and the state. The failure to manage groundwater in the barani areas is a salutary warning. As described by van Steenbergen and Gohar:[32] 'Overuse of groundwater is dramatic in some of the barani areas of Pakistan… (with) orchards in Balochistan being dismantled and by out-migration, destabilizing a region that is already volatile by nature and location…. the constant overuse of groundwater in the last decades has

Fig. 3.26: Declining groundwater table in Punjab



Source: Steenbergen and Gohar, 2005.

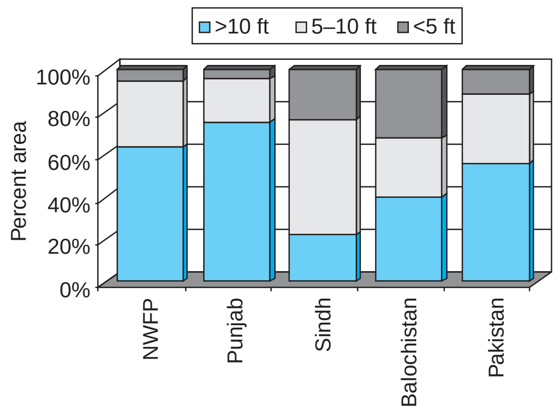
Fig. 3.27: Effect of the depth to the water on last of pumping



Source: Steenbergen and Gohar, 2005.

32 Paper 11.

Fig. 3.28: Depth of water table by province



Source: Steenbergen and Gohar, 2005.

made the barani areas of Pakistan less resilient to drought.' This descent into non-sustainability, and the huge associated social, economic, and political costs should be considered as a warning of the importance of action to manage the groundwater of the Indus Basin.

There are special challenges of managing groundwater in the vicinity of Pakistan's burgeoning cities, most of which depend on groundwater for water supply. The large-scale exploitation of the aquifer underneath the cities and in urban periphery has however led to falling water tables and to contamination of water supplies by leaking sewerage systems and septic tanks as documented for Karachi, for example. In Quetta the over-exploitation of the confined aquifer by agricultural users around the city has already led to a number of doomsday projections, predicting that in a foreseeable future even the supply from deep fossil groundwater to the capital of Balochistan province will dry up. It is estimated that the remaining groundwater may be exhausted by 2016.[33] And the water table around Lahore has fallen at more than half a meter a year for the last thirty years, resulting in a cup-shaped depression prone to the migration of saline groundwater.

Global experience suggests several things about managing scarce groundwater. First, it is a very difficult task, even under good governance conditions. Second, it requires changes in several related areas, including legal and administrative. Of particular importance (and sensitivity), it means that the rights of individuals to pump as much water as they wish from their land have to be curtailed. Water rights have to be vested in the state, with individuals then given entitlements (usually related to historic use) to pump specific volumes. The administrative challenge is immense, both to register historic use (and entitlements) and to manage those. Van Steenbergen and Gohar[34] describe some of the experience to date in this regard: 'The Groundwater Rights Administration Ordinance is a useful model for *barani* areas, whereas the Groundwater Regulatory Framework developed but not yet endorsed in Punjab can serve as an example for the alluvial aquifer systems in the Indus valley. At the same time—preferably within the Provincial Irrigation and Drainage Authorities—Groundwater Management Units need to be established and activated in each Province. Past history showed that such efforts quickly went in dormancy, for instance in Balochistan and Punjab. By giving the Units a central role in the enforcement of groundwater legislation and in the implementation of programs… they can become vibrant organizations in their own right.'

In all instances where groundwater management has had some success, the foundation has been Aquifer User Associations who are supported very strongly by government who have a vital role in providing the information and systems for making decisions (for example on the

33 Paper 11.
34 Ibid.

total amount of pumping from an aquifer) and in providing the necessary legal and administrative support. In the case of the Indus Basin there are three complicating factors. First, some of the aquifers are very large, much too large to be managed by a single Aquifer User Association. (Experience in the huge Ogallala Aquifer which stretches from Minnesota to Texas shows that a single aquifer can, indeed must, be broken down into pieces which can be managed by local associations.[35] The smaller such units become, the less realistic it is to treat them as individual aquifers; but the larger they become the more difficult the management of users becomes. This will require, as with so much, a learning approach and adaptive management). Second, it is particularly important to manage the sweetwater aquifers which border saline aquifers with special care. The tendency will be for more pumping from the sweetwater aquifer, thus causing the phreatic level in the sweetwater area to fall relative to the level in the saline aquifer, inducing saline intrusion and destroying the sweetwater aquifer. Third and finally, given the highly integrated nature of the canal and groundwater systems, integrated management of surface water and groundwater is a must. What this suggests is that a pragmatic initial approach would be to develop aquifer associations on the foundation of the Farmers' Organizations (FOs) which are being formed in various provinces for management of water distribution at the distributary canal level. And here a key issue is sequencing—as long as the FOs are weak, they should not be encumbered with the complex additional task of extending their mandate to cover groundwater, too. But once the FOs find their feet, then the next step should be to expand the scope of their work to include both surface water and groundwater.

The forms of organization would necessarily be different in different parts of the country. As suggested by Gohar:[36] in the Indus Basin there are 43 main canal commands, for which aggregate and distributary-level water balances could be developed as a basis for the formation of integrated surface water/groundwater user associations. In the mountainous areas (such as the Pishin-Lora, Quetta Valley, and Bund Kushdil Khan areas of Balochistan) water balances have been or could be developed, and provide the knowledge base for the development of aquifer associations.

In their background paper, van Steenbergen and Gohar[37] describe an initial experience with some elements of such an approach: 'This approach worked well in the Kamalia Distributary that takes off from Burala Branch Canal of LCC. The initial response of farmers and local agencies was lukewarm, but after a first awareness building stage the ice was broken. During the course of the pilot, participatory piezometers were installed at farmers' land and local water management was discussed in plenary. The results were a shift of paddy cultivation to other crops and water releases to the tail ends of the distributary for the first time in three years.'

In a large number of developing countries (including Mexico[38] and India[39]), this intrinsically difficult task has been greatly complicated by a tradition of subsidizing electricity for groundwater pumping. This genie, like most other genies, is very difficult to put back in the box, and it means that stabilization of aquifer levels (which is inevitable, one way or another) will come at much higher economic, social, and environmental costs.

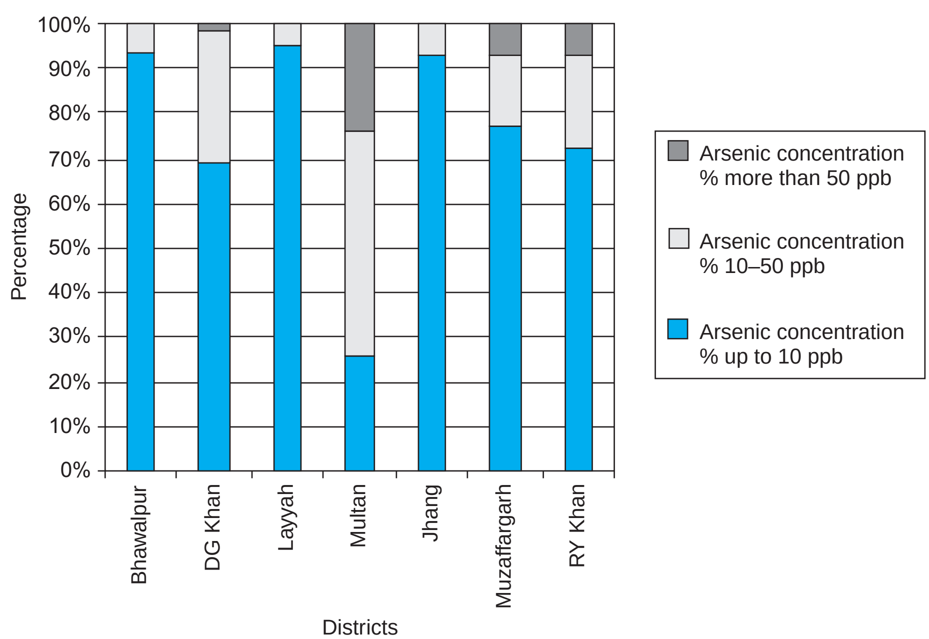
35 White, Stephen E., and David E. Kromm, 'Local groundwater management effectiveness in the Colorado and Kansas Ogallala Region', *Natural Resources Journal*, Vol. 35, 1995.
36 Shamshad Gohar, personal communication.
37 Paper 11.
38 Kemper, Karin, and John Briscoe, *Mexico: Policy Options for Aquifer Stabilization*, The World Bank, 1999.
39 Briscoe, John, and R.P.S. Malik, *India's Water Economy: Bracing for a Turbulent Future*, Oxford University Press, New Delhi, 2006.

The situation in Pakistan is not ideal—tariffs for agricultural tubewells are approximately 35 percent below rates for the domestic or industrial uses (with serious anomalies in Balochistan, where the subsidies are much higher and have been fundamental to digging a hole so deep that in places escape is almost impossible). In addition, at present 86 percent of tubewells are powered by diesel motors, and thus unaffected by electricity prices. But this will change as rural electrification improves and as the groundwater table falls. As in all other countries, there are and will be populist temptations to subsidize energy for pumping groundwater. A high priority for policymakers at both the national and provincial levels is not to succumb to such pressures. If there was to be a decision to increase subsidies to agriculture, then these subsidies should be ones that enhance water productivity (as has been done in Mexico[40]), not destroy the resource base.

This management will not be only an issue of managing quantity—the issues of quality are equally important, and closely related to the quantitative aspects of aquifer management.

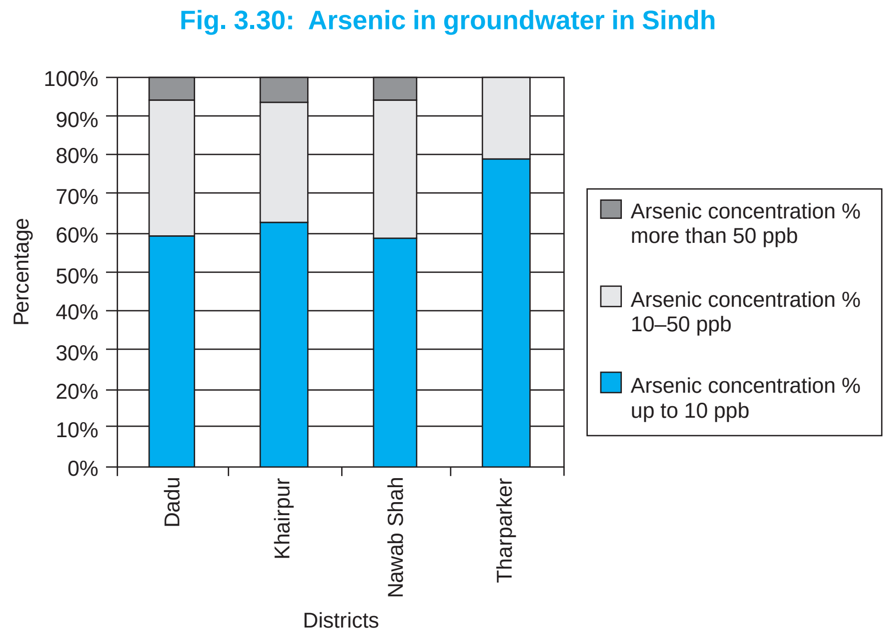
Most people in rural and urban Pakistan depend on groundwater for their drinking water. Of the major towns, only Karachi and Islamabad rely primarily on surface water sources. With the emergence of the problem of arsenic contamination in the Ganges-Brahmaputra Basin, there is now concern about this issue in Pakistan, too. 'The extent of arsenic contamination of groundwater has recently been documented for the first time. Preliminary findings of the National Water Quality Monitoring Programme indicate that arsenic found its way in large number of water samples from cities such as Bhawalpur, Multan and Sheikhupura and Lahore'.[41] Figures 3.29 and 3.30 show the levels of arsenic, relative to the WHO guideline of 10 parts per billion (ppb).

Fig. 3.29: Arsenic in groundwater in Punjab



Source: Steenbergen and Gohar, 2005.

40 Kemper, Karin, and John Briscoe, *Mexico: Policy Options for Aquifer Stabilization*, The World Bank, 1999.
41 Paper 11.



Source: Steenbergen and Gohar, 2005.

The presence of fluoride in the groundwater is also a potential health risk. 'A survey of 987 samples from sources of domestic water supply, showed, however, that they are predominantly low in fluoride, with 84 percent containing less than 0.7 ppm of fluoride….suggesting that fluoride and fluorosis—including the dental and bone deformation—are not uniform but can be serious at specific places'.[42]

As concluded in the background paper by van Steenbergen and Gohar:[43] 'for both arsenic and fluoride contamination, alertness is required without being alarmist. The result of the recent studies needs to be substantiated, before initiating programs to deal with these issues. It is important at the same time to keep things in perspective and not lose track of the fact that bacteriological contamination remains the major contamination and cause of morbidity in drinking water.'

In addition to these 'natural' contamination problems, human-induced contamination now constitutes an additional threat to the quality of groundwater. This is especially serious where aquifers are being used to dispose of long-lived synthetic organic chemicals and heavy metals, pollutants which will concentrate and persist in aquifers for many decades. (This issue is discussed further in the section on environment.)

Finally, the most fundamental of all quality challenges, however, is salinity—where will the salt go? How will groundwater be managed so that freshwater aquifers are not destroyed by intrusion from saline aquifers? among other things—a subject to which we now turn in the next section.

42 Paper 11.
43 Ibid.

Maintaining the Resource Base—Salinity Management[44]

The management of salinity constitutes one of the major challenges for long-term sustainability of irrigated agriculture in the Indus Basin.

Why is salinity such an issue? The basic concern is that high salinity in the root zone greatly inhibits the productivity of most crops. The simplified physics starts with the fact that as rainwater turns into streamflow, it travels through soils and dissolves salts that are naturally present in the soils. When this water is then used for irrigation, most of the water is lost to the atmosphere through the process of evapotranspiration. The salts, however, do not evaporate, but stay behind, generally in the root zone or even on the surface of the soil. In temperate climates where there is a lot of rainfall and where evapotranspiration rates are low, the salts are mostly leached out to rivers and eventually the ocean, and pose little problem. In arid environments, however, the situation is reversed—evapotranspiration rates are very high (meaning that a large amount of salt 'stays behind'), and there is little rainfall or excess water applied to wash the salt out of the root zone and into sinks where it no longer constitutes a threat. Complicating the issue in arid environments is the fact that the process of irrigation often mobilizes large amounts of salt that were previously in deep aquifers and soils where they caused no harm.

As described in the background paper by Bhutta and Smedema,[45] the salts presently occurring in the Indus Basin are of a variety of origins. Firstly, there are the fossil salts deposited as a result of evapotranspiration during the drier period in the geological formation of the Indus plains. These salts occur at various locations and depths in the substrata and in the groundwater. Most of the fossil salt is safely stored in the deeper substrata but some are mobilized by the ongoing tubewell pumping and by the deeper groundwater flows. These mobilized salts then become part of the salt dynamics of the root zone and underlying shallow groundwater zone.

Secondly, much of the lower basin is of marine origin (having been elevated through movements of the earth and by the deposition of silts from the Indus). Further inland, where the deposits are older, some of the marine salts in the upper soil have been leached out over time. But in the younger lands of lower Sindh, the marine salts are still strongly present at shallow depth.

Third and finally, there are the salts imported by the Indus irrigation water. Although this water is mostly of low salinity (only some 200–300 ppm at Tarbela and other rim stations), this means that about 30 million tonnes of salt are being imported each year. Before the advent of large-scale irrigation, roughly similar amounts of salt were being exported to the sea. (Minor salt sources, such as those released by mineral weathering, and imported by fertilizers and rain are generally too insignificant to be considered in the salt management planning.)

The advent of large-scale irrigation had dramatic implications for salinity in the Indus Basin. First, flows of both water and salt to the ocean were reduced. Today, only about 10 million tonnes are being returned to the sea each year in the Indus and about 4 million tonnes via the Left Bank Outfall Drain (LBOD). This means that about 15 million tonnes of salt (or about 1 tonne of salt per hectare per year of irrigated land) are being stored somewhere in the basin.

Second, as described earlier, large amounts of water were dumped into the unsaturated zone above the then-deep aquifers. These waters dissolved some of the salts which had previously been safely stored well below the root zone. In

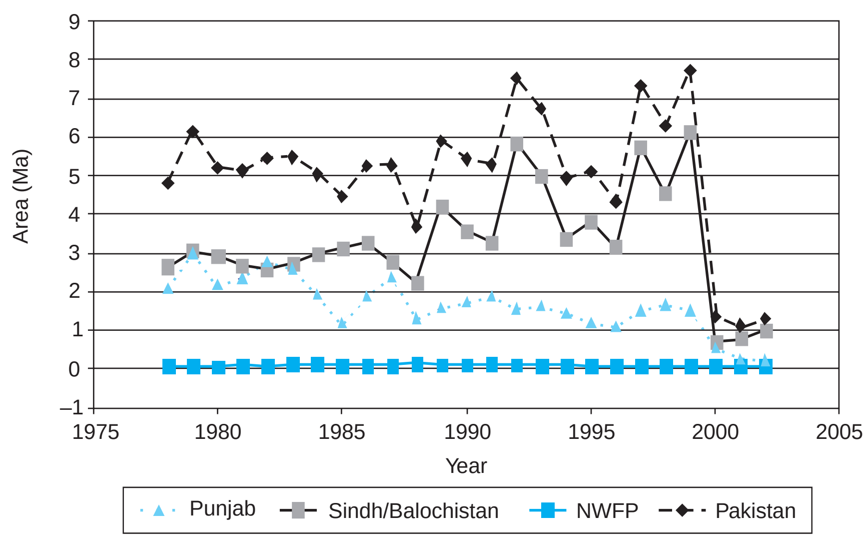
44 This section draws heavily, and often directly, on the background paper by Bhutta and Smedema (Paper 15).
45 Paper 15.

many places, the water table has now come close to or even intersected the surface. This meant large increases in evaporation, with the salts that were in the water being deposited in the root zone or the soil surface. As described in Chapter 2, by the 1960s the waterlogging and salinity problem posed a major threat to large areas of the irrigated plains of the Indus. The response to this challenge showed what can be done if the nation's and the world's best scientific and technical minds are put to work on a problem. It was realized that 'the solution' comprised three integrated actions—first, to lower the groundwater table through massive pumping, thus reducing large evaporation losses (and the corresponding salt deposition); second, to increase the application of water to crops, so that salts would not accumulate in the root zone but be leached down and out of harm's way; and third, to use the incentive of greater crop production to motivate farmers to engage in greater use of groundwater.

In many ways this salinity management strategy has worked extraordinarily well over the past forty years on the aggregate (fig. 3.31). But with water, like politics, everything is local. And there are still substantial areas, especially in the lower part of the delta, where groundwater is naturally saline and where waterlogging and salinity remain immediate problems (fig. 3.32).

Paradoxically, in a country where water scarcity is a looming problem, it is scarcity which helps reduce the salinity problem! Consider the following two examples. In Sindh the area affected by waterlogging and salinity varies enormously (by a factor of 5 over the 1990s) and appears (fig. 3.33) to be directly related to the quantity of water applied during the previous year.[46] And overall, as described earlier, water shortages in the Indus Basin have little impact on production, because the deleterious effect of water shortages is offset by the positive effect of reduced waterlogging and salinity and because of supplementary

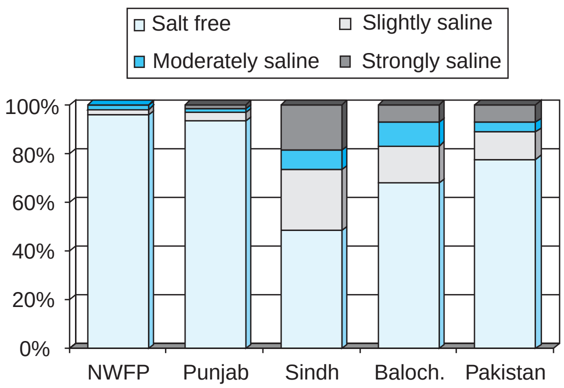
Fig. 3.31: Long-term trends in severe waterlogging



Source: Bhutta and Smedema, 2005.

46 Paper 11.

Fig. 3.32: Salinity levels by province



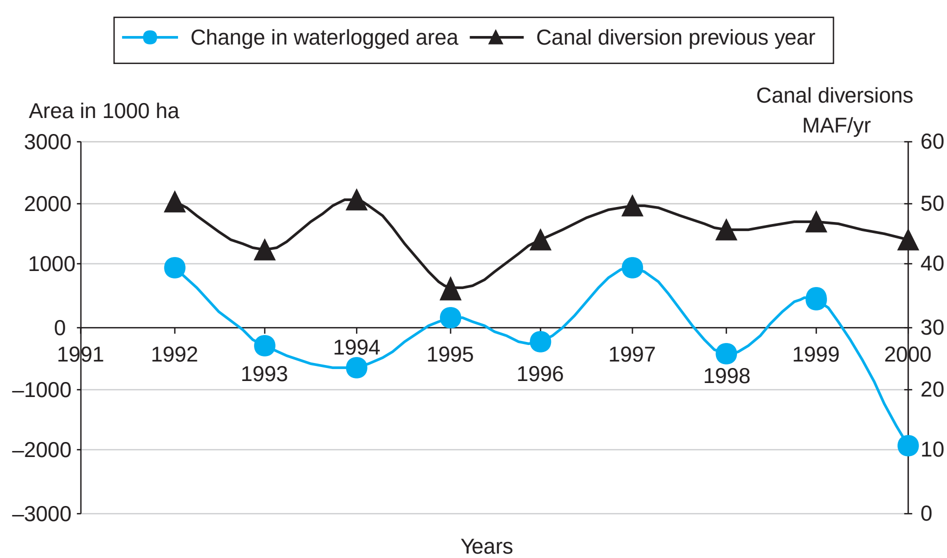
Source: Bhutta and Smedema, 2005.

irrigation from groundwater. It is also salutary to recognize that this happy coincidence cannot persist for long, because of constraints on both the quality and quantity of groundwater.

Twenty years ago, it was believed that the only way of maintaining salt balances in the basin would be to construct a 'drainage superhighway' which would transport salts from Punjab, NWFP, and Sindh to the sea. The (planned and inadvertent) successes of the last decades has led—as reflected in the report of the Expert Panel on the Drainage Master Plan—to a fundamental rethinking of the needs for this infrastructure. The general consensus is that these large drains (such as the LBOD) are necessary in the salt-plagued lower delta, but that the fundamental approach is now to reduce the 'drainable surplus' through more efficient water use and local use of saline drainage effluent, and that extension of the existing drains further up the plains will not be necessary.

While there is much that has been enormously positive in Pakistan's remarkable success at stemming the plague of waterlogging and salinity, there are also very worrying signs that this was at least as much good luck as it was good judgment. Experience in other arid areas has shown that salinity management must be built on a strong knowledge base, both system-wide and locally. And here, after so many years, there are gaping holes in the knowledge base even at the system level. Consider, for example, the most basic piece of knowledge, namely a system-wide salt balance

Fig. 3.33: Canal diversions and waterlogging in Sindh



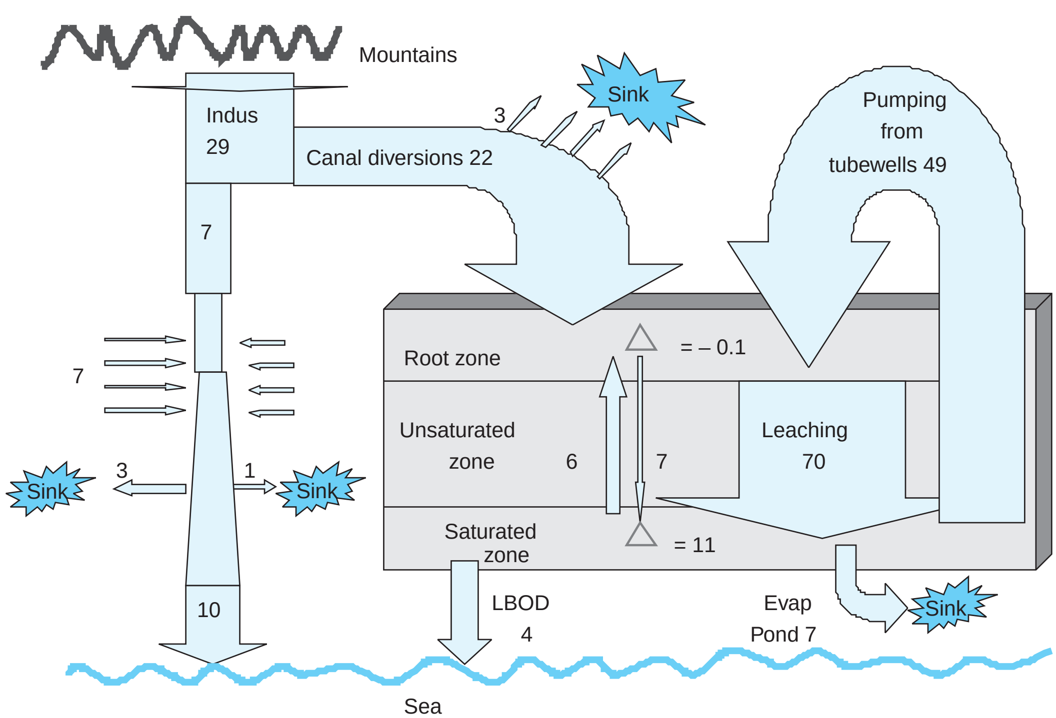
Source: Steenbergen and Gohar, 2005.

which would indicate the flux of salts both horizontally and vertically. The Drainage Master Plan is attempting, for the first time, to construct a system-wide salt balance. While there is a reasonable understanding of what is coming in and what is going out of the system, knowledge of how much salt is being retained in the root zone, or being flushed down to the deep aquifer is rudimentary at best. The first estimate of the Drainage Master Plan was that there are 34 million tonnes of salt accumulating in the root zone. The WAPDA figures, however, showed that soil salinity levels in the root zone had stabilized in the 1990s and actually declined during the last five years. This led to a revised salt balance (fig. 3.34) in which it is estimated that the root zone is actually losing 3 million tonnes of salt a year.

This is a profoundly important issue. If salt is not managed, there will be major productivity, social, and environmental consequences; and to achieve a salt equilibrium in the fresh groundwater areas it is essential to know how much salt needs to be exported and where it should be stored. This cannot be done without reliable salt balances at fairly disaggregated levels.

Each new era of water development poses new challenges to water managers. As described earlier, over the coming decades groundwater tables in the sweetwater areas are likely to continue to fall, in many cases quite rapidly and steeply. In addition to the other challenges described in the previous section on groundwater, this raises an important salinity concern in the aquifers which border on saline areas. Because as the groundwater table falls in the sweetwater area, the hydraulic gradient will be steeper, and the normally slow horizontal flow of water will increase, in this case out of the saline aquifers into the sweetwater aquifers. In addition, the heavy pumping of groundwater can cause up-coning of saline water from deeper aquifer (which caused more than 250 drainage cum irrigation tubewells installed in the fresh groundwater zone

Fig. 3.34: Approximate current salt balance in the Indus Basin (million tonnes a year)



Source: M.N. Bhutta, personal communication.

of SCARP-II to be abandoned[47]). It is vital to monitor both water and salt flows, so that this process does not become a local threat.

A central and politically sensitive issue is the fact that, from a salinity perspective, there are areas in the Indus plain which are suitable for irrigated agriculture (generally near the mountains and far from the coast) and others which are not so suitable (especially those in the saline lower reaches of the basin). It is useful to step away, momentarily, from the obvious and very sensitive political implications of this gradient and see how other countries have dealt and are dealing with similar problems. A good example is the Murray-Darling Basin in Australia, which is of about the same size and faces many of the same salinity problems. A cornerstone of the Australian salinity management strategy is to define different strategies for different saline areas. In some areas there is a strategy of saline agriculture, which encourages cropping with salt-resistant crops and the use of saline groundwater for this purpose. In other areas of high salinity not only is productive agriculture not possible, but it would mobilize large amounts of salt which would cause systemic harm. In these areas, the strategy is to offer farmers incentives—including sale of their water entitlements—to retire their land from irrigation. The implications for Pakistan are obvious—there is a need for detailed assessment down to the local level, and there is a need to have a support and incentive structure which will ensure that the right type of agriculture is done in the right areas. Migration of water and other inputs must be a voluntary one in which those who are surrendering their right to use them are compensated. In Australia, the growing water markets do this in a way that farmers in these low-productive areas do far better from the revenues from selling their water rights than they did by practicing irrigation. Salinity management, then, in the words of the former CEO of Australia's Murray-Darling Basin Commission 'is as much about managing human expectations as it is about managing salt. Salt creates its own distributional impacts which for many areas bear no resemblance to the original design or individual equity within irrigation schemes. Therefore, effective salinity management schemes always contain a significant restructuring component to enable individuals to leave the industry in a managed way. This is generally much cheaper than trying to eradicate salinity.'

In summary, there is an urgent need to invest heavily in monitoring, and scientific and technical capacity to deal with the salinity issue. At a macro level it is clear that the difference between salt being imported and salt being exported is about 15 million tonnes per year. This gives rise to two key questions.

Key question 1—where is this salt going? Is it to 'safe storage' or into places where it will affect agriculture?

Key question 2—there are very large amounts of salt already stored at various places in the soil and groundwater. Are water management actions keeping these out of harm's way, or are these being mobilized (for example, through pumping of deep groundwater or through lateral movement from saline to fresh aquifers)?

For this, managers need to know global balances but, more importantly, they need: to be able to get inside the 'black box' and find out what is happening in terms of both stocks (where is the salt?) and flows (where is it moving?), and to have a very good knowledge base for local situations.

In conclusion, it is important to note that about 80 percent of irrigated agriculture in Pakistan currently operates in a largely salt free environment. This figure is not static, however, and maintenance of this proportion depends on good management. For both currently 'safe' areas and those where salinity levels are high, sound knowledge-based strategies for living with and managing salinity must be developed to avoid adverse long-term effects on the productivity and sustainability of the system.

47 Paper 11.

Reversing Large Scale Environmental Degradation[48]

Salinity management is the biggest and most fundamental environmental challenge in the Indus Basin. But there are other environmental challenges too—of managing the coastal zone and delta, of preserving wetlands, and of managing pollution.

The delta

The coastal zone of Sindh is highly productive in terms of photosynthetic processes and biodiversity,[49] with about 200 species of fish reported in the delta. The delta produces large quantities of shrimp—about 25,000 tonnes a year, more than half of which is exported. Mangroves are a centerpiece of the deltaic ecosystem. Estimates using satellite imagery show a steady decline in mangrove coverage in the Indus delta. A 1977 estimate was of 263,000 ha; a 1990 study estimated 160,000 ha of mangrove forests; and the latest estimate in 2003 reported that 106,000 ha of mudflats are under the mangrove forests along the coast of Sindh.

There are multiple reasons posited for this decline. The mangroves have traditionally been used as a source of wood for construction. However, today the residents of the coastal villages mainly use them as a source of fodder for livestock, and as a source of fuel. In addition, professional livestockers from the interior of Sindh bring large number of camels to the coastal lands for grazing and browsing mainly during the flood season. These factors notwithstanding, it has long been clear that the reduction in freshwater outflow to the delta and the decrease in sediments and nutrients play a role in this decline, and the associated decline in fisheries and livelihoods in the delta.

To a substantial degree the retreat of the delta is an inevitable phenomenon and a part of the bargain struck in order to support large numbers of people in the Indus Basin. That said, it has also long been recognized that it is important to provide some managed flows to sustain the delta to the degree that this is possible. This was, in fact, an item which was specifically discussed as part of the Indus Waters Treaty. There is a long-standing debate about the flows that are needed to maintain reasonable quality in the delta. In his definitive history of the Indus Waters Treaty, Gulhati[50] records that 'for salinity repulsion at the mouth of the Indus and for purposes of navigation between Kotri and the sea, Pakistan wanted to reserve 17 MAF as an "existing use"'. This was taken up again in 1991 in the discussions of the Water Accord. 'The need for certain minimum escapage to sea, below Kotri, to check sea intrusion, was recognized. Sindh held the view that the optimum level was 10 MAF, which was discussed at length, while other studies indicated higher/lower figures. It was, therefore, decided that further studies would be undertaken to establish the minimal escapage needs down-stream Kotri'.[51]

After many years of discussion, the Ministry of Water and Power has commissioned major studies by international consultants to examine the issue of the decline of the delta, the various contributing factors, the role of diminished flows, and to make recommendations about the quantity and timing of managed flows for the delta. The report is due soon and is expected to result in a final agreement.

Wetlands

Pakistan possesses a great variety of wetlands from the Indus delta to the high Himalayas. The area of inland waters in Pakistan has been estimated at

48 This section draws heavily, and often directly, on the background paper by Vakar Zakaria.
49 Paper 3.
50 N.D. Gulhati, *Indus Waters Treaty: An Exercise in International Mediation*, Allied Publishers, Bombay, 1973.
51 Indus River System Authority, 'Apportionment of Waters of Indus River System between the Provinces of Pakistan: Agreement 1991 (A chronological expose)', undated.

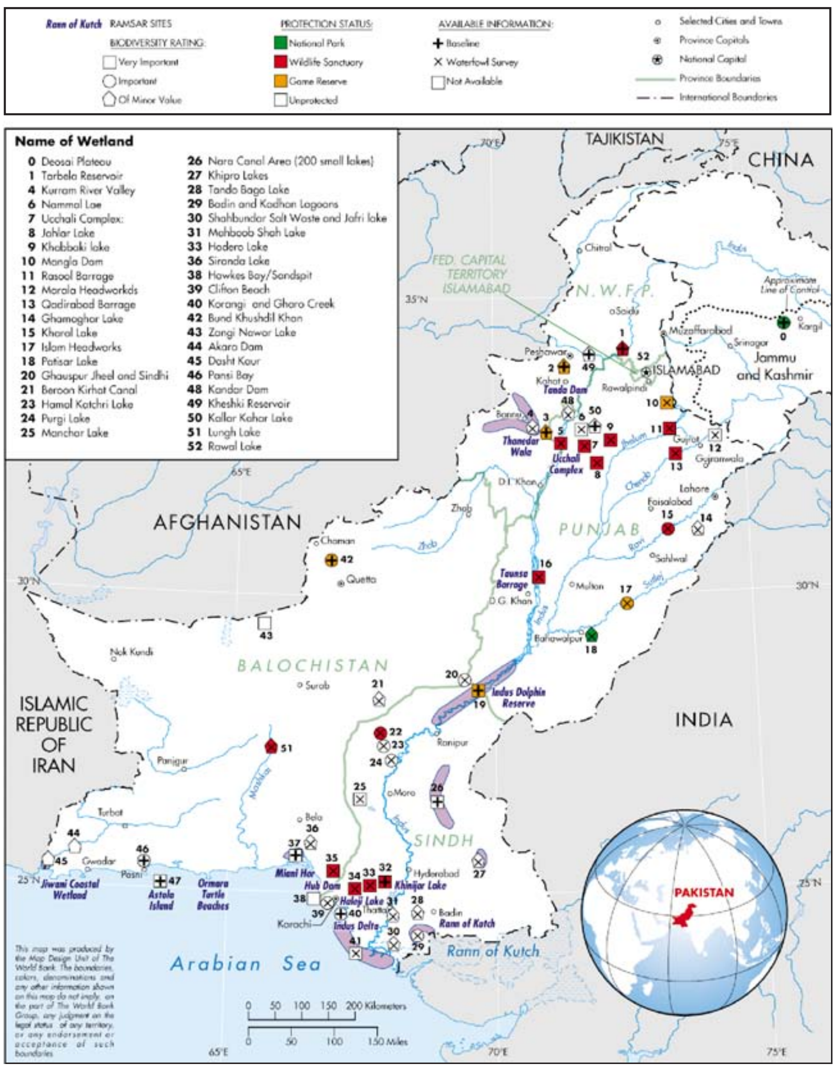
7,800,000 ha. Pakistan's Wetlands Action Plan, recently prepared by WWF-Pakistan and NCCW, gives an overview of 53 important wetlands of Pakistan, and describes their location, area, threats, and management status.

Figure 3.35 shows the location of important wetlands in the country. As is implicit in the description of the major types of important wetlands—man-made reservoirs (31 percent), brackish lakes (35 percent), and freshwater lakes or *dhands* (17 percent)—the large-scale use of water for irrigation has had both positive and negative effects on this environment.

Wetlands are a vital part of the ecosystem. Examples of key values and functions of wetlands in Pakistan include:

- Flood control: Kinjhar and Haleji lakes reduce the impact of Indus floods, while Manchar lake accommodates water from

Fig. 3.35: Pakistan's wetland resources



Source: Zakaria, 2005.

Indus and also from torrential hill streams.
- Groundwater replenishment: Wetlands in such areas are valuable source of groundwater recharge, for example, the Hub reservoir in Balochistan.
- Reservoirs of biodiversity: Haleji lake holds 60,000 to 10,000 ducks and coots in mid-winter.
- Ecosystem services: A large fishing community is dependant on Manchar lake for subsistence.
- Recreation, tourism, and cultural importance: Haleji lake in Sindh, Taunsa barrage in Punjab, and Sheosar lake in the Northern Areas attract visitors.
- Support local economy and cottage industries: Baskets made from typha are an important economic activity in central and lower Indus Basin.

Pakistan's wetlands are under a variety of threats. In the past, wetlands have generally been considered as wastelands, and have been used for drainage of water, reclaimed for agriculture, or treated as dumping grounds for all kind of refuse. The resources of the wetlands—fish, mangroves, and birds—have been harvested indiscriminately without any attempt to regulate their exploitation. It is estimated that around 36 percent of the wetlands are facing a high level of threat, and a further 30 percent are facing medium-level threats. The major threats include:

- Reductions in floods as a result of Tarbela and Mangla. Although obviously desirable for other reasons, reduced flooding together with the construction of *bunds* have significantly reduced riparian forests. A species shift from *Acacia* to *Prosopis* is common in riverine areas. This has threatened many mammal species, including the hog deer.
- Some of the drainage systems have reduced recharge of the wetlands and changed their habitats by discharging saline effluents into the wetlands. Many coastal lakes like Pateji were freshwater lakes prior to the LBOD project.
- Land reclamation for various purposes, particularly for agriculture, has eliminated many wetlands. A recent study assessed the evolution of wetlands in Thatta and Badin districts in lower Sindh, and concluded that several lakes had become either reduced considerably in size or had completely dried up. In part, this was attributed to extensive rice cultivation by the local population.
- Discharge of sewage, effluents, irrigation, and industrial waste is putting a serious stress on aquatic ecosystems. Almost all sugar mills in Sindh are discharging their effluents in drains, many of which discharge into wetlands. Haleji and Lal Suhanra lakes are facing the threat of eutrophication.
- Overexploitation of biological resources like food, feed, and fuel has degraded large wetlands. Kinjhar and Manchar lakes are important examples.
- Sea water intrusion and storms in coastal areas has destroyed the ecosystem of a large number of lakes. Kalkani, Khadi, and Jhim dhands are important costal wetlands that have become saline in recent years.
- Unregulated harvesting of wildlife species, particularly hunting and trapping of waterfowls, is causing a steep decline in populations. Chachh dhand in Thatta district supports a good population of waterfowls. However, the population of wintering birds is declining rapidly due to excessive hunting. All dhands along the Nara canal are facing similar threats.
- Introduction of exotic species in lakes is a serious threat to the population of indigenous species. Carp introduced in the Kallar Kahar lake are proliferating at the expense of indigenous species.
- Unmanaged tourism is also a significant threat to the wetlands. Major hazards

associated with tourism are damage to vegetation, killing or capturing wildlife, and littering. Haleji lake, Mangla reservoir, and Sheosar lake in the Northern Areas are examples.

One hundred and fifty years ago, a decisive choice was made, namely to render the sparsely populated Indus plains fit for large-scale human habitation by manipulating the natural water system. Such a decision inevitably leaves a very large ecological footprint. Pakistan has started the process of examining this footprint, and of prioritizing those environmental issues which are most important, and most amenable to change by human action. As the above description suggests, many of these changes (many deleterious, some positive) are irrevocable. And in virtually all cases the need is for actions on many fronts, including modified water management regimes.

Water Pollution

As described earlier, Pakistan is urbanizing and industrializing very rapidly. The number of people living in cities has increased almost four-fold over the last twenty years, and has been accompanied by a similar increase in industrial activity. To date there has been little effective action to reduce the environmental impact of this rapid concentration of people and activity.

First, consider the issue of wastewater disposal. As shown in table 3.1, there is very little treatment of wastewater or of industrial effluent in the burgeoning cities: it is estimated that only some 8 percent of urban wastewater is treated in municipal treatment plants, where treatment is at best partial owing to poor operation and maintenance.

Furthermore, there is very little separation of municipal from industrial effluent and both flow directly into open drains, which then flow into

Table 3.1: Wastewater treatment in the cities of Pakistan[52]

Major Cities	Population (millions)	Status and Condition of Facility
Karachi	10	TP 1, 2 and 3 non-operational. Maripur being operated by semi-private arrangement.
Lahore	5	Sewage treatment plants proposed but not implemented. BOOT advertised, but lack of interest resulted in schemes being shelved.
Faisalabad	2	One of the treatment plants is functioning but not satisfactorily. Three other plants proposed but none yet installed.
Rawalpindi	1	No sewage treatment yet. A plant is planned under an ADB loan for second phase of Rawalpindi Urban Development scheme.
Islamabad	0.50	STP 1 and 2 grossly overloaded, while STP 3 was never commissioned. French loan for STP 4 being utilized in 2005.
Quetta	0.50	No sewage treatment facility exists.
Hyderabad	1	There are two treatment plants. None of them is functioning.
Gujranwala	1	No sewage treatment facility exists.
Peshawar	1	Hayatabad STP non-functional. Other plants in Charsadah and Warask are being constructed.
Multan	1.2	No sewage treatment facility exists.
Sargodha	0.50	No sewage treatment facility exists.

Source: Paper 8.

52 Paper 8.

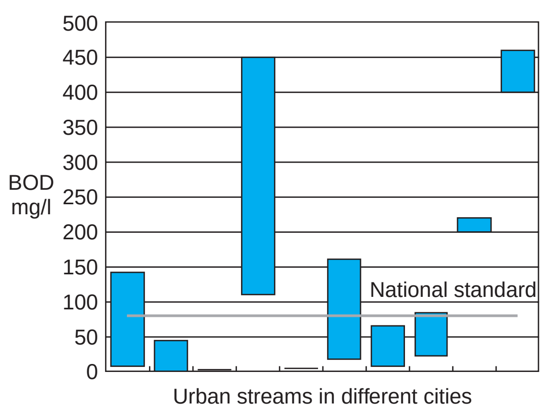
nearby natural water bodies. In the absence of the latter, the effluent collects in stagnant pools, within residential areas or near industrial plants.[53] In Lahore, only 3 out of some 100 industries using hazardous chemicals treat their wastewater. Figures 3.36 and 3.37 show that the BOD and COD levels in urban streams are in orders of magnitude higher than national standards.

In Karachi, Sindh Industrial Trading Estate (SITE) and Korangi Industrial and Trading Estate (KITE), two of the biggest industrial estates in Pakistan, there is no effluent treatment plant and the waste containing hazardous materials, heavy metals, oil, etc. is discharged into the already polluted river and harbor. The industrial pollution discharges combined with mangrove destruction are resulting in sharp decrease in shrimp and fish production. The Kasur Water Treatment Plant is generally considered to be the only common effluent treatment plant for industrial wastewater that is currently functioning in the country, but in fact it is only a pre-treatment plant and causes major odor problems.[54]

The overall effect is that the population is exposed to major health hazards, and it also means that nearby groundwater is becoming seriously contaminated. Since all major cities, apart from Karachi and Islamabad, depend on groundwater as their source of raw water, this poses a serious and rapidly growing problem for the cities. In addition, many cities are having difficulties in getting sufficient quantities of raw water as local aquifers are being overpumped and contaminated. Consider the case of Lahore, for example, which has 300 tubewells installed pumping over 300 mad of water. Over the past few years, water quality has become a serious issue as the existing sewerage system is in a state of disrepair and there is no sewage treatment facility. Wastewater is contaminating groundwater supplies in many areas of Lahore.

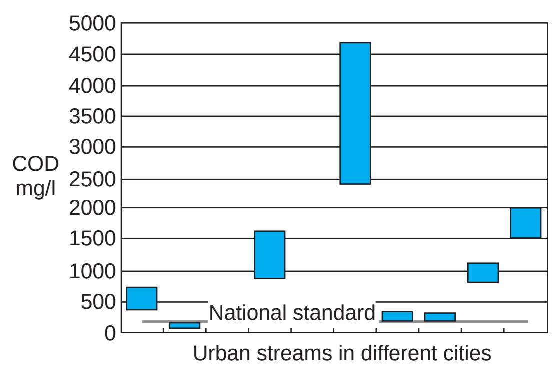
In one of the many brutal trade-offs that poor people make on a daily basis, on the urban periphery irrigating with low-quality water or sewage is often the only option. But even when farmers do have access to surface water and groundwater, many prefer sewage because they are guaranteed a constant supply, and the nutrients the water contains allow them to save on fertilizer.[55]

Fig. 3.36: The quality (Biochemical Oxygen Demand) of urban streams



Source: Zakaria, 2005.

Fig. 3.37: The quality (Chemical Oxygen Demand) of urban streams



Source: Zakaria, 2005.

53 Paper 3.
54 Shahida Jamil, personal communication as part of a review of an earlier draft of this Report.
55 Paper 5.

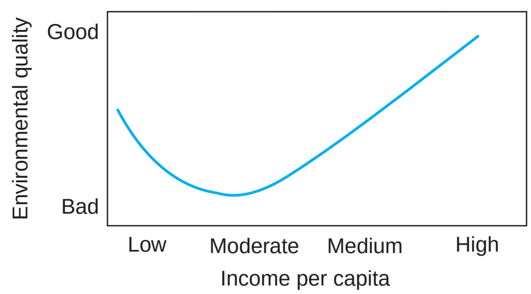
Water pollution is, however, not only a consequence of urban and industrial pollution. About 5.6 million tonnes of fertilizer and 70 thousand tonnes of pesticide are consumed in the country every year. Pesticide use is increasing annually at a rate of about 6 percent. Pesticides, mostly insecticides, sprayed on the crops mix with the irrigation water, which leaches through the soil and enters groundwater aquifers and sometimes contaminates water supplies, as appears to be the case in the recurring problems of water-related deaths in Hyderabad.[56] The quantity or quality of agricultural runoff has not been measured or tested at the national level. In 107 samples of groundwater collected from various locations in the country between 1988 and 2000, 31 samples were found to have contamination of pesticides beyond FAO/WHO safety limits.[57] A recent study, conducted by the Environmental Protection Department in Punjab took 280 samples, distributed evenly over all districts in the province. It found the concentration of the different heavy toxic metals (cyanide, cadmium, chromium, mercury, lead, boron, nickel, selenium, and zinc) to be in excess of WHO standards for up to 25 percent of the samples.[58]

It is instructive to differentiate two different water-related environmental challenges. Category One are issues of environmental degradation that would improve dramatically if water was used and managed more effectively and efficiently; and Category Two are issues that require supplementary actions and resources.

If the recommendations discussed in earlier sections of this Report—water entitlements, water pricing, accountable institutions, effective regulation—were implemented, the majority of water-related environmental problems in Pakistan would be ameliorated to a significant degree. Specifically, this would mean an end to wasteful water use in both agriculture and urban areas; it would mean reductions in mining of aquifers and the consequent quality problems. It would also mean shifting the focus of government attention away from the traditional areas (of constructing and operating water supply infrastructure) and 'creating fiscal space' for investing in environmental quality and other public goods.

Global comparisons show that there is something like a 'Kuznets curve' for many indices of environmental quality. As illustrated schematically in fig. 3.38, in the early phases of development there is typically a sharp decline in environmental quality. As economic growth is sustained, however, societies place a higher value on environmental quality, and they have more resources to spend on the environment. For many measures of environmental quality there is then a slow but steady climb out of the environmental abyss.

Fig. 3.38: The 'Kuznets curve' for environmental quality



Source: The World Bank, 1992.

Living with Floods

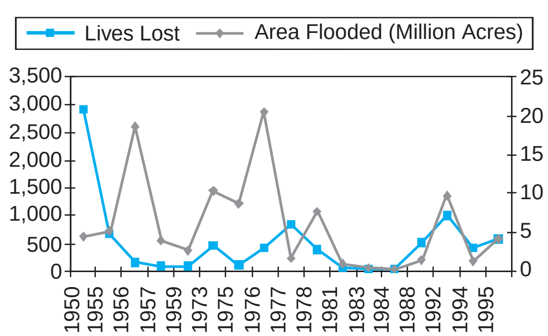
The natural state of heavily-silt-laden rivers (like the Indus) is to meander. This is because as silt builds up in their beds, the rivers seek lower lands and change their courses. This creates havoc with

56 Paper 2.
57 Paper 3.
58 Paper 11.

human settlements and so, throughout the world, such rivers have been trained and confined by embankments within relatively narrow beds. But as with everything watery, solving one problem gives rise to another. In this case, the bed keeps getting higher and higher, and soon the river is, as in the lower parts of Sindh, above the level of the land. (To some degree the trapping of silt in upstream reservoirs alleviates this particular environmental hazard.) Over time, the likelihood of embankment breaching increases, as do the problems of drainage from flooded lands. When this coincides with unfavorable tidal conditions, the consequences can be disastrous.

As shown in fig. 3.39, floods have, with considerable regularity, inflicted large damages and caused many deaths. The nature of the flood protection and management challenge varies considerably across the country. As is always the case, water is mostly a blessing and sometimes a curse. The hill torrents of NWFP, Balochistan, and certain parts of Punjab sustain agriculture in an area of about 1 million hectares[59] but also, as described by Asif Kazi:[60] '…pose a serious threat due to their steep slopes resulting in flashy flows of high magnitudes from torrential rains.' In Punjab, 'the problem of inundation and land erosion are both prevalent.'[61] The problem of Sindh is, in many ways, the most difficult and intractable. In the words of Asif Kazi: 'The province of Sindh has virtually been the delta area for millions of years, and there is ample geological evidence that there is not a single square meter of Sindh where Indus has not been flowing. It has been filling up the lowest lying areas wherever they might have been, depositing sediment, and then moving on to the next low area and so on. Changes in the course of Indus to even far away low routes, of course, took place during high floods. The process continued till an uncertain situation such as this became totally unacceptable to the inhabitants. Therefore, over the past one hundred and fifty years or so dykes have been constructed progressively to a point that the Indus river has now been put in a straitjacket, thereby fixing its location. This naturally resulted in deposition of transported sediment largely on its own bed giving rise to a situation where the river is now significantly higher than the natural ground. The choice would be between dredging and excavation to lower the bed, or to continue to raise the side embankments. Currently, when a protection bund breaches in the province of Sindh, inundations are prolonged, and the floods not only damage summer crops but they also interfere with the sowing of subsequent winter crops. The potential for economic losses, and human sufferings for the poor inhabitants of relatively cheap flood-prone lands near the river, are the greatest. In addition to millions of acres of irrigated land that is subjected to flooding, the country's major rail and roads are also sometimes affected by super flood events that keep the infrastructure out of service for long durations.'[62]

Fig. 3.39: Flood losses in Pakistan



Source: Kazi, 2005.

59 Van Steenbergen, personal communication as part of a review of an earlier draft of this Report.
60 Paper 14.
61 Ibid.
62 Ibid.

In his excellent background paper, Asif Kazi[63] gives a comprehensive overview of the challenges of flood management, of what has been done (a lot) and what needs to be done (a lot more). The major conclusions are as follows:

- As in many countries, attention to floods is episodic and goes into hibernation during periods of drought, with devastating consequences (as witnessed in the recent drought-ending floods in Balochistan).
- Pakistan has a long-standing and sophisticated understanding of flood management, and has long emphasized both 'hard' solutions (such as dams, embankments, and drainage works) and 'soft' solutions (such as watershed management, land use planning, and flood warning systems).
- There are a number of factors—including declining storage capacity in the major reservoirs, and the increased flows likely as a result of glacial retreat—which indicate that Pakistan is likely to be entering an era of increased flooding.
- Flood management always involves difficult trade-offs. Embankments and drains and other protective structures cannot realistically be built to such a level that there is no threat of floods. And so when floods do occur, they should not be seen as 'a failure' of the system, but rather as an inevitable part of the uneasy balance which is struck when man lives in very large numbers in a hazardous environment. In addition, populations move into the Indus flood plain, which sustains a productive shallow-tubewell-based agriculture.
- Priority must be given to structural protection of high-value infrastructure assets, the failure of which would be catastrophic. This obviously includes the barrages, where there is both need for urgent structural attention (witness Sukkur Barrage) and attention to bypass floodways that need to be properly demarcated and channelized, and from which encroachments need to be removed. There are some major structures, such as the Alexandra Railway Bridge over the Chenab, that need to be extended to avoid choking and flood ponding upstream that causes frequent inundation of towns and villages.
- A major problem is that maintenance of the existing flood protection infrastructure is deficient, with the result that breaches/ damages are not uncommon. As for all other infrastructure (discussed in more detail in the next section), there is a need for an asset management plan, and assessment of liabilities and mechanisms for regular funding of these.
- While the concept of flood hazard land-use planning is well understood, the fact is that there is little enforcement, and growth of vulnerable developments in flood-vulnerable areas continues unabated.
- Post-dam records are long enough to give a fairly good indication of the effect of the reservoirs, but the quality of regulation is not being improved by extending the period of record by simulating reservoir operation for the pre-dam periods. There is a need to review the magnitude of Probable Maximum Flood (PMF) for major facilities.
- Flood response plans exist but implementation is weak, with specific priority items being the need to raise the level of awareness, and to the timing and reliability of warnings and how they are understood by the general population.
- Progressive deposition of sediment on the river beds, particularly in the lower reaches of the Indus, is proceeding unchecked. Current management of the problem by

63 Ibid.

correspondingly raising the dykes to contain the river every few years is certainly not sustainable on a long-term basis.

- Flood management is characterized by 'short bursts of feverish activity stimulated by a flood event followed by long periods of complacency… as the memory of flood fades into the past, the motivation for action also passes away'.[64]
- The lack of maintenance is a very serious institutional and financial issue. 'Since 1958, with the transfer of major development works to WAPDA, provincial irrigation departments' functions were reduced mainly to the operation and maintenance of the systems. PID managers have not been finding these functions sufficiently challenging, and over the years have lost much of their initiative, innovativeness, and morale. The PIDs' attention remains almost exclusively focused on the irrigation distribution network. Let alone the flood protection works, even the river barrages have been in a state of neglect. Whenever a major problem of a catastrophic nature takes place on a barrage or a flood protection embankment, lack of adequacy of maintenance funds is given as a standard cause which in several cases would be valid while in others not quite so. Deferred maintenance has become a routine practice with PIDs, which eventually results either in a disaster or in a major repair and restoration undertaking in the shape of an independent project.'[65]

In summary, there is a long tradition of excellent professional flood management capability in Pakistan. But the great challenges are those of making explicit but difficult trade-offs, financing, implementation, maintenance, and institutional performance—in short, the fundamental problems of development.

Renewing Existing Infrastructure: Addressing the 'Maintenance Gap'

Pakistan has a very large stock of major irrigation and bulk water infrastructure, with an estimated replacement cost of about US$60 billion.[66] Much of this infrastructure is very old, with major structures operating well beyond their design life. As described earlier, the services provided by this infrastructure are critical for national well-being. But the services are only forthcoming if the structures are maintained and, when their useful life is over, replaced.

Neither the federal government nor any of the provinces in Pakistan has a modern Asset Management Plan, and thus there are no reliable estimates of the annualized costs of replacing and maintaining this infrastructure. From international experience, a typical figure—assuming regular maintenance—of replacement and maintenance is about 3 percent of the value of the capital stock of water infrastructure,[67] with roughly a half of this being for replacement and half for maintenance. Taking the case of Punjab (which has US$20 billion of water infrastructure managed by the Irrigation Department) this would imply that the cost of replacement and maintenance of Punjab's stock of water resource and irrigation infrastructure would be about US$0.6 billion a year. This would, using the

64 Paper 14.
65 Ibid.
66 Estimates prepared by Punjab IPD, September 2005.
67 The Australian experience shows that the average 'renewals annuity', which includes the cost of both replacement and operations and maintenance, 'is about 3 percent to 4 percent for older, and 2 percent to 3 percent for newer assets'. Personal communication, Golbourn Murray Water and the Murray-Darling Basin Commission, 2005.

benchmark ratios, mean that Punjab should be investing an average of about US$0.3 billion a year in replacement and a similar amount in maintenance. In fact there is no budget for replacement, and the Government of Punjab's budget for maintenance is about 1.2 billion rupees, or about 6.5 percent of the above benchmark estimate of the cost of maintenance. Now there are several reasons why the costs of replacement and maintenance may be somewhat lower than the above benchmark, but the stark fact is that the provisions for replacement and maintenance are a small fraction of what is required to maintain the infrastructure stock in good condition.

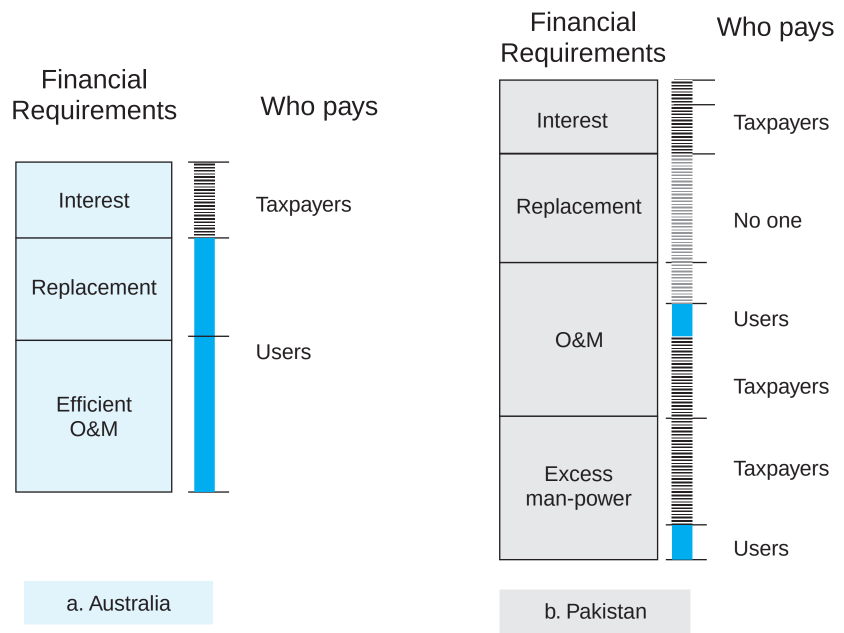
And this shows. As described by Asif Kazi[68] in the previous section, the cumulative effect of neglect of the river barrages has left these strategic structures in a precarious state. Some recent events in the form of breaches in the first line of protective embankments in Sindh and the current situation at Sukkur Barrage, are clear evidences of accumulative neglect. In Punjab as well, at present, some six barrages have deteriorated to a point that deferred repairs are now being undertaken as major 'Remodeling Projects'. And Sarfraz Qureshi[69] describes: 'the deteriorated condition of many distributaries, minors and watercourses, and their related structures such as gates and outlets—seepage losses along these canals are often high and their hydraulic performance low with the result that the system does not function as it was designed or intended. Thus, plots in different parts of the command area, but especially near the tail of these canals, would receive less water than was intended.' Government of Punjab officials estimate that the delivery capacity of canals is 30 percent below design because of the cumulative effect of deferred maintenance and lack of rehabilitation.

Three further factors exacerbate an already dramatic situation. First is the fact that large proportions of recurrent budgets—76 percent in the case of Punjab—are spent on overstaffed irrigation department staff. The politics of these public enterprises is such that salaries have the first call on resources, with maintenance being a 'residual priority'. Second is the fact that large amounts (especially in Sindh) are spent on keeping unnecessary public tubewells running.[70] Third is the reality that revenue collection is low and declining. If the true costs of maintenance are, say, 0.5 percent of the value of the stock of infrastructure (one half of the international benchmark), then the annual cost of maintaining the system would be about US$15 (or Rs 900) per hectare.[71] Actual *abiana* (water charge) collection in Punjab, for example, amounts to about Rs 150 per hectare.

The result of this pattern of declining revenues and rising personnel costs is illustrated schematically in fig. 3.40. In a financially well-structured irrigation system (such as that in Australia), users pay for efficient operations, maintenance, and replacement costs of the assets which provide their services. The government pays (reluctantly!) the interest on debt accumulated in the past. The system (see part (a) in fig. 3.40) is clean and the incentives right (for the users to demand efficient operations and maintenance (O&M), and replacement only of essential assets and that at least cost). The typical Pakistani system is much more complex (see part (b) in fig. 3.40). First, there is an extra 'block of payment' to be made for the extra costs incurred by having large numbers of unnecessary workers. Second, the user payments represent only a small fraction of the total money available for O&M (including salaries). Most of the O&M allocations are from the budget (that is, paid for by all taxpayers), but these amounts typically do not cover what is required for O&M, leaving an unfilled 'deficit'

68 Paper 14.
69 Paper 1.
70 Van Steenbergen, personal communication in a review of an earlier draft of this Report.
71 An asset value of US$60 billion over 20 million hectares implies an asset per hectare served of US$3,000.

Fig. 3.40: The financing of water services in Pakistan



for O&M. At the top end, the interest on past investments is paid for by taxpayers. What this means is that there is a yawning gap, paid for neither by users nor taxpayers. This means that O&M is not done adequately and—since it is last in the queue—there is no investment in replacing aging assets.

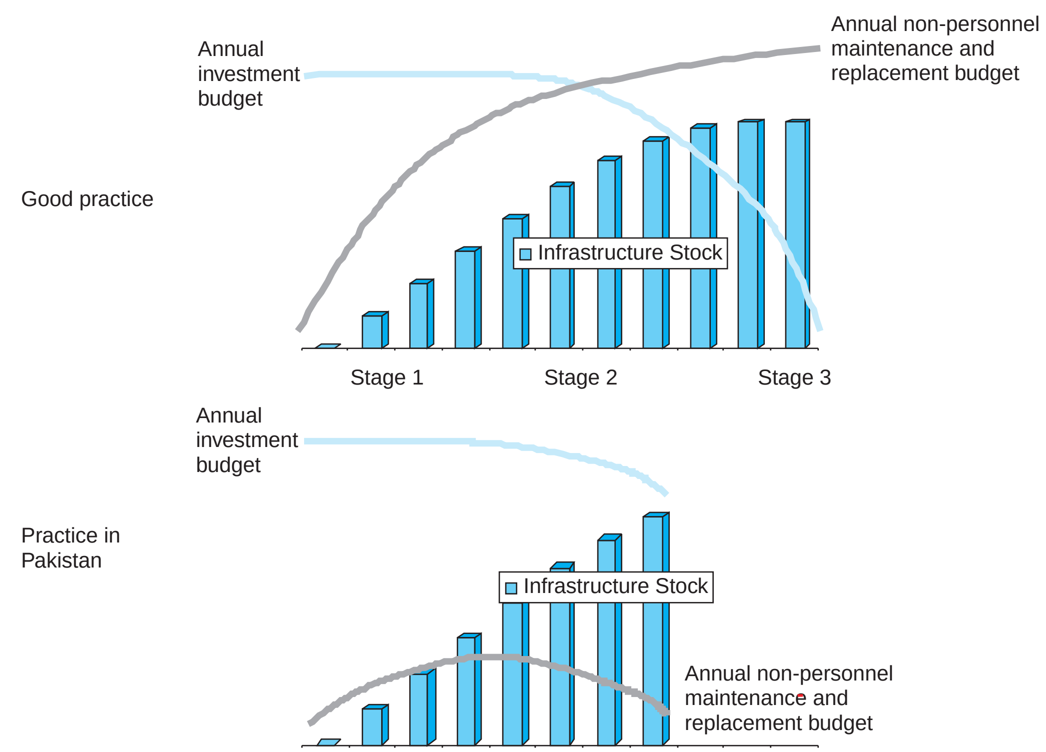
And it means that much of what masquerades as 'investment' is, in fact, a belated attempt to rehabilitate the crumbling infrastructure, both for irrigation and for municipal water supplies. (Most World Bank 'investments' in water infrastructure are, in fact, not investment in new infrastructure, but an attempt to make some inroads into the huge liabilities from deferred maintenance.)

The contrast between globallyaccepted good maintenance-and-replacement practice and that of the systems in the subcontinent—accurately described[72] as 'Build-Neglect-Rebuild'—is represented schematically in fig. 3.41. In the 'good practice' case, the stock of infrastructure grows fast in 'Stage 1' (referring back to the 'Stages' illustrated in fig. 2.18) and then tails off in Stages 2 and 3. But as this stock grows, so the financial demands for maintaining and replacing this stock increase. In the Pakistan case—arguably in Stage 2—the stock is still growing, but the finance available for maintaining and replacing that stock has fallen rather than risen.

Much of what is built is not being maintained, and that which does still function, delivers services of a low quality. This in turn reinforces the vicious cycle—users who are receiving such poor services reasonably refuse to pay, meaning that revenues decline still further, and the maintenance and replacement gaps widen still further. Later in the Report, we look at some ways of trying to approach the difficult but vital challenge of moving from a vicious to a virtuous cycle. There is no silver bullet for this—it will need dramatic increases in the

72 Briscoe, John, and R.P.S. Malik, *India's Water Economy: Bracing for a Turbulent Future*, Oxford University Press, New Delhi, 2006.

Fig. 3.41: Depleting Pakistan's infrastructure stock



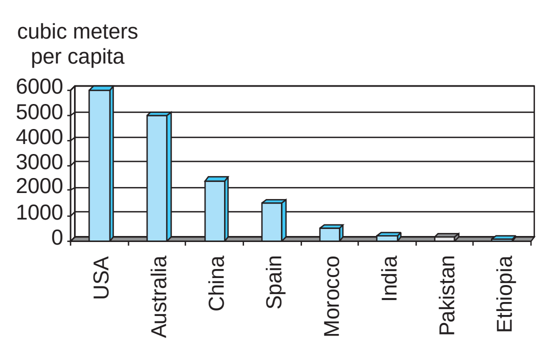
Source: Bank Staff.

efficiency of the providers of the public services, it will require 'transition plans' so that improved services can induce greater confidence in the services and willingness to pay for them, and it will require recognition of a simple financial fact: there are only two ways to pay for infrastructure—from taxes or from user charges. As long as government is not prepared to do either or both of these, there is no hope for building and maintaining the infrastructure necessary for a more productive economy.

Investing in Priority New Infrastructure

When river flow is variable, then storage is required so that the supply of water can more closely match water demands. Relative to other arid countries, Pakistan has very little water storage capacity. Figure 3.42 shows that whereas the United States and Australia have over 5,000 cubic meters of storage capacity per inhabitant, and China has 2,200 cubic meters, Pakistan has only 150 cubic

Fig. 3.42: Storage per capita in different semi-arid countries

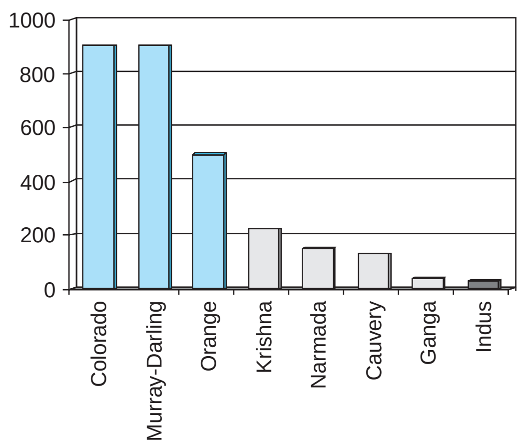


Source: The World Bank analysis of ICOLD data.

meters of storage capacity per capita. And fig. 3.43 shows figures for some major arid basins in the world. The dams of the Colorado and Murray-Darling rivers can hold 900 days of river runoff. South Africa can store 500 days in its Orange river, and India between 120 and 220 days in its major peninsular rivers (fig. 3.43). By contrast, Pakistan can barely store 30 days of water in the Indus Basin.

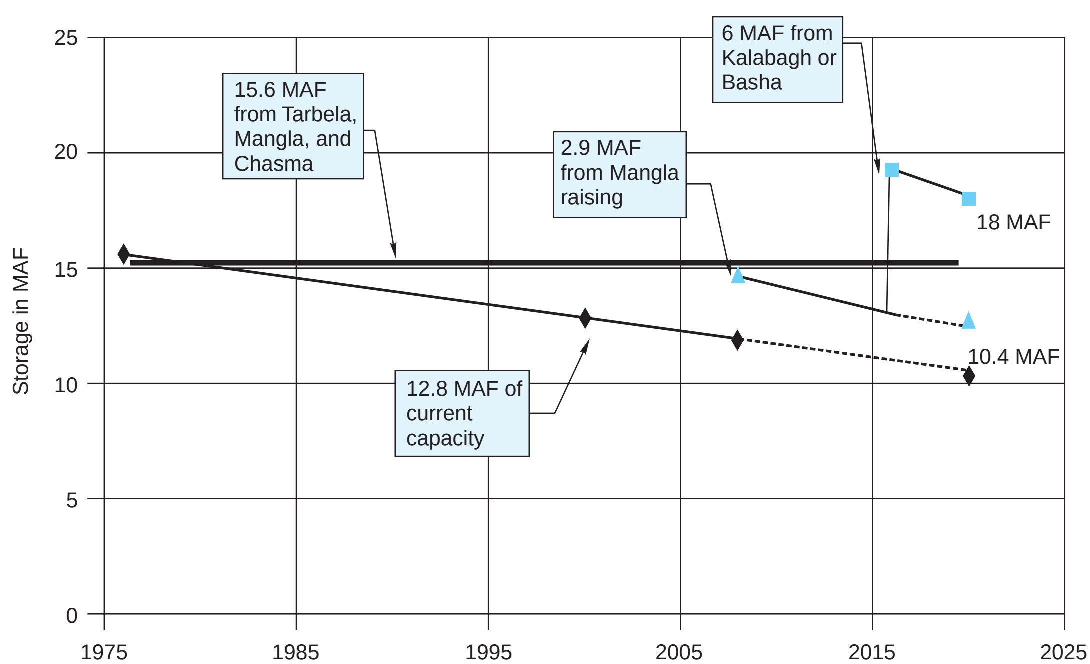
When the Indus Basin Works were being planned, it was clear that the construction of Tarbela and Mangla were not a 'final solution', for two reasons. First, because it was known that the high silt loads from the young Himalayas meant that effective storage capacity would decline over time (fig. 3.44) and that it was necessary to build further storage to replace this loss. And second that at such low levels of storage there were—see the storage-yield curve in fig. 3.45—substantial benefits from increasing the overall amount of storage in the system. The Pakistan Water Strategy (financed by the Asian Development Bank) and WAPDA's 'Vision 2025'

Fig. 3.43: Days of average flow which reservoirs in semi-arid countries can store in different basins



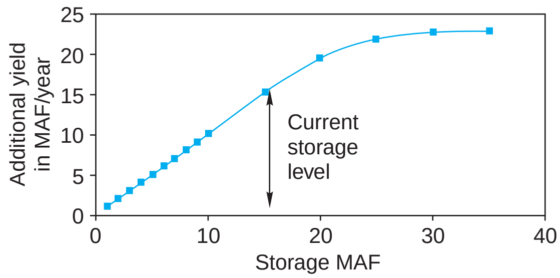
Source: The World Bank analysis of ICOLD and GDRC data.

Fig. 3.44: Sedimentation and storage capacity



Source: The World Bank, 2003.

Fig. 3.45: Storage-additional yield curve for the Indus



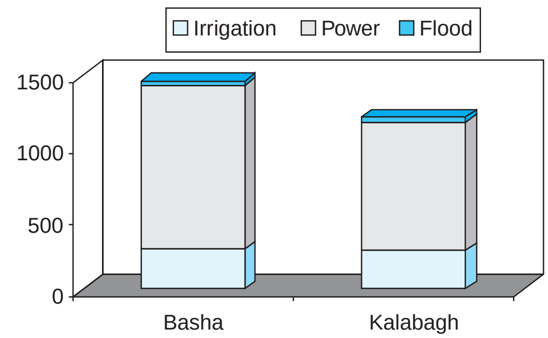
Source: Lieftinck, 1968.

have reviewed likely future demands and the implied requirements for storage. If no new storage is built, canal diversions will remain stagnant at about 104 MAF and the shortfall will increase by about 12 percent over the next decade. The Pakistan Water Strategy calculates that Pakistan needs to raise storage capacity by 18 MAF (6 MAF for replacement of storage lost to siltation and 12 MAF of new storage) by 2025 in order to meet the projected requirements of 134 MAF.[73]

Large dams do not only increase the assurance of water supply, but they can also generate large amounts of electricity. Currently, about 30 percent of Pakistan's energy is generated from hydropower.[74] Even though Tarbela is operated as an irrigation dam (with hydropower a 'by-product'), power benefits account for 60 percent of the overall economic benefits from the dam.[75] And (as fig. 3.46 shows) power benefits would be an even higher proportion of total benefits from either Kalabagh or Basha.

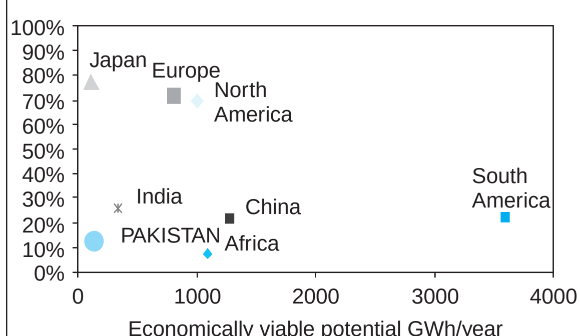
As shown in fig. 3.47, Pakistan has used only about 10 percent of its estimated 40,000 MW of economically viable hydropower potential, a proportion much lower than, say, India and China (around 30 percent) and much lower still than developed countries (around 75 percent). Recognizing the value of power which is not subject to market volatility, which generates substantial local economic multipliers (the mostly local construction content of hydropower is about 80 percent versus about 20 percent for thermal power), and which provides high-value peaking

Fig. 3.46: Benefits from Basha and Kalabagh



Source: Amir, 2005.

Fig. 3.47: Development of economically-feasible hydropower potential in Pakistan in international context



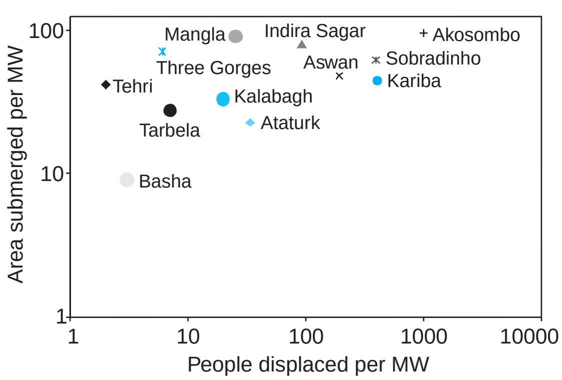
Source: Lieftinck, 1968.

73 Paper 10.
74 Paper 2.
75 ASIANICS Agro-Dev., 'Tarbela Dam and related aspects of the Indus River Basin, Pakistan', Report prepared for the World Commission on Dams, ASIANICS Agro-Dev. International, Islamabad, Pakistan, 2000.

power (which is likely to be worth about four times the value of a unit of base load), Pakistan is planning for hydropower to provide about half of new generation in the medium term.[76]

Deciding on which dam should be built involves comparisons on many axes—economic, financial, technical, safety, environmental, and social—and multidimensional trade-offs. Figure 3.48 compares some partial indicators (using a log-log plot) of environmental and social impact of existing and possible future large dams in Pakistan with other major multipurpose dams in the world,[77] using very rudimentary indicators. This suggests that for Kalabagh the environmental and social footprint is smaller than for most other large multipurpose dams; for Basha the footprint is much smaller. While such comparisons provide a first-order check, there are many other elements to be factored in before coming to any conclusion on the relative merits of specific dam sites. (For example, while the design of Kalabagh is well advanced, this is not so for Basha, where there are considerable questions about the safe height of a dam. In addition, social costs are not just a matter of numbers—whereas most of the involuntary resettlement at Kalabagh would be to nearby areas, in the case of Basha resettled populations would have to be relocated long distances from their original homes.)

Fig. 3.48: Partial environmental and social indicators for some multipurpose dams



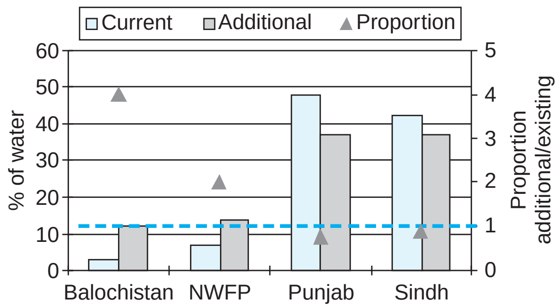
Source: Ledec, 2003.

Because hydropower produces such a reliable stream of revenues, it opens the possibility of attracting substantial amounts of private capital, in a public-private partnership, in which the public sector takes those risks which it is best able to (including exploration, and the considerable geological risks involved in any major dam construction) whereas the private sector can shoulder those risks which it is best suited to (including financing and operating the electricity generating station). For this potential to materialize, improvements have to be made in a number of other aspects—including contracting and pricing practices, the electricity market structure and trading rules, water rights, and water use priorities. In addition, environmental and social risks play an important role in the response of the private sector which is usually more inclined to invest in run-of-the-river projects, of which there are a substantial number in Pakistan.

At the time of planning of the Indus Basin works, it was recommended that planning for the next major dam on the Indus should commence after the construction of Tarbela and Mangla was complete. Thirty years later, after an enormous amount of discussion, no decision has been taken to proceed with the construction of the next dam. The most frequent ostensible reason is that it is already-privileged Punjab which will be the major beneficiary. As part of the 1991 Accord, the shares of any increase in water available as a result of new storage are clearly allocated. As shown in fig. 3.49, this part of the Accord has a strong redistributional component, with the smaller

76 Paper 4.
77 Supplementing data presented in 'Good Dams and Bad Dams', George Ledec and Juan Quintero, The World Bank, 2003.

Fig. 3.49: Who benefits from new Indus storage?



Source: Water Accord and Bank Staff.

provinces (Balochistan and NWFP) getting much larger shares of the 'new water' than they have of existing allocations. The shares of both Sindh and Punjab would be less than their shares of 'existing water', with Punjab, in relative terms, being the biggest loser. Why, then, such hostility, and the perception that new storage would disproportionately benefit Punjab? In part, this is for legitimate and necessary reasons (such as the resettlement of substantial numbers of people, and lack of transparency about who would get the royalties from power generation), partially for legitimate but resolvable reasons (lack of transparency and trust in the implementation of the allocations under the Accord), and partially because the discussion of dams has become a vehicle for a host of remotely or unrelated historical and current political grievances.[78]

It is obvious what the federal government needs to do. The federal government needs to give priority to the development of infrastructure in Balochistan and NWFP to enable them to utilize their allocated shares in the apportionment accord from the existing storages and storages to be created in future including shares out of flood flows.[79] Government must also provide objective and understandable information (as has been done, at least in part, as shown in box 3.3). More

Box 3.3: Public information on Kalabagh Dam (an extract)

Apprehensions of Sindh

(i) The anxiety that the project would render Sindh into a desert.
(ii) There would be no surplus water to fill Kalabagh reservoir.
(iii) High level outlets would be used to divert water from the reservoir.
(iv) Cultivation in riverine (Sailaba) areas would be adversely affected.
(v) Sea water intrusion in Indus estuary would accentuate.
(vi) Mangrove forest, which are already threatened, would be further affected adversely.
(vii) Fish production and drinking water supply below Kotri would be adversely affected.

Answers:

(i) Dams don't consume any water. Instead these store water during flood season and then make it available on crop demand basis for the remaining dry periods of the year. The real demonstration of this came after full commissioning of Tarbela Dam in 1976. During pre-storage era of 1960–67, average annual canal withdrawals of Sindh were 35.6 MAF. After Tarbela the corresponding figure rose to 44.5 MAF with over 22 percent increase in the *rabi* diversions alone increased from 10.7 to 15.2 MAF. It is estimated that after Kalabagh, canal withdrawals of Sindh would further increase.
(ii) WAA of 1991 has allocated, on the average, about 12 MAF additional supplies to the provinces almost all of which is in *kharif* season. On the other hand, factually the surplus water is available only within 70–100 days flood period. It is estimated that to provide additional allocated water over the

(Contd)

78 Khaled Ahmed, 'Sindh: The feel-bad factor', *Friday Times*, Lahore, May 2005.
79 Paper 13.

Box 3.3 (Contd)

year, a storage of about 3.6 MAF would be needed (out of this, 2.2 MAF would be in the early kharif season of April to July).

(iii) Initial studies have indicated that construction of high level outlets at Kalabagh is economically unviable. Notwithstanding this, if any province wants to build, then its share of water would be strictly governed by WAA, 1991.

(iv) a. An impression is also prevailing that with Kalabagh Dam, riverine areas of Sindh, commonly called 'Sailaba' would go out of production due to control over floods. It can be appreciated from configuration of riverine area that Sailaba crops are grown on the land adjacent to main river and the creeks. Though crops are sown on the soil moisture soon after the floods, these need more than one watering to mature. As a result, Sailaba lands give poor yields. Consequently, farmers are generally required to provide irrigation facility through shallow tubewells or lift pumps. Prime movers on these tubewells have to be removed during the flood season to avoid damage.

b. Sindh has presently 660,000 acres of Sailaba cultivated area from Guddu Barrage to the sea. This area is initially sown due to the moisture provided by flooding with river stage of 300,000 cusecs and above.

c. Flood peaks above 300,000 cusecs would still be coming after Kalabagh, without much detriment to the present cultural practices, while large floods would be effectively controlled. This would, in fact, be conductive to installation of permanent tubewells to provide perennial irrigation facility in riverine areas. Towards this end, a separate scheme is being included in NWRDP.

(v) a. The fear that present extent of sea water intrusion in the Indus Delta would be further aggravated by Kalabagh is not substantiated by factual data. Studies indicate that presently the total effect of the Indus estuary is only limited to the lowermost portion of the Delta and gets dissipated below Groh and Chowgazo. Gauge heights at Garho are completely insensitive to Indus discharges of up to 700,000 cusecs. Therefore, the sea water intrusion, which seems to be at its maximum even now, is unlikely to be aggravated further by Kalabagh Dam.

b. Another apprehension is that sea water intrusion into existing aquifer system would cause serious quality deterioration. The groundwater contained in the aquifer is effectively saline as far north as Hyderabad. Therefore, intrusion of sea water along the shoreline of the Delta is of little consequence. This is further supported by the fact that there is southward oriented groundwater gradient throughout this aquifer. Considering the very low transmissivities of the aquifer in the Delta region, upward sea water intrusion can be almost ruled out.

(vi) a. Out of the total 1.53 million acres (MA) tidally inundated historic Indus Delta, mangrove forest cover an area of almost 0.32 MA. In this forest, spreading from Karachi in the west to Rann of Kutch in the east, 95 percent of the population now consist of a salt tolerant variety.

b. Extent of the active delta area (as distinct from the historic delta area described above) is about 294,000 acres. Out of this, the mangroves cover only 7,400 acres or 2.5 percent of the area. Most of the remaining area is in the form of mud-flats. The reason for this area being too small could be a combination of factors. Recently, NED University of Engineering and Technology has carried out a study titled 'What Really Threatens Us and Our Mangroves'. This brings out that reduction in mangroves is essentially due to frequency of tidal inundation being too small instead of fresh water reduction caused by upstream abstractions, which started with Sukkur Barrage in 1932. Other major causes are uncontrolled overgrazing and cutting due to extreme population pressure of Karachi.

c. Therefore, in order to revive the mangroves, real need is for replanting salt tolerant varieties with provision for controlled doses of fresh water. Obviously, this possibility would be much enhanced with an upstream storage facility like Kalabagh.

(Contd)

Box 3.3 (Contd)

(vii) a. A recent study has shown that there is no clear evidence to suggest that fisheries stocks in the river reach below Kotri have declined due to progressive reduction in the surface water supplies. On the other hand, fish production has been constantly increasing as indicated by statistical data. As such, Kalabagh Dam is unlikely to have any adverse effect on fish production in the area.

b. In the riverine area downstream to Kotri Barrage, groundwater is predominantly saline or brackish and as such unsuitable for either irrigation or water supply. After Kalabagh, winter supply in the river would improve, thus assuring more drinking water.

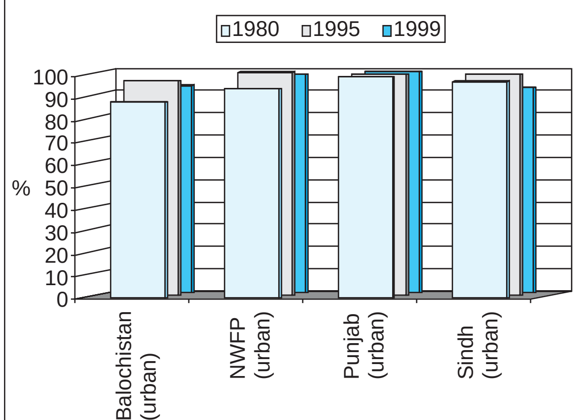
Source: Government of Pakistan web site http://www.infopak.gov.pk/public/Kalabagh_Dam.htm.

fundamentally, the federal government needs to do everything possible to improve the transparency and trust in the implementation of the current allocations under the Accord. Here, as described earlier in Chapter 2, the federal government would be well advised to appoint a neutral auditor who would have the resources to measure all abstractions from the system and to report these in a public and transparent way. The federal government also needs to conclude, as it plans to do, the long-in-abeyance dispute about releases to the delta. It is important, too, to actively address the other legitimate issues relating to new storage—Who will pay? Who will get the contracts? Who will be employed during construction? Probably most important of all is who will get the hydropower royalties—will it remain the anachronistic practice which specifies that 'whoever has the powerhouse gets all of the royalties', or will it evolve into a more logical approach whereby royalties are divided depending on location of dam, power house, area submerged, and population to be resettled?

Finally, with each of the many delays in the past, the economic and social costs for any of the major options have risen substantially because of increases in property values and population growth in the areas of the proposed dams.[80] Further delay is not in the interests of the country.

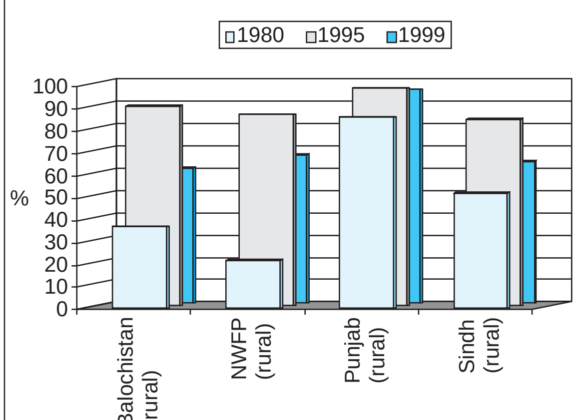
In addition to the bulk water, irrigation, and hydropower infrastructure, Pakistan needs to make

Fig. 3.50: Urban water supply coverage



Source: Siegmann and Shezad, 2005.

Fig. 3.51: Rural water supply coverage



Source: Siegmann and Shezad, 2005.

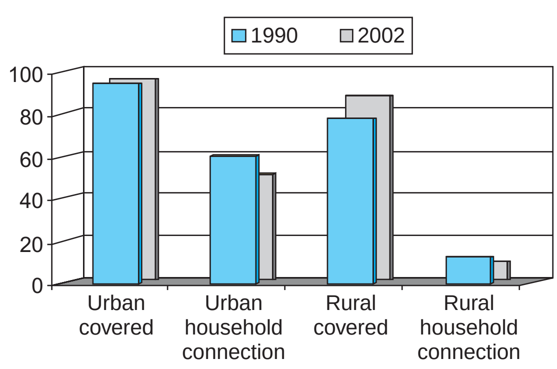
80 Paper 10.

substantial investments in water supply and sanitation facilities for those who do not have services in both rural and the rapidly-growing urban areas. Figures 3.50 and 3.51 show reported water supply coverage figures for, respectively, urban and rural populations in different provinces, and figs. 3.52 and 3.53 show the official WHO/UNICEF figures for 2002. There are obvious problems with the data. As in other developing countries, these numbers are probably a better indication of the infrastructure that has been built than the services that are actually provided—there are large numbers who do not have adequate services. The instability of the reporting (especially for rural areas) suggests that there is considerable uncertainty about actual coverage. And the 2002 WHO/UNICEF figures show coverage levels for both water and sanitation to be twice as high in Pakistan as in not-obviously-worse-off India.

The large subsidies, justified in the name of the poor, in fact benefit those who get water (people who can exert influence on rationed supplies, and are therefore not the poor) and those who use a lot of water (the middle class and the rich). In Karachi, for example, daily water consumption of highly subsidized water ranges from 340 liters per day per capita in high income areas to 60 liters per capita per day in slum areas.[81] In all cities many of the poor depend to a large extent on private tanker trucks, and end up paying 10 or more times per cubic meter than do the rich who receive the subsidized services through house connections.

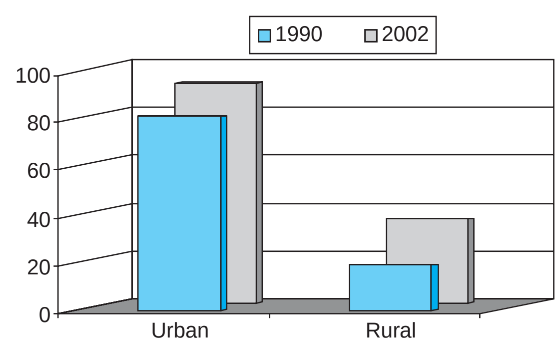
On the sewerage side, the situation is similar. The rich get subsidized sewers; the poor live in often appalling sanitary conditions. The world-renowned Orangi Pilot Project in Karachi,[82] conceived and implemented by the remarkable duo of Akhter Hameed Khan and Arif Hasan, provides sewerage services to over a million poor people and provides many lessons which can and are being emulated on a larger scale. The key lessons include: how poor people, just like rich people, want good quality services; how poor people can transform their environment if they are 'liberated from the demobilizing promises that politicians never plan to fulfill'; how costs can be reduced to a small fraction of 'standard costs' by technical innovation, elimination of corruption, and mobilization of self-help labor; how important it is to have high-quality, technical-cum-social mobilization support; and how, eventually, there

Fig. 3.52: Improved water supply coverage



Source: WHO/UNICEF, 2004.

Fig. 3.53: Improved sanitation coverage



Source: WHO/UNICEF, 2004.

81 Paper 2.
82 The World Bank, Environment and Development, *The World Development Report*, Washington DC, 1992.

must be a partnership between the informal sector (which can handle much of the local infrastructure better than the municipality) and the government (which must build the bulk collection and wastewater treatment facilities).

The primary immediate challenges for the water and sanitation sector are to extend services to the unserved, to improve the quality of services to those who are nominally served, and to find mechanisms which are much more efficient and accountable in order to do this. This will mean going beyond the traditional public utilities and mobilizing the resources and innovative capacity of community organizations (like the Orangi Pilot Project) and the private sector, large and small, domestic and international.

A recently completed study calculates the costs of providing proper WSS cover to 90 percent of Pakistan's population as US$4.8 billion, with associated annual recurring costs of over US$828 million.[83] By comparison, current total capital and recurrent spending on the water and sanitation sector is about US$120 million a year.[84] It is, therefore, imperative that users, especially the non-poor, pay a much greater proportion of the costs incurred in providing the water and sanitation services they receive. And it is equally important to increase investments, and the returns to these, because the sanitary conditions of cities and towns (as described earlier) are imposing large health, economic and environmental costs, and these can only be built and operated with public funds.

Is Enough Attention Being Given to the Barani Areas of Pakistan? The problem is somewhat different in the extensive barani areas outside the Indus Basin. Water scarcity in these areas is extreme and has led to unsustainable exploitation of groundwater, rangeland, and forests. Small dams on perennial and non-perennial streams to capture seasonal runoff, especially flood flows, have been an important means of water harvesting and water development in the barani areas of Pakistan for many years. Water stored in a reservoir is used principally in two ways: first, seepage from the reservoir adds to the natural recharge of groundwater, increasing water supplies for both irrigation and drinking water; and second, water can be drawn directly from the reservoir by a canal or pipe to meet these same purposes. When conditions are favorable, reservoirs are also potentially valuable fisheries and small-scale sources of hydropower.[85]

There is a long history of constructing these types of dams and water harvesting structures in Pakistan and there is a high demand for them from farmers and villagers in barani areas. There are few options for water development in these areas other than to capture the annual, though highly variable, flood flows. Groundwater is used for village water supply and for limited irrigation, but overuse in many areas where it is available has resulted in a precipitous decline in the water table and steadily rising cost of pumping. These projects are seen as contributing significantly to groundwater recharge,[86] and if the site is favorable, introducing a new source of surface water for farmers and villagers.

An informal Bank study done in connection with Drought Emergency Recovery showed that the cost of water is extremely high in these projects and that little attention has been given to

83 Paper 3.

84 Paper 8.

85 For example, if rainfall is higher, streamflow may extend over several months in addition to the relatively short duration flood flows, in which case proportionately more water can be stored for a longer period if the site has sufficient reservoir capacity. However, since the prevailing conditions over most of the year are arid to semi-arid, there must always be a concern for the higher evapotranspiration losses that stem from storage of water in an open reservoir.

86 There appears to be little systematic study and analytical results on which to base estimates of the amount of recharge possible or the extent of its influence at a particular site.

command area development. Many in Pakistan would argue that because there are so few development options in these areas (large) government subsidies involved are not only warranted but obligatory. But the point of the study was not that subsidies should not be given or the project should not be implemented. Rather, the conclusion was that government should insist on a much higher standard for the planning, design, and implementation of these projects to minimize whatever subsidy is required and maximize the real benefits people receive.

CHAPTER 4

WHAT NEEDS TO BE DONE

While Pakistan still needs to invest in some major water infrastructure, it is clear that the major challenge facing the country is to more effectively manage both the water resources (and the associated natural resource base) and the water services. The evolution also shows that the major successes of recent decades—in increasing production, and in controlling waterlogging and salinity—have been driven primarily by the action of private individuals pursuing their own goals. The review shows three worrying realities: first, that in coming decades unmanaged action by private individuals is likely to give rise to major problems (especially with groundwater); second, that the demands on government to perform, both as service provider and regulator, are going to be much greater; and third, that government policies have not yet internalized the fact that the principal challenge is to formulate a set of 'rules of the game' that will provide organizations (irrigation departments, urban utilities, and private farmers) with the incentives to do what is in the greater common good. Many countries have had to address similar challenges in the water and other sectors, and out of this experience has come a different vision of what constitutes a modern institutional structure for addressing water management challenges.

Principles for a Modern Institutional Structure

There is growing recognition, evident in most of the background papers by water experts in Pakistan, and in the discussions with experienced Pakistan water managers, that the principal task in water management in Pakistan today is to design a set of instruments—the rules of the game that determine how people use and dispose of water—that are better aligned with the looming resource, environmental, financial, and economic challenges facing Pakistan. What would an incentive-based approach to water reform in Pakistan involve?

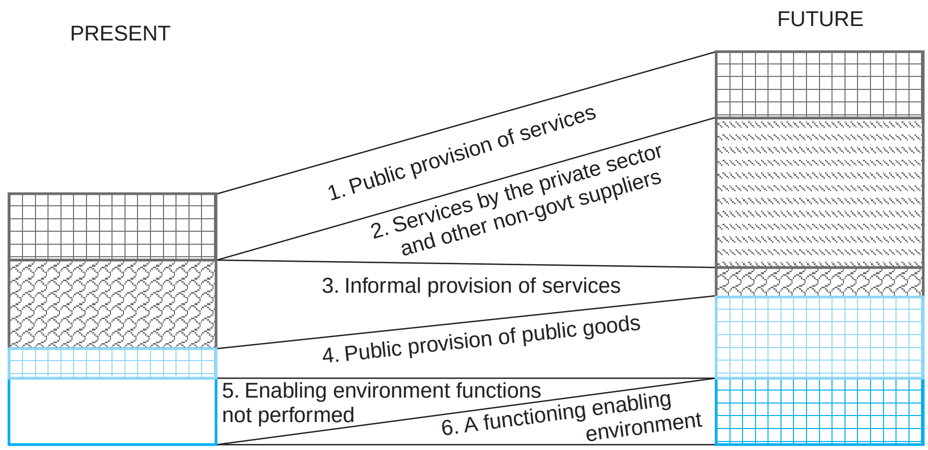
Most fundamentally, as suggested in fig. 4.1, it would require a major change in the role of the state. The government would allow others (including the private sector) to compete for the right to provide water and irrigation services, while the government would turn its attention to the financing (and in some cases the delivery) of major storage, flood control, sewage treatment, and other public goods, and would have as its central task the development and implementation of an integrated package of instruments—entitlements, pricing, and regulation—which would structure the relationships among water users so that water is used efficiently, and environmental and financial sustainability is assured.

Many discussions of water reform in Pakistan (and elsewhere) focus on organizational issues—the perennial favorites being Water Users' Associations (WUAs) and issues such as a National Water Council. The perspective of this Report is that emphasis should be on instruments, not organizations. Accordingly, this section describes each of the central instruments that would form part of an institutional package of reforms, stressing continuously that this is an integrated package in which the whole is more than the sum of the parts.

Consider, for example, the issue of irrigation services. In his excellent book on the political economy of water in South India, David Mosse[1]

1 David Mosse, *The Rule of Water: Statecraft, Ecology and Collective Action in South India*, Oxford University Press, New Delhi, 2003.

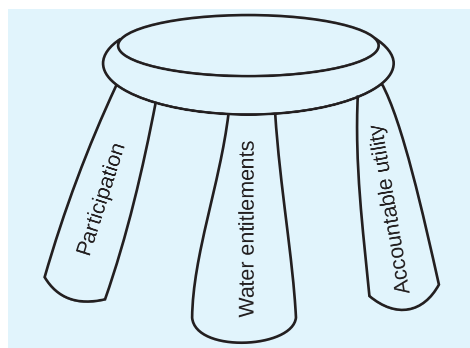
Fig. 4.1: The desired evolution of functions and actors



describes the necessary set of interlocking changes well: 'Since irrigation involves wider hydraulic systems which are beyond the control of WUAs and which inevitably render them dependent upon the state, farmers' organizations have little chance of surviving as independent self-managed social organizations. The next step, therefore, does not lie in knowing how to organize farmers' organizations…but how to overhaul the administrative system so that the state irrigation departments and farmers can be bound into productive relations. Participatory Irrigation Management (PIM) cannot become a reality nor can it become self-sustaining without the restructuring of state irrigation departments… What is striking in PIM programs is how little attention is given to water rights. The government's rights to water are unchallenged, while its obligations to deliver water to WUAs are rarely legally binding…'. In short, as illustrated in fig. 4.2, a sound irrigation service model requires mutually reinforcing changes in all three 'legs of the stool'.

The key to putting this 'new institutional structure' in place, therefore, has less to do with the familiar preoccupation of how organizations are structured, and more to do with the incentive structure which is put in place. It is to the key elements of this incentive structure that we now turn our attention.

Fig. 4.2: The basis for sound irrigation service provision



Instruments

The variety of problems now in full bloom in the Pakistan water sector have been evolving for some time, and have been the subject of considerable reflection by the government and others. Consider, for example, the conclusions which have emerged from discussions of the irrigation sector, summarized by two of the principal actors in these reforms:[2] 'In the 1990s, after consultations with international agencies, the Pakistan government embarked on major institutional reforms. At the provincial level, the three-tiered system of PIDA, AWB, and FO was established, through the PIDA Acts (1997). The FO was to supply water to irrigators, be responsible for levying and collection of water charges, and make payments to the AWB. The operating public utility would be the AWB, with an average command area of 600,000 hectares. It would be established at the level of one or more canal commands, of which there are 43 in the Indus Basin irrigation system. The AWB would manage and distribute irrigation water, through formal volume-based contracts with FOs, and trade water with other utilities. The PIDA would be responsible for such functions as province-wide water delivery, system maintenance and development, and sales of water beyond amounts contracted with AWBs.' There has been some progress made in implementing this model, especially in Sindh. Punjab, the province with the largest irrigated area, played a major role in articulating this vision, but then, with a change of leadership, did not choose to put the model into practice to any significant degree. Punjab is, once again, engaging with the reform process, and expects to make major progress in developing a 'Punjab model' which is consistent with the spirit and logic of the above reforms, but is adapted to the varying conditions in the province.

While some progress has been made, it is also increasingly clear that reforms focussed on WUAs alone is like trying to sit on a stool with one leg (to use the image captured in fig. 4.2). And the discussion has focused far too much on organizational forms, when modern institutional theory and practice tell us that the heart of the matter is less organizational form and more the instruments which govern relationships among the various actors. What are some of the critical instruments (bearing in mind that there is no silver bullet, but that the art is of constructing an enabling environment of mutually supportive and mutually consistent instruments)?

Unbundling and Competition

As discussed elsewhere in this Report, the poor quality of public infrastructure is a pervasive problem in Pakistan. Studies throughout the world[3] have shown that where industries have to self-provide, costs of production go up sharply, competitiveness is reduced, and economic growth is dampened. The self-provision of water supplies is just one manifestation of a far broader breakdown in public infrastructure in Pakistan. A recent survey[4] shows that 42 percent of Pakistan's manufacturing entities have captive power generating units—a figure which is just 16 percent for China, and 17 percent for Brazil.

The provision of formal irrigation and water supply services in Pakistan is the virtual exclusive monopoly of government agencies, which do not provide services to many—especially the poor and tail-enders—and provide poor quality services to those who do have access. The situation in Pakistan remains one in which public monopolies face no competition either 'in the market', or 'for the market' (where head-to-head competition is not possible).

The one overriding lesson from the global revolution in the provision of public services is that competition matters. In some cases, competition 'in the market' is possible. For example, it is technically quite conceivable in the large irrigation systems to unbundle the bulk and distribution

2 Paper 7.

3 Kyu Sik Lee, 'Costs of infrastructure deficiencies in manufacturing in Indonesia, Nigeria and Thailand', Policy Research Working Paper WPS1604, The World Bank, 1996.

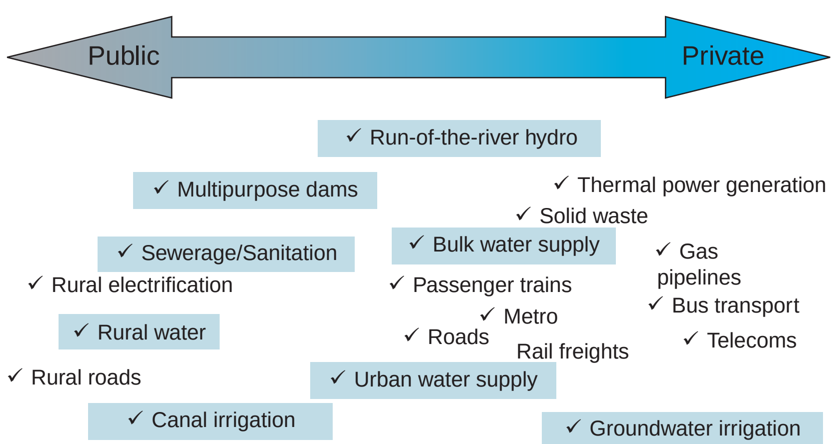
4 Omkar Goswami, 'The urgent need for infrastructure', *The Economic Times*, Delhi, 25 April 2005.

functions and then have a variety of forms—cooperatives, the private sector—for providing distribution services to farmers. As has happened elsewhere, such changes would unleash a chain of healthy systemic changes which would transform the business of the provision of public services. First, it would require a clear contract between the bulk provider (the Irrigation Department) and the non-governmental provider which would define the rights and responsibilities (for water and for payments) of both parties. The absence of such contracts is one of the major reasons why the monopoly providers remain unaccountable to users, and information remains so poor and opaque. As always, discretion and lack of accountability are the handmaidens to corruption. Second, it would require that costs are 'revealed', and the distinction between legitimate costs and those—such as massive overstaffing—which should not be passed on to users. Third, the entry of private and other non-governmental providers would naturally lead to comparisons between the costs and quality of services provided by different providers, and thus pressures—for the first time—on public providers to improve their performance. (This latter factor has, arguably, been the single biggest advantage of the introduction of the private sector in other countries. In the US, for example, public water utilities have improved, in large part, as described in a study by US National Academy of Sciences,[5] 'because if public utilities did not improve they would be taken over by the private sector'.)

Until quite recently it was assumed that the private sector could play a role in the provision of formal water services in cities and towns, but that this would never happen in irrigation. Indeed, the mix of public and private financing for the provision of services does vary widely for different types of infrastructure (fig. 4.3).

But recent developments have shown that while most canal irrigation services will remain in public hands for the foreseeable future, the private sector can play the same stimulating, competitive role that it plays in water supply. Political leaders in Punjab have raised the possibility of 'professional management' contracts, whereby a canal command would be given under management contract to a private sector operator who would operate under license to provide farmers'

Fig. 4.3: Typical public and private roles in the provision of infrastructure



5 National Research Council, *Privatization of Water Services in the United States: An Assessment of Issues and Experience*, Washington DC, 2002.

organizations with their water entitlements. In other countries—for example, Chile and Morocco—the authorities have gone further and given out 'reverse concessions', whereby private operators operate public irrigation systems, with the 'winning operator' being the one that requires the smallest subsidy to provide the services.

Similarly, in the historically public business of wastewater treatment, there is much innovation taking place. In relatively advanced developing countries, typically less than 25 percent of sewage treatment plants actually function.[6] Three years ago, the federal government in Brazil took an innovative approach to this problem. It set up a fund called 'Compra de Esgoto' (or 'buying treated sewage') whereby municipalities are paid for the production of treated sewage, not for the construction of treatment plants. The program is working well, and producing much better outputs than the traditional 'pay for inputs' approach.

In recent years there has been a lot of discussion about 'benchmarking' in irrigation services, worldwide and in Pakistan. The International Commission on Irrigation and Drainage and others have developed a useful set of practical tools for 'benchmarking' of irrigation services,[7] and the Asian Development Bank has produced similarly important material for comparing the performance of water utilities across Asia.[8] The common reaction to these materials has been for the public utilities to see these as technical inputs, to be considered by the engineers of the agencies when considering if and how they might change their modus operandi.

This misses the central value of such tools, which is to expose monopolies to forms of 'comparative competition', and in which public discussion and transparency are as important as technical information. In some cases,[9] technical benchmarking information has been supplemented by 'accountability' scorecards in which users are directly asked their perception of critical service issues.

The stimulation of 'competition in the irrigation distribution market' is of high priority. It will require a lot of technical assistance from professionals from countries who have done this (with Australia being a 'best practice' case). Important questions include: How does one ensure a level playing field? How might workers in the irrigation departments be encouraged, as was done in Mexico City,[10] to form their own irrigation services companies, thus ensuring that their expertise is put to work, that resistance to the change is reduced, and even that this helps retrench a heavily overstaffed state? How should auditing of performance, and flows of water and money be done so that audits are trusted by all? How does one write enforceable contracts 'up' between the service provider and the government, and 'down' between the service department and the users? These issues are being incorporated into new World Bank-financed irrigation projects, and will be given high priority and supported with the necessary technical assistance and capacity building.

In the urban water sector there has been some progress, and some roadblocks. The progress concerns some NGOs who have been very successful in dealing with the 'internal' issues of sanitation—in the OPP case described earlier this has meant self-financed, self-maintained sewers for over a million people, something which has been achieved only in few other countries in the world.

6 The World Bank, 'The Environment and Development', *The World Development Report*, Washington DC, 1992.
7 Molano, H., and M. Burton, 'Guidelines for benchmarking performance in the irrigation and drainage sector', *IPTRID Knowledge Synthesis Report 5*, 2001, www.fao.org/iptrid.
8 Asian Development Bank, *Utilities Data Book*, Manila, 2003.
9 Public Affairs Centre, *Towards user report cards on irrigation services: Learning from a pilot project in India*, Bangalore, December 2002.
10 Manuel Contijoch, personal communication.

In many ways, the central idea of the OPP approach is similar to that of the WUAs in irrigation—that local infrastructure can be better managed, and even built and financed by well-organized local people with effective outside technical assistance. And just as the WUAs depend on the irrigation departments doing their work beyond the outlet level, specifying the water entitlements of the WUAs and providing these in a predictable, accountable and transparent way, so too does the OPP 'pass responsibility' to the Karachi Development Authority for the 'external' infrastructure (sewer mains and treatment plants). The one difference, of course, is that the water flows from the bulk supplier to the user and the sewage in the opposite direction, making these sewage cooperatives much less dependent on the performance of the bulk infrastructure manager.

On the urban side there have also been several efforts at breaking up the public sector monopoly and introducing the private sector. These are described in detail in the background paper by Khurram Shahid.[11] The most prominent case was that of Karachi, where 'the government was pressurized by labor unions and NGOs (who merely wanted KWSB to remain in the public sector) and eventually the project was scrapped following a decision by Sindh High Court that water is a national asset and cannot be handed over to private foreign companies. The case is still pending in the Supreme Court of Pakistan.' Partial attempts were also made in Lahore, Islamabad, Sialkot, and Hyderabad, but in an amateurish manner, with a single provider and without transparency, that was doomed to failure.[12] The Government of Punjab is, appropriately, restarting a process for Lahore, but this time ensuring that the process is managed according to best international practice.

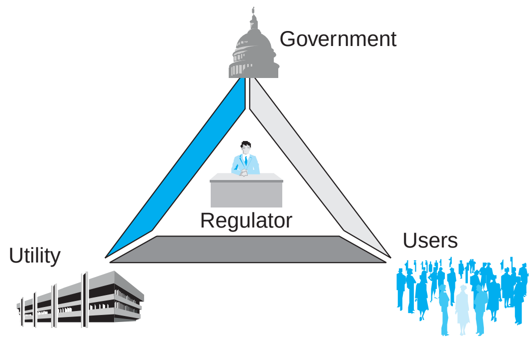
Regulation

A cornerstone of modern institutional arrangements is the separation of regulation from provision. To date, government agencies in the water sector in Pakistan have seen their role primarily as one of provision, and have done little on regulation, even when there is a legal framework in place for this (as in the case of the Water Accord). There are two fundamental areas in which government regulatory capacity must be developed—in regulating the delivery of services, and in regulating the use of water resources.

On the service side, the government should understand that its fundamental role is to provide an enabling environment, and a regulatory capacity, to ensure that there are modern, fair, and enforceable contracts between providers (public, private, and NGOs) and users, both in irrigation and water supply and sanitation. Where the public sector does continue to play a major role as a service provider (as will be the case for the foreseeable future) it is important that these public service providers are corporatized, and their operations ring-fenced from the regulatory and policy operations of the government. Public providers, just like private and NGO providers, should have contracts with users (which specify the rights and responsibilities of both parties, especially with regard to water and money) and should be subject to effective, transparent regulation, the objective of which is to compare obligation with delivery, and to stimulate competition by publishing benchmarking information. A key requirement, therefore, is that the government develop regulatory capacity for balancing the disparate interests of the providers, the users, and the government itself (as shown in fig. 4.4). This is all quite new for the water sector

11 Paper 8.
12 Ibid.

Fig. 4.4: Participants in modern regulation



in Pakistan, but there is a lot to learn from the experience of other countries which have put such frameworks into place (Australia being an excellent example, because the reforms there have focused heavily on competition and a level playing field, and have allowed both public and private service providers to continue an active role. See the web sites for Water Services Association of Australia, for example www.wsaa.asn.au). The emerging experience with a similar model in Maharasthtra[13] in India is also of relevance. And water regulators can also draw on the growing experience in Pakistan with independent regulation in other service sectors (such as the telecommunications and electricity sectors).

It will take some years and a process of trial and error to find the right forms for such service regulation, especially in a sector in which the notion of contracts and competition and transparency have been almost entirely absent. It is critical to take a learning approach to this, and not to see the first signs of difficulties as a reason to go back to 'the old ways'.

The second area where regulation is essential is in the management of water resources. On the surface water side, there is, in many ways, already a sound basis for the regulation of surface water supplies in place, via the entitlements which are defined in the Water Accord and which, in many ways, are also partially defined down to the level of individual users (discussed in more detail in the next section).

The biggest challenge of all on the water resource side is that of groundwater management (which has to, of course, eventually be integrated with the surface water entitlement and regulatory system). Global experience shows that moving from an anarchic groundwater management system to one where there is a balance between abstractions and recharge is a very difficult one, which is less than perfect even in very good governance environments. Experience also shows that command-and-control type of approaches—'prohibiting more abstractions'—simply do not work, again even in relatively easy environments.[14] The essential ingredients of 'the least unsuccessful approach' are clear.[15] Groundwater management requires: a legal framework which constrains the rights of people to pump as much water as they wish from their land; the definition of groundwater entitlements, with the latter usually based on historical use and subject to modification should the total entitlements exceed the sustainable yield of the aquifer; strong government presence to give legal backing for the development of participatory aquifer management associations and to provide the decision-support systems which enable aquifer associations to monitor their resource; and, above all, clarity that the primary responsibility for the maintenance of the resource on which they depend is with those who have entitlements to use water from a particular aquifer. There are many difficult technical details to be

13 Maria Saleth, 'Water Rights and Entitlements', as quoted in J. Briscoe and R.P.S. Malik, *India's Water Economy: Bracing for a Turbulent Future*, Oxford University Press, New Delhi, 2006.

14 White, Stephen E., and David E. Kromm, 'Local groundwater management effectiveness in the Colorado and Kansas Ogallala Region', *Natural Resources Journal*, Vol. 35, 1995.

15 Kemper, Karin, and John Briscoe, *Mexico: Policy Options for Aquifer Stabilization*, The World Bank, 1999.

worked out—for example, the trade-off between hydrological reality (which suggests very large aquifer associations in the Indus Basin, since all the aquifers there are connected) and the transactions costs of including large numbers of small farmers (which argues for smaller associations). Experience in other very large aquifers (such as the Ogallala aquifer which runs from Minnesota to Texas) shows that it is perfectly practical to chop a single aquifer up into a large number of 'semi-independent' aquifers which are run by a reasonable number of users.[16] In the Indus Basin, this would suggest that the canal command, or possibly the distributary, would be the appropriate specification of the 'social aquifer unit'. In this case it is essential that the best does not become the enemy of the good! And it is important to start with several logical possibilities suggesting themselves, including: formation of an aquifer management association for Pishin district around KK Bund in Balochistan, where groundwater is being heavily overdrawn to the detriment of all; and formation of aquifer associations based on the geographical areas covered by well-functioning farmer organizations (or possibly even Area Water Boards) in Sindh and Punjab. The critical thing now is to make a start, because it will take time and effort to develop an effective model, and every day that passes, the costs of delay (in terms of stabilization of the aquifer at a deeper level) imposes escalating costs on farmers and the environment.

Water Entitlements

Chapter 2 argued that Pakistan will not be able to successfully address the many service and resource management challenges it faces without the implementation of a transparent and enforceable system of water entitlements at all levels. Many of the background papers emphasize the importance of this issue. Faizul Hasan[17], for example, in an excellent and comprehensive review of water entitlements in Pakistan, concludes: '...ownership rights are necessary to realize efficiency gains, improve equity of distribution, legitimate water sales, reduce deficit, and promote long term investments. Lack of individual water rights does not give tail-end users legal basis for any formal claim or loss of canal water resulting from miss-appropriation by head-reach users.' Shahid Ahmad[18] reports: '...farmers now increasingly complain of inflexibility of the IBIS and demand more flexible water allocation, distribution, and utilization rules, which also allow water trading among the water users.'

Earlier sections of this Report showed that in many respects Pakistan has a very good base—unquestionably one of the best in the developing world—because surface water entitlements (usufructuary rights) in the Indus Basin are already clearly specified at the national, provincial, and canal levels, and, through the warabandi at the level of individual farmers. What is missing now is the transparent implementation of these entitlements and, eventually, the extension of the entitlement approach to cover both surface water and groundwater.

Once this is done, such a management system will give rise to a series of fundamental and healthy changes. First, those requiring additional water (such as high-value agriculture, and people living in growing cities) will frequently be able to meet their needs by acquiring the entitlements of those who are using water for low-value purposes. Second, there are strong incentives for low-value water users to voluntarily 'forebear' from use, making reallocation both politically attractive and practical. Since water allocation in Pakistan is close

16 White, Stephen E., and David E. Kromm, 'Local groundwater management effectiveness in the Colorado and Kansas Ogallala Region', *Natural Resources Journal*, Vol. 35, 1995.

17 Paper 6.

18 Paper 5.

to becoming a zero-sum game, such voluntary, consensual approaches to water reallocation are vital. Third, the establishment of formal water entitlements gives rise to strong pressures for improving the data required to manage the resource. And fourth, this reduces the pressures of a 'race to the bottom of the aquifer', since those who have entitlements have a powerful interest in the sustainability of the resource base.

This is not to imply that the administration of such a system is simple, for canal water, let alone groundwater, in an environment in which governance is weak. Nonetheless, the last ten years have seen enormous progress globally in the use of formal water entitlements—with well-functioning systems now working in Australia, Chile, Mexico, Argentina, and South Africa. (box 4.1, from Australia, provides a particularly clear description of the central but quite different roles of water entitlements and pricing in sustainable water management.) It is noteworthy that all such established systems are working, often

Box 4.1: Water entitlements are the principal mechanism for ensuring efficiency, sustainability, and voluntary reallocation of water

Letter to the Editor, (*The Economist*, July 2003):

Your special survey on water ('Priceless', July 19) embodies in its title a prejudice that experience from the real world rarely justifies. You refer specifically to the experience of the Murray-Darling (M-D) basin.

In the M-D, water use is constrained to equal the sustainable supply through a complex system of water rights, defined in terms of volumes and security of supply. In this drought year—the worst for more than a century—many users are receiving less than 16 percent of their 'normal' entitlement, and that restriction is enforced entirely through the water rights system—not through pricing mechanisms.

Formally codifying these property rights—in systems that were already well managed and orderly; where customers were educated and accustomed to following rules; and allocation rules were already broadly in place and enforced—took a number of decades. Once this process was complete, it was possible to introduce a system of trading in these codified property rights, allowing managers the flexibility to better manage their enterprises (in some areas last year as much as 8 percent of water delivered was traded). The water rights system also provides the basis for improved environmental management. The parallel system of charging for water services in the M-D is quite separate from the sale and purchase of water rights, and exists to ensure that the income of water supply agencies is adequate to cover ongoing maintenance and projected major capital replacements.

Three lessons may be drawn from this successful achievement of sustainable financial management and sustainable resource use: First, the primary means of balancing supply and demand for water resources is definition of water rights consistent with available supply. This is the approach followed in Australia, Israel, the US, and elsewhere. Second, defining water rights is contentious and difficult at the best of times. Where water is already over-allocated so that 'tail enders' often get no water, or fresh aquifers are consistently overdrawn to meet current demand, defining and enforcing sustainable water rights is an enormous political and social challenge. This is the case in many water-short developing countries. Third, the primary role of water pricing in irrigation is not to balance supply and demand, but rather to achieve sustainable financing. Implying, as *The Economist* article does, that pricing water has a central role in achieving the required resource balance is to grossly mislead policymakers facing the challenge of reducing water consumption to a level consistent with long term availability and proper environmental management. The solution inevitably requires stable and well specified access rights to water, institutions with the capacity to manage the water access regime, and appropriate water pricing to ensure the long term operation of the infrastructure.

Don Blackmore, Chief Executive, Murray-Darling Basin Commission, Australia
Chris Perry, Professor, Economics of Irrigation, Cranfield University, UK

after initial adjustments, and are performing well. In none of the countries that have adopted such systems is there any thought to returning to the previous government-managed allocation procedures.

Pakistan has long been heading in this direction, as the very important progress in establishing entitlements at the farm level (through the warabandi) over a hundred years ago, then fifty years ago at the international level (through the Indus Waters Treaty), and in 1991 among provinces (through the Water Accord). The issue has been highlighted in many forums—it is a cornerstone of the 1994 World Bank report on irrigation and drainage in Pakistan and in the National Drainage Program. Many of the Pakistani professionals who wrote background papers for this Report highlighted this issue, and it emerged as one of the most important areas of discussion in two major consultations held in the course of developing this Report. The issue is now to move to implementation. To which, naturally, there is considerable resistance.

There is resistance for several reasons. First, it will inevitably lead to pressures to modernize the long-established warabandi system, as described by Shahid Ahmad: '...the assumption behind the *warabandi* concept is that there is no conveyance loss in the watercourse and time equity system will provide reasonable level of volume equity—completely a false assumption. Research work and pilot testing on *Warimetric* system by adding the water loss function in the *Warabandi* Formula was initiated in India. Similar activity at least at the pilot scale is needed in the IBIS.'[19] There is also resistance because clarity on water entitlements will inevitably require greater investments in measurement. (Investments which would, however, have huge returns since, in the words of the Chinese when asked in the 1980s by The World Bank whether they were not measuring when the costs exceeded the benefits, answered 'but if we don't measure we can't manage'!) And probably most important is resistance which emanates from some powerful users, politicians, and irrigation department officials who are able to use the 'discretion' and 'lack of transparency' in the system to pursue personal profit at the cost of both others and broader welfare.

There are several obvious areas in which there could be rapid movement. At the national level, there is an urgent need, for a host of reasons described earlier, to rapidly move towards verifiable, transparent administration of the 1991 Water Accord. It is remarkable, and distressing, that for something so obvious, on which there is such broad consensus, and which raises such huge political issues and issues of trust, so little progress has been made. IRSA often seems to function more as a sounding box for the airing of ancient complaints about the fairness of the formula, and of contemporary mistrust about actual abstractions. While reform and restructuring of IRSA (so that it can serve as a basin agency—an issue we return to later in this Report—along the lines of best-practice cases like the Murray-Darling Basin Commission in Australia), is very important, this is going to take time. Given this level of mistrust, the federal government might consider appointing an independent 'water auditor' with the power to install the necessary measurement devices, and the obligation to make the entitlements and flows into and out of the system totally transparent (on the web, at least, and probably published at least weekly in most major newspapers) and in a way that is easily understandable to the public. In the initial years, when mistrust is so high, the government might follow a path similar to that described earlier for the Murray-Darling Basin in Australia, where none of the four involved states were willing to trust anyone from another state, and so they have a water auditor who comes from Western Australia 3,000 miles away to do the job periodically (and

19 Paper 5.

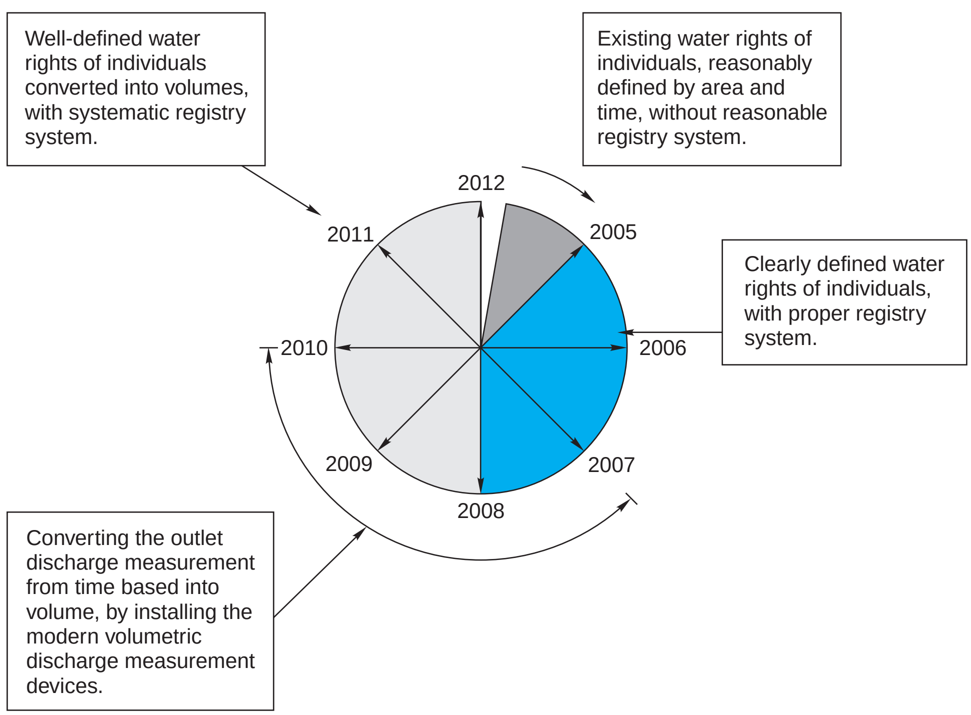
then go back home, presumably so as not to be corrupted by nefarious local interests)!

At the provincial level, too, canal water entitlements are well defined, as discussed earlier. Again the issue is the same—making these public, making public what is actually being delivered in a transparent and credible way. The Government of Punjab is considering doing this, initially at the canal level and eventually all the way down—in appropriate forms for each level—to the outlet. In his background paper Faizul Hasan provides a clear description of what is necessary, and a proposed prioritized and sequenced path (fig. 4.5) for putting such a management system into place: 'The register of water rights is required to be established at both the canal and distributary levels. It will register the withdrawals at the head of each canal and distributary. The outlets are the most important points in a distributary, where withdrawals of the outlet and entitlements of the farmers will be documented in this register.'

The important thing now is to start. This should also be done with immediate effect in Sindh, especially in the areas where FOs and WUAs are operating effectively, and where there are major questions about the irrigation department delivering entitlements and about direct outlets. And it should also be done immediately at the canal command level in Punjab, and then drilled down to the outlets, starting in the areas such as LCC East, where FOs are already formed.

Sardar Tariq and Shams-ul-Mulk[20] have summarized well what needs to be done. A partial list of their recommendations includes:

Fig. 4.5: Indicative, sequenced, and prioritized timetable for implementation of a formal water entitlement system



Source: Hasan, 2005.

[20] Paper 7.

- In water distribution, the water entitlements are crucial and need to be streamlined for future management—clear individual entitlements need to be defined.
- Groundwater management needs to be vested in the state, and must address the issue of groundwater entitlements.
- Free trade of water and creation of water markets would help resolve many issues.
- At the macro level, the Inter-Provincial Water Accord needs to be reviewed in the light of ensuring minimum flow for biodiversity.

Practical steps required over the next five years:

- Draft Water Policy should be reviewed to address water entitlement issues along with other issues in much detail.
- Groundwater management should be vested in the state.
- Guarantee individual entitlements.
- Introduce information management system as a critical and essential activity.
- Capacity of grass roots organizations needs to be built.
- Measurement tools need to be introduced.

Transparency

Central to the three instruments already discussed—competition, regulation, and entitlements—is the issue of transparency. Indeed, one could argue that if there were an unequivocal commitment to transparency, then all of the other priority actions and instruments would flow from this.

And, indeed, a central feature of modern water management in a liberalized economy and democratic environment is that of openness and transparency. In most countries now all relevant information—hydrological, performance, and planning—is available publicly, on the web and in real time. Representative web sites show this clearly: TVA in the US (www.tva.gov), Murray-Darling Basin Commission in Australia (www.mdbc.gov.au), Ministry of Water and Forestry in South Africa (www.dwaf.gov.za), National Water Agency in Brazil (www.ana.gov.br) to cite just a few examples.

Pakistan has been slow and uneven in adapting to this changed information environment. It remains very difficult for a user to even find out what data might be available. When one reports that there are concerns about the transparency with which the Accord is being implemented, this is dismissed as 'totally false…someone playing politics…we have the data which show that this is not the case'. And if the (privileged, in this case) interlocutor asks to see the data, a bell is rung and, indeed, ten minutes later a log is brought which shows entries in hand which, it is explained, shows exactly what is being taken out of each canal and each distributary. Coming to a judgment of whether this is what the log actually says is beyond the capacity of anyone who has not been in the irrigation department for many years. (The summary sheet, shown in fig. 3.21 earlier, kept by Punjab Irrigation Department for its 24 canal commands is an exception, and is exactly the simple and understandable information that needs to be publicly available in real time at all levels.) And even if the eventual conclusion of the inquiry would be 'yes, it is', then the very opaqueness of the process and the lack of public availability of the data make it obvious why mis-trust is so rampant. Discussions with officials—of high professional and moral standing—reveal a dissonance about what takes place as a result of this opacity. 'The allocations are made absolutely faithfully, according to the entitlements of each canal'. But then… 'This is a very good Minister, not once has he asked us to use discretion in his favor ….', or 'making this public will make the job of officials of the irrigation department very difficult because they will lose the discretion they need to operate the system'.

In many instances there is also a circuitous argument with hydrologists and irrigation engineers, who argue that such systems cannot be put in place until there is a 'very good' information base available. It is obvious that the pre-existence of such information would be ideal, but in the real world there is a powerful feedback loop between data availability, quality, and support for data collection activities. Global experience shows that hydrological, geohydrological, and hydraulic data systems will be maintained only when the data have meaning for users (for example, in telling them whether they are getting their entitlements), when users can get easy access to the information, can find the data they need in a user-friendly way, and who can become pressure groups on the government to commit the necessary funding to the data collection activities. Indeed, experience in developed countries (with the US Geological Survey for example), shows that any attempt by the executive branch to cut funding for the data collection and dissemination activities produces a fire-storm by state and local governments, utility managers, farmers, scientists, and NGOs who depend on these data. In Pakistan, with such a large, complex, integrated system, quality information is of tremendous importance, and it is such a healthy, open, demand-driven transparent information system that Pakistan's water sector should aspire for.

Again, in their background paper Sardar Tariq and Shams-ul-Mulk have summarized succinctly and well what is needed. IRSA's technical and management capacities need immediate attention so that trust between the provinces can be developed in the long run:

- Telemetry System to give real time data to provinces
- Independent audit of IRSA would create great trust and transparency
- Transparency in allocation and distribution needed at all levels
- Users' participation—government must support user participation
- Capacity building at both community and agency levels

Practical steps required over the next five years:

- Prepare register of entitlement
- Readily available information
- Installation of measurement devices and data dissemination
- Formal government policy for participation and supporting resources

Knowledge

The sustainable management of a huge, inter-linked, and very complex natural resource base is the single most challenging long-term task for water managers in Pakistan, and requires the development of world-class capacity in three related areas.

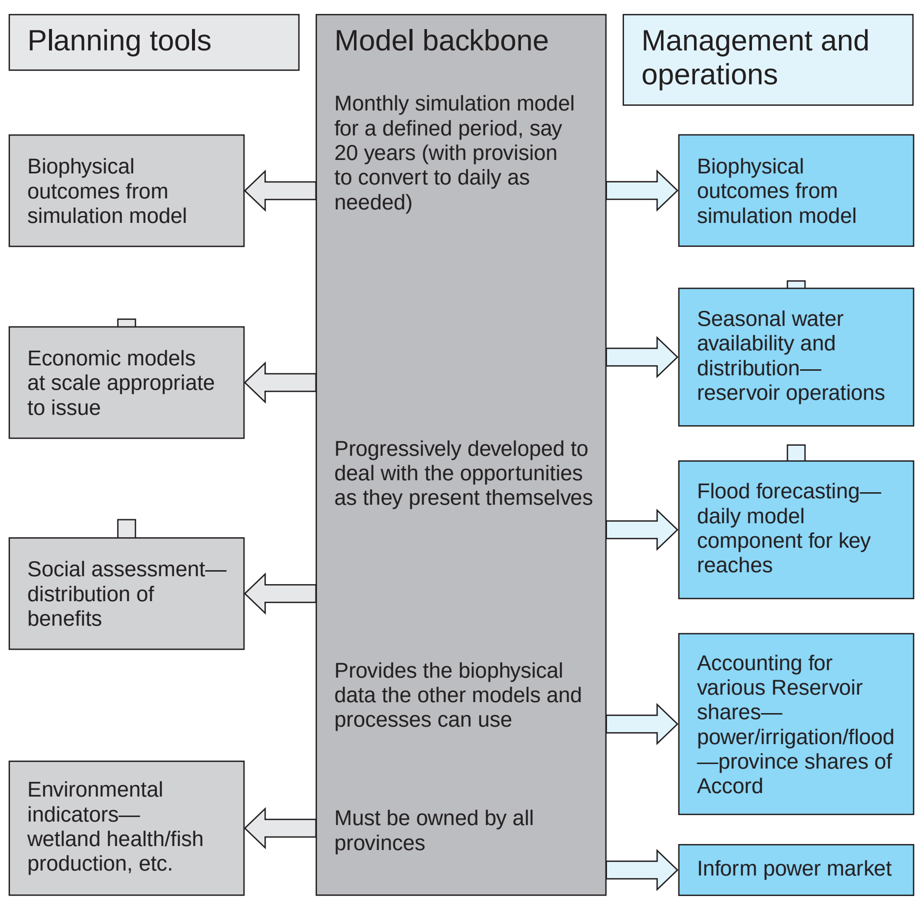
First are the natural sciences. Adaptive management of the Indus Basin system requires high levels of knowledge and understanding of a series of linked basic natural processes, the more important of which include: the behavior of the glaciers as climate change proceeds; the fate of the large amounts of salt being mobilized; the qualitative and quantitative dimensions of the aquifer systems in the Indus Basin and in the other parts of the country; the evolution and behavior of the ecosystems of the delta; and the impact of changed sediment loads on river morphology.

Second are the engineering sciences. The plumbing for the world's largest contiguous irrigation system has underpinned much of Pakistan's development. Pakistan has long been a world leader in hydraulic engineering and in water resources planning. However, the country has not invested in maintaining the capacity it has—the once-renowned Indus Basin Planning Models are no longer operative, and there is no model of the basin and its hydrology and hydraulics which can provide high-quality information on critical planning issues (such as 'what are the consequences of different storage options for the quantity and reliability of water deliveries') or on critical operational issues (with much of the distribution of water through the vast canal system of Punjab, for example, done entirely by one—fortunately very competent and honest—person relying entirely on his own judgment). A properly developed, calibrated, and maintained suite of simulation models of the Indus River System (see fig. 4.6), which can produce 'quality assured' and 'repeatable' assessments is vital for IRSA, and a host of activities related to the development and management of Pakistan's water resources.

The third leg of the intellectual stool are the social sciences. Because at the end of the day the government is going to have to design institutions and instruments which will ensure that the actions of the millions of people who live in and off of the natural and engineered water systems are in consonance with the requirements of those systems. And, as described above, the new institutional arrangements are going to be one in which interactions with citizens and users are going to be at the core of such water management, and such interactions are areas where engineers—marvelous people otherwise—are famously incompetent.

The bottom line is that Pakistan needs to build a strong natural, engineering, and social scientific cadre capable of working with all users in defining the problem, developing solutions, monitoring, assessing, and adjusting. This is a capacity which requires a wide range of disciplines—those

Fig. 4.6: Systems models for planning and management



necessary for understanding climate, river geomorphology, hydraulic structures, surface water and groundwater hydrology, limnology, water chemistry, sediment management, hydraulics, soil sciences, terrestrial and coastal ecosystems, agronomy, plant physiology, industrial organization, conflict management, politics, economics, and financing. It will require an expansive and long-term human resource strategy which will update the skills of the formidable capacity which exists in Pakistan, but will also strengthen the capacity of universities and other scientific and training institutions to produce high-quality applied research and to train the next generation of water policymakers and managers.

Financing

In Chapter 2 some of the tremendous financial holes in the Pakistan water sector were described—the wide gap between what is available and what is required for the maintenance of the existing stock of infrastructure (the so-called 'build-neglect-build' model of infrastructure financing[21]); the large number of people who have no water or sanitation services; the huge requirements for environmental management; and the large requirements for building much-needed new infrastructure. Where is this money going to come from, and how are priorities to be set? In considering these fundamental questions, several factors need to be considered.

The first and most fundamental reality is that there are only three ways of paying for the costs—they must be paid either by general taxpayers, or by users, or by gifts from abroad (which are very small relative to the former two, and should generally be thought of as 'quasi tax money', and subject to the same tests). There are two ways of looking at the water sector in Pakistan today—the formal sector, including the irrigation and water supply services, are overwhelmingly paid for with public funds, while the (very large) informal sector (tubewell users, and households who self-supply or purchase from vendors) is almost entirely financed by users themselves. There are several implications. First, there is a lot more money flowing in 'the water sector' than shows up on government books. This represents an opportunity, because in several areas formal services of good quality can provide good service at a fraction of the cost of the informal arrangements. This means that good public services could 'suck in' a lot of cash that is currently in the private economy. Second, this is an arrangement which is very inequitable, since those getting access to rationed publicly funded services are those who can exert influence, and who are overwhelmingly not poor. Third, the application of money in this way defies the basic tenet of public finance, which says that users should pay for mostly private goods (including irrigation and water supply services) while the taxpayers' money should be used for public goods (including drainage, sewage treatment, and flood management).

To start redirecting public finances into a more appropriate pattern, one has to start 'where the money is', which is in financing irrigation and water supply services. What is a reasonable path for the government to follow, over time, to increase the proportion that users pay and reduce the proportion paid by general taxpayers?

Both common sense and empirical evidence show that starting with the idea of increasing charges (for bad services provided by corrupt and inefficient agencies) will quite reasonably be resisted. For this reason, the idea of bringing tariffs into balance with costs must be the third leg of a triangle in which the first two legs must be 'improve services first' and 'provide those services in an efficient and accountable manner', and in

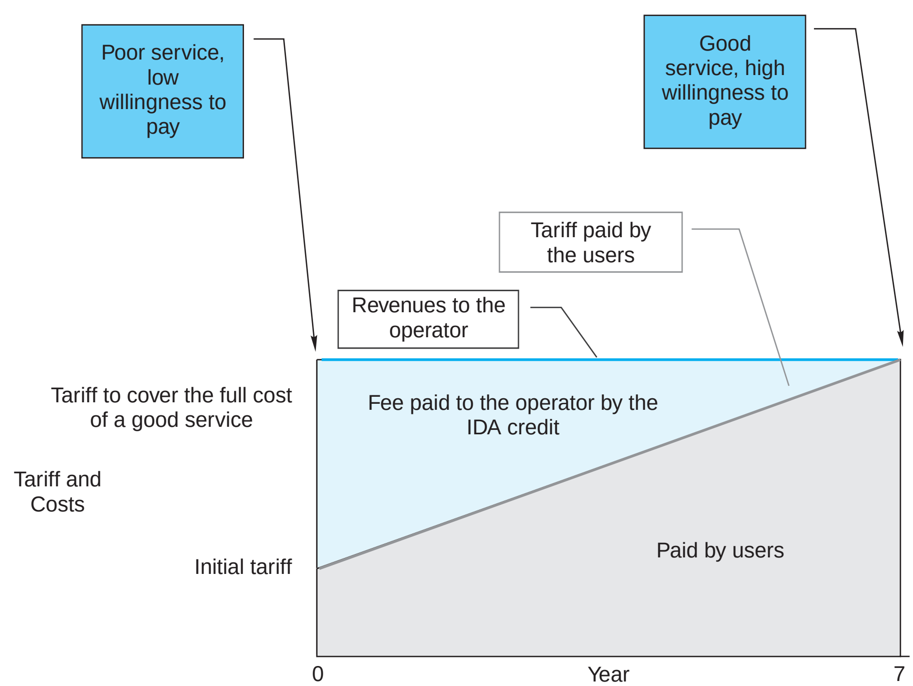
21 Nirmal Mohanty, 'Moving the Scale', as quoted in J. Briscoe and R.P.S. Malik, *India's Water Economy: Bracing for a Turbulent Future*, Oxford University Press, New Delhi, 2006.

which 'you will pay for the costs of those services' can come only after the first two have been clearly done and are so perceived by users. Again, it is the 'competition/accountability/transparency/regulation' nexus that is key to establishing the first step, which is restoring trust that users are getting efficient, accountable services. Again, the Orangi Pilot Project—where sewers were financed entirely by poor users—shows the enormous potential that exists. (And on which Akhter Hameed Khan, always cutting to the chase, explained to the community: 'I am not bringing in any external funding for this—except for the technical assistance—because once I do you will focus on getting your hands on that money, not on the task at hand.')

Figure 4.7 gives a relevant and reproducible example of how this was done in an urban water project in Africa. Financing these sorts of 'transition costs' for moving from a low-level to a high-level equilibrium (the triangle in the figure) is an area which is perfectly suited for the application of donor funding, and is something that The World Bank and other donors should be supporting on a large scale.

A particular challenge in moving towards greater user charges in Pakistan is that many have made such large personal investments in 'coping with poor public services'. This has not worked badly—a middle-class family in any of the major cities actually gets water twenty-four hours a day, even though the water from the utility comes for just an hour or two. Middle-class families have done this by making large investments to cope. But the existence of these 'sunk costs' poses a particular challenge, because these users would actually benefit little in the short run from more reliable supplies. This means that, again in the short run, they would oppose higher user charges even if service quality improved. They would only

Fig. 4.7: From low-level to high-level equilibrium in Conakry



Source: The World Bank, 1992.

become supporters in the medium run when they understood that they did not need to replace their assets (their pump and overhead tanks and water filters) because they could now rely on the piped distribution system. At the very least this requires that information on improvements, and the savings this brings in the short run (lower electricity costs) and medium run (no replacement of equipment for coping) needs to be made clear and communicated effectively. It also means that the time span for bringing tariffs in line with costs needs to be tailored to this reality.

An additional factor that needs to be factored into the design of tariff reform is the fact that the status quo is quite satisfactory to many in the public agencies who profit from the discretion which they exercise. As David Mosse[22] notes: 'Only the rare engineer supports Participatory Irrigation Management. Most consider it a fad that should wear itself out in time…with fear for the loss of gratuitous incomes should farmers begin to function independent of the irrigation department.'

Complicating the situation is the fact that the anti-reform rhetoric of 'increased tariffs will hurt the poor' and 'this will cost jobs' has been honed to a fine art, and has the strong support of some political parties. There is no easy answer to this issue, but it is clear what are some of the elements that need to be addressed. On the 'carrot' side, there are creative ways of providing new opportunities for those in the public sector agencies to participate in a new service arrangement. As was done in a successful process in Mexico City, public workers were given training, capital, and preferential access in setting up firms which could compete for contracts handed over to the private sector. On the 'stick' side, the government itself is complicit in, and even the architect of the present arrangement, and is unlikely to be an effective change agent. What is needed is, as described earlier, to bring as much as possible 'into the light of day': Who has entitlements to the water? What is the contract between the provider and the user? What are the penalties for non-performance? What is the performance of the different providers?

What this means for Federal and Provincial Governments

The agrarian economy of Pakistan accounts for about 25 percent of GDP and employs about half of the labor force. While the transition to an urban and industrial economy can and must continue, agriculture will remain central for the well-being of large numbers of people. And it is important to recall the arithmetic of water—a person requires about 100 liters for household purposes each day, but requires between 3,000 and 5,000 liters to produce his/her food. Much of the discussion of at least the quantitative aspect of water management is, therefore, primarily about water use for agriculture.

Water is a key constraint to improving agricultural productivity and generating jobs. Over the past several decades farmers have largely taken the problem into their own hands, and 'solved it' by sinking hundreds of thousands of tubewells which provide just-in-time water for their crops. To a substantial degree, the main function of the canal systems has been to recharge the groundwater—about 80 percent of groundwater abstractions in Punjab come from recharge from canals. The survival of the water economy over the last several decades has largely been despite rather than because of the state—it has been the tapping of the unmanaged groundwater by millions of farmers, by towns and villages and industries that have pulled the economy through. It is clear that this era of 'productive anarchy' is

22 David Mosse, *The Rule of Water: Statecraft, Ecology and Collective Action in South India*, Oxford University Press, New Delhi, 2003.

now coming to an end, since groundwater is now being over-tapped in many areas (including both the Indus Basin and Balochistan, and other non-Indus areas). This poses two very major challenges to the state. First, surface water supply systems are going to resume their previous high importance, and need to be managed much more accountably and effectively. Second, groundwater will have to be managed—for related reasons of quantity and quality—much more aggressively than has been the case in the past.

It is also obvious that the needs for water are changing substantially as a result of agricultural diversification, urbanization, industrialization, recognition of environmental needs, climate change, and the evolution of the natural resource base. Since there will be, if anything, less rather than more water, it means that the new water economy is going to have to be one which is much more flexible, in which a key will be the voluntary reallocation of water from those who need it less to those who need it more.

It is going to require a very different type of state machinery at both the federal and provincial levels to meet these challenges. In constructing this 'new water state', the focus must be primarily on instruments which govern the relationships of different users with water, and with each other. The logical organizational architecture then is that which is required to manage the instruments, and order the relationships between the parties. Some of the key elements of the 'new water state' will be:

- Introducing accountability, efficiency, transparency, and competition into the surface water supply business. This will mean unbundling the business into bulk, transmission, and distribution enterprises, with relations among the parts governed by contracts which specify the rights and responsibilities of both parties. This will mean encouraging competition below the distributaries (with Farmers' Associations competing 'for the market' with the irrigation department) and into the canal commands (where private companies can, again, compete under a clear regulatory framework with the irrigation department). In many cases, professionals from the irrigation departments would be encouraged to form private businesses for the provision of such services, thus ensuring that their skills are not lost, and that they do not see the changes as purely a loss of security. The bulk business (operation of dams and barrages) would probably remain in state hands, but with many major functions (such as operation of power plants) concessioned out to private operators. A similar institutional architecture would pertain for the drainage infrastructure.
- In such a system (which would take place in a sequenced and prioritized process over many years), the government would, gradually, play a very different role. It would corporatize the state-owned operating units, and develop new capacities to do the economic regulation. The government would also be far more active in groundwater management, where it has been largely absent. This would mean developing a new legal and regulatory framework for comanaging groundwater with user associations. It would mean developing the sophisticated natural resource management capacity required for the management of water and land systems.
- A centerpiece of these systems, both surface water and groundwater, would be improving the administration of an unusually well-established system of water entitlements. What is now needed is finalization of the agreement on environmental flows into the delta (a process that is underway), and then implementation of the Accord in a transparent manner, audited by an auditor who is, and is perceived to be, neutral. The

same system then needs to be 'drilled down' to the canal commands within the provinces (where entitlements are mostly well established but not transparently administered). And so on down all the way to the users' associations and eventually to the farmers. There is broad agreement among most water professionals in Pakistan that this improved administration is quite feasible, and that it would increase efficiency, allow flexibility in adapting to scarcity, and reduce conflict and install trust in the system.

- A similar, and even more difficult, process is essential for groundwater, since groundwater reservoirs are already being mined in the sweet water areas. Again, this will take a well-thought-out, pragmatic, patient, and persistent strategy. The central elements will be heavy involvement of users, substantial investments in modern water and agricultural technology, and the state playing a vital role in developing the enabling legislation, and as regulator and provider of knowledge and decision support systems.

CHAPTER 5

PRINCIPLED PRAGMATISM AND 'RULES FOR REFORMERS'

This Report (and many other documents) makes it clear that Pakistan will have to make major changes in the way it develops and manages its water resources, and that this process has to start soon. The experience of all countries shows that it is easy to articulate principles, but translating principles into practice is essentially and necessarily a political task, which is very different in different historic, cultural, and political environments. In his background paper, Imran Ali[1] states the challenge very well: '...in the institutionally complex environment of Pakistan, reform proposals are accompanied by variable, contradictory, and even conflicting viewpoints. There is consequently much difficulty in implementing a reform agenda, since political realities and considerations continue to impinge on economic efficiency criteria. The decision-making environment has to contend with competing interests, differing perceptions, unequal power relationships, and imperfect information. Therefore, the outcome of reform policies usually depends on the interaction between supporters and opponents. This scenario is quite different from the assumptions of economists who feel that society should move towards market-oriented models, through institutional reform policies based on a rational process of objectives identification, options evaluation, and strategic choice. Such an approach can be too simplistic, or lead to strategic errors, if it fails to incorporate real world issues, and more specifically the role of interest groups, in devising a more pragmatic set of reform sequences.'

Reviews of water reform efforts throughout the world suggest that the guiding mantra must be 'principled pragmatism'.[2] 'Principled', because principles matter a lot. And 'pragmatic', because principles can only be translated into practice by following a step-by-step, persistent process, which 'fits' with the local culture, people, and environment. This section reflects on some of the lessons of 'principled pragmatism' in water reform processes elsewhere,[3] and from reform processes in other sectors in Pakistan. They are presented in the form of 'rules' (really suggestions) which a reforming government might keep in mind.

Rule #1: Water is Different

There is much that aspiring water reformers can learn from reforms in other sectors—such as power, telecommunications, and transport. But it is also true that water is, and is perceived to be, different from these other 'created' sectors in many fundamental ways. The resource economist Kenneth Boulding's ode to water[4] (see 'Overview and Executive Summary', p. xxvii) captures many of these distinctions very well.

1 Paper 9.
2 The World Bank, *Water Resources Sector Strategy*, Washington DC, 2003.
3 John Briscoe, 'Managing water as an economic good: Rules for reformers', *Water Supply* 15(4), 1997, supplemented by the observations of many people and politicians who have led reform processes around the world (Reference: Hague session).
4 Kenneth Boulding, 'The Economist and the Engineer', pp. 82–92, in *Economics and Public Policy in Water Resources Development*, ed. S.C. Smith and E.N. Castle, Iowa State University Press, 1964.

Rule #2: Initiate Reform where there is a Powerful Need and Demonstrated Demand for Change

Habits of water management and use, and the organizations and practices involved, have evolved over time and have, at some time, 'fitted' the particular prevalent economic, social, and environmental circumstances. Change is not easy or welcomed, unless there is a very strong need for change. Abstract and idealized statements (such as 'river basin management' or 'integrated water resources management', the mantra of the international community in recent years) have some resonance with professionals, but do not constitute a reason for organizations and people to change the way water is managed.

Because changes are difficult and often wrenching, they will be undertaken only when there is a powerful need and a demonstrated demand for change. Global experience[5] shows that the impetus for change is usually either a serious breakdown in services, or an environmental failure which affects large numbers of people, or a fiscal crisis which makes the status quo untenable.

In Pakistan today, there are a number of settings where there is a powerful need and demonstrated demand for change and which are, accordingly, the areas where reformers should put their initial efforts. These include:

- There is a strong demand from all quarters for clarity on entitlements, and for transparent and impartial delivery of those entitlements. Predictably, this demand is strongest from tail-enders, be they provinces or farmers.
- Cities where individual households are facing greater and greater difficulties in making their 'coping strategies' work, because the groundwater option is becoming a less and less tenable option, and because the breakdowns in regulation (such as in the tragic current case of Hyderabad) give rise to strong demands for change.
- For farmers, too, the 'exit option' of self-providing groundwater is becoming more and more costly, increasing the pressure on the irrigation departments to improve the quality of service.
- Agrarian Pakistan is undergoing a quiet but rapid revolution—contract farming is increasing, high-value crops are displacing food grains, aquaculture is increasing, among other things. In each case the importance of a predictable supply of water becomes vital. There has been a rapid uptake of drip irrigation and other new technologies, but these 'exit options' will not be sufficient, and there will be pressures to allow water to move more flexibly and voluntarily from low-value to high-value uses. Much of this now takes place in informal water markets, but as agricultural production moves to scale there will be pressures to formalize such relationships. Again, this is an important area where there will be demand for changes in water management practices. It is striking how large-scale 'progressive farmers' are becoming an increasingly articulate voice for change in the delivery of irrigation services in Punjab, for example.
- The security risks of deferred maintenance are becoming apparent to planning and finance officials in the federal and provincial governments. In several instances, high-ranking officials in these departments are becoming strident voices demanding that public resources are used better, and that the irrigation departments be reformed to ensure this.

5 John Briscoe, 'Managing water as an economic good: Rules for reformers', *Water Supply* 15(4), 1997.

The key message is that there are many windows of opportunity opening up for water reforms which will constitute specific and practical solutions to local problems. It is these which will show what can be done, and will, by producing tangible results, constitute a pressure on, and example for, others to follow.

Rule #3: Involve those Affected, and Address their Concerns with Understandable Information

People are, for good and not-so-good reasons, always apprehensive about changes which will be thrust upon them. And when it involves something as sensitive as water, communication, discussion, and information become central elements for any reform process. What would this mean in Pakistan?

The case of construction of a new dam on the Indus is a case study in many of the 'dos and don'ts' of communication.[6] First, several times in the past the government has believed that a decision could simply be imposed as being 'in the best interest of the people', without the extensive public discussion that such a massive and sensitive investment merited. More recently, the communication effort and political process has been much more appropriate and professional. It has included heavy involvement of the Parliament, technicians, and the media. And it has included some excellent material (partially summarized in box 5 earlier, and available in full on www.infopak.gov.pk/public/Kalabagh_Dam) which acknowledges that different provinces and groups have different views and concerns, and which disaggregates these and addresses many of them in a simple and clear language.

In developing a political/communications process for reforms, it is important to understand that the present situation (of unclear entitlements, discretion, and lack of transparency) suit important groups in society. The essence of the reforms outlined in this paper would be to reduce monopoly power, and introduce transparency, thus greatly reducing the space for discretion and corruption. Imran Ali has described why some groups would tend to oppose such changes, and outlined strategies for neutralizing such opposition: 'Larger landowners could be the most opposed to change, since they have been gaming the system for decades. Clearly, they do exercise political influence, and benefit most from the deinstitutionalized politics that are currently in vogue. However, the attraction of contracted, formalized water rights, with capacity to purchase additional demand through efficient water markets, could prove an adequate trade-off for the pressures of constant manipulative activity and threat of water conflict. Also, there is now, hopefully, a sufficient element of modernizing larger farmers who are making a transition to high value agriculture; and who approach agricultural production through capitalistic rather than feudalistic values. The engineers and staff of the PIDs could be against these reforms, fearing they would entail dissolution of their service, and a breakdown in existing rent relationships. Another disincentive could be leaving the relative security of service with the provincial government, for more novel contractual work with more transparent and accountable institutions.' What is critical is that these fears are real and constitute major barriers to reform, and that they cannot be wished away. Reform strategies must devise mechanisms for addressing such fears. As described earlier, irrigation departments might draw on the model followed in Mexico City,[7] where workers in the

6 Paper 10.
7 Manuel Contijoch, personal communication.

water utility were given privileged and in some cases sole access to contracts, provided they set up—with help—private companies to provide the hitherto publicly provided services. The same could easily be done in irrigation departments, for example starting with some of the equipment and repair shops.

While there is widespread public dissatisfaction with the way in which water is managed, this does not mean that the public at large, or influential groups in particular, will necessarily welcome reform efforts (as is illustrated by the vehement opposition by some NGOs and political parties to private sector involvement in water supply in Karachi). Again, as Imran Ali[8] points out:'Fears and misgivings over the issue of water as an economic good should be removed, whether these are held by the public at large, or articulated by institutional players, advocacy groups or political elements. Those areas should be identified where continued perception of water as a public good might be actually harmful to the community, carrying various disguised costs such as high informal charges or health hazards. The distinction should be made with certain programs where water resources can continue to be regarded as a public good, such as in the management of the larger drainage and flood control systems.'

Finally, such discussion is necessarily political and must necessarily take into account the political realities of each country. Again, quoting Imran Ali: 'The fact that roughly half of Pakistan's existence has been under military rule gives little clue as to which direction popular choice would take the country. The civilian regimes of the 1990s did maintain a steadfast commitment to market forces, and this could continue in the future with a more complete return to civilian politics, except if religious-oriented parties can succeed in stigmatizing Western influences. Therefore, a prerequisite for the success of the reform process will be continuity in the state's strategic directions. The certainty of such continuity would have been more plausible had these issues been discussed more comprehensively in the nation's parliament, or other representative forums.… The World Bank should endeavor that such a discussion and debate does take place, so that the outcome is seen as the product of popular support, rather than an arbitrary imposition. Perfectly rational and badly needed reforms can suffer if the process of adoption and decision making is not transparent.'

Rule #4: Reform is Dialectic not Mechanical

Ideas like 'river basin planning' and 'integrated water resources management' have sound conceptual roots, and appeal to technicians, many of whom perceive implementation of these ideas as the path towards better water management. Useful as they are, in the words of the Operations Evaluations Department of The World Bank '...progress takes place more through "unbalanced" development than comprehensive planning approaches'.[9] As Karl Marx (had he addressed the subject!) might have said: water reform is a dialectical, not mechanical process.

Improvements in water management occur when there are tensions (between users, between users and the environment, and between the water agencies and the finance ministries) which can no longer be accommodated within the existing institutional arrangements. But reforms do not lead to nirvana—they simply mean that 'lower-order tensions' are replaced by higher-order tensions. That is the yardstick by which reforms should be judged.

8 Paper 9.
9 Operations Evaluations Department, *Bridging Troubled Waters*, The World Bank, Washington DC, 2002.

Rule #5: It's Implementation, Stupid

Lawrence Summers[10] has observed that the great distinction between developing countries which have progressed over the last thirty years and those that have stagnated is not the ability to formulate perfect policies, but the ability to translate reasonable policies into actions on the ground. Paraphrasing Bill Clinton's famous election mantra, 'it's implementation, stupid'.

And so it is with water in Pakistan and elsewhere—policies and recommendations abound, some very good. What matters is identifying improvements that can actually be implemented.

Rule #6: Develop a Sequenced, Prioritized List of Reforms

Any journey requires a knowledge of the destination and a road map for getting there. However, the journey itself is taken step by step. And so it is with water reforms—there must be a long-term vision, but immediate attention must be on putting first things first—to sequencing, and prioritization. The practice of (aborted) water reform by government agencies in Pakistan (reinforced by some of its external supporters) has often been to make everything (and therefore nothing) a priority, a criticism which has often been leveled at the 'over-ambitious' National Drainage Project.

A relevant example of a principled but pragmatic approach to sequencing relates to that of 'cost recovery' for irrigation services. Cost recovery is, of course, an appropriate aspiration, but it is almost never the place to start. Farmers will not and should not pay for the costs of poor services which are delivered by inefficient and corrupt agencies. The first step must be to address the issues of accountability and efficiency (as described earlier in this Report). Once services are improved and there is trust in the service provider, then tariff increases to bring revenues in line with costs becomes possible. As described in the urban water supply example in Guinea, Africa (fig. 4.7), public funding will generally be necessary on a declining basis to 'finance the transition'.

Rule #7: Be Patient and Persistent

Water reform processes are never short, decisive affairs. A review of the experience of rich countries by the OECD[11] shows that progress in water reforms takes place over decades, not years, and that even the most advanced of countries is only about half way towards the ideal forms of water management described in declarations of intent by the countries themselves and by the international community.[12] Moving from, say, '30 percent okay' to '40 percent okay' over the course of a decade is a reasonable aspiration.

Rule #8: Pick the Low-hanging Fruit First—Nothing Succeeds like Success

The world over, citizens are either concerned or skeptical about announcements of 'reform', with some advocating abolition of the word from the public policy lexicon. 'By casting their agendas as reforms, political advocates don't aim to stimulate debate and discussion. They aim to suppress it. They aim to stigmatize adversaries as nasty, wrong-headed, selfish, or misinformed. The trouble is

10 Lawrence Summers in 'Practitioners of Development' series, The World Bank, www.worldbank.org.
11 OECD, 'Water management: Performance and challenges in OECD countries', Paris, 1998, www.oecd.org.
12 The International Conference on Water and the Environment, Dublin, www.wmo.org, and The World Bank, *Water Resources Management Policy Paper*, Washington DC, 1993.

that as a society, we need debates over principles and practicality. All reforms are not desirable, at least not to everyone.'[13]

The corollary is that public support will only build if there are visible, tangible results from the changes which are advocated. The key is 'show me'.

It certainly can help to show opinion leaders that these changes have been effected in other countries. The formation of the famous French River Basin management system in the 1960s was strongly influenced by the successful experience of the Ruhrverband, established in neighboring Germany in 1916. And the political leaders of the water reform process in Brazil ascribe high importance to a study tour of Mexico and Colorado at a critical time. But there is nothing like demonstration on home territory. And since changes are always difficult, it is imperative to start changes where conditions are propitious—where there is a real demand for change, where there are champions, and where it is possible to show results.

Rule #9: Keep Your Eye on the Ball—Don't allow the Best to become the Enemy of the Good

Almost any progress is progress worth making, whether or not it measures up to some abstract global notion of 'excellent'. The idea that practice can go from terrible to perfect in one fell swoop is one that is attractive to outsiders and is sometimes adopted by financial agencies (so-called Volvo instead of Volkswagen standards[14]). But it fits poorly with the one-step-at-a-time gradualism which characterizes water reforms, everywhere.

A good example of 'the best is the enemy of the good' rule at work is the justly famous Indus Treaty, which has, since its inception, had its detractors in both Pakistan and India refer to it as 'not fair'.[15] Confronting the Pakistani detractors of the Treaty, Ayub Khan gave advice which is relevant for all would-be water reformers: '...very often the best is the enemy of the good and in this case we have accepted the good after careful and realistic appreciation of our entire overall situation...the basis of this agreement is realism and pragmatism....'[16]

Rule #10: There are no Silver Bullets

The challenges which Pakistan faces in water management are environmentally, socially, and technically complex. There is a justifiable human fantasy that there is a single 'silver bullet' which will 'solve the problem'. In some parts of the Pakistan water establishment today there is still faith that the old remedy—more dams, and variants of this—will solve all water problems and should be given near-exclusive priority.

What is clear is that the most effective responses to the water challenges in Pakistan are going to vary very widely, and are going to require a host of interventions of different scales. As suggested by 'Stages of water development' in fig. 2.18, the major instrument is not going to be infrastructure alone, but management supported by both old and new types of infrastructure, large and small. 'Management' is going to mean systemic sets of legislation, capacity building, organizational change, and the use of entitlement, pricing, and regulatory instruments. And it is not

13 Robert Samuelson, 'Reform ain't what it used to be', *The Washington Post*, 5 June 2004.
14 Sebastian Mallaby, *The World's Banker*, Penguin, 2004.
15 N.D. Gulhati, *Indus Waters Treaty: An Exercise in International Mediation*, Allied Publishers, New Delhi, 1973.
16 Undula Alam, 'Water Rationality: Mediating the Indus Waters Treaty', Ph.D. dissertation, Durham University, 1998, p. 340.

going to be the task of the government alone, but concerted and reinforcing actions by a host of stakeholders. But that there were a silver bullet!

Rule #11: Don't throw the Baby out with the Bathwater

A corollary of the previous rule is that there is a tendency when the silver bullet does not work (mixing metaphors badly) to throw the baby out with the bathwater. Dams (or the NGO-preferred supply-side alternative, rainwater harvesting) are propagated with missionary zeal, and when they do not deliver communities to the promised land, they are stigmatized and it is argued that they should no longer be part of the 'toolkit'.

Take the example of dams. There is an energetic and resourceful anti-dam lobby in Pakistan. Spurred by legitimate issues such as the lack of trust in administration of the Water Accord, and the effects of ever-greater water abstractions on the people of the Indus Delta, and pulling in a host of historic unrelated grievances,[17] these groups (working together with international anti-dam groups) have identified a new dam on the Indus as the greatest curse that could befall the people of Pakistan in general, and Sindh in particular.

Take another example, that of Water Users' Associations. The idea of WUAs transforming irrigation services has been, and is, a powerful and persistent one, despite mounting and long-standing evidence that reality is a bit more complicated. Similar evidence from around the world notwithstanding, the idea has had remarkable staying power in the global water community, again, 'because of their power as narrative, these accounts are rather invulnerable to empirical evidence'.[18]

For some, the case is clear: the idea of WUAs is partly a cruel trick played so that the more difficult issues—of real reform of the irrigation agencies, and the ceding of enforceable water entitlements—can be avoided. But the fact is that organized farmers do play a role in all successful irrigation schemes throughout the world, but only as part of a set of reinforcing instruments, which always include water entitlements and accountable service delivery agencies. The WUAs should not be thrown out with the bathwater, but propagated as part of an overall reform package. The distinction between necessary and sufficient conditions for progress is a vital one.

Rule #12: Reforms must Provide Returns for the Politicians who are Willing to make Changes

Politicians may not be the most revered figures in Pakistan (or elsewhere), but it is they who are 'in the game', who are elected to make crucial trade-offs, and who have the critical role as judges and champions of reform. A discussion with politicians who have led water-related reforms throughout the world[19] found general agreement in a 'rule' that: 'If it is to work, water reform must be good politics.'[20]

The bottom line: an essential element of any reform program is that it must be viewed as a 'good thing' by sufficient numbers of people, so that they will consider voting for the politician who championed the reform.

17 Khaled Ahmed, 'Sindh: The feel-bad factor', *Friday Times*, Lahore, May 2005, and Paper 10.
18 Judith Tendler, 'Why are Social Funds so Popular?', *Local Dynamics in an Era of Globalization*, The World Bank, Washington DC, 2000.
19 World Water Forum, Hague, 2000.
20 Articulated at the Hague World Water Forum in 2000 by Digvijay Singh, the then Chief Minister of Madhya Pradesh in India.

There are two important riders to this 'rule'. First, it is often quite difficult to judge how actions relating to water are being received by citizens. For example, consider the conclusions of a recent book on how environmental reporting is done in the English-language and vernacular press in India. Anyone reading the English language newspapers of India would perceive that the Sardar Sarovar Project on the river Narmada is almost universally opposed. However, a detailed analysis of press coverage by Sussex University[21] showed that the picture was considerably more nuanced: 'Environmental debate in India is governed by the language in which it is presented and understood. The message coming out of India, most likely to be heard by the developed world, comes out of its English language media, representing just 2 percent of the population. This elite group has adapted a pro-environment stance and is more likely to protest against new dams…. But inside India, the far bigger local language media representing the vast majority and poorer sections of society are expressing the heart-felt cry for development.'

Second, and related, is the fact that on any reform proposal there will be a cacophony of voices. 'Sometimes I feel as if there's a completely false assumption that if only you talk to everybody you will get an agreement. Only on a very boring issue or in a very boring country would you find that. To my mind the debate…. Does not eliminate the need for political risk… At the end the government has to take the risk….'[22] In short, while all voices must be heard, much greater weight must be given to the voices of those who have responsibility and face the voters, and less weight to those who are self-appointed or who represent small special interests.

21 Chapman, Graham, Keval Kumar, Caroline Fraser, and Ivor Gaber, *Environmentalism and the Mass Media: The North-South Divide*, Routledge, 1997.

22 Montek Ahluwalia, *Practitioners in Development*, The World Bank, 2004.

CHAPTER 6

THE EVOLVING ROLE OF THE WORLD BANK

What the Bank has Done in the Past

Water Resources and Irrigation[1]

The World Bank has played a central role in the development of Pakistan's Indus Basin irrigation system, the largest integrated irrigation network in the world. The Bank's partnership with Pakistan in the water sector dates back to 1952 when the first loan was approved for a water project in the then East Pakistan. In the 1950s, the Bank's good offices were instrumental in the successful negotiations of the Indus Waters Treaty (1960) between Pakistan and India, which settled the division of the waters of Indus Basin between the two countries following Partition in 1947. After the signing of Indus Waters Treaty, the Bank helped to mobilize funds and administered the Indus Basin Development Fund (IBDF) during 1960–67, which financed the physical works to implement the Treaty provisions, also known as the Indus Basin Development Project (IBDP). Subsequently, from 1968 onward the Bank administered the Tarbela Development Fund (TDF), which was extended to the post-Tarbela construction period during which extensive remedial works were implemented after the first impounding of the Tarbela reservoir. Thereafter, the Bank played a catalytic role in periodic major reviews of the irrigation and power strategy, and funded parts of the resulting investment programs.

Altogether, the Bank has, so far, supported 40 operations in the irrigation, drainage, and water resources development with thirty six[2] IDA Credits (US$13,455 million in 2005 prices) and four IBRD loans (US$5,807 million). During this period, these operations constituted 16.5 percent of the total Bank lending to Pakistan. The background paper by Usman Qamar[3] includes a complete list of Bank operations in the water sector and the subsectoral composition of its water sector portfolio since 1952. As shown in fig. 6.1, annual lending for water-related projects has varied between $620 million a year in the period 1960–70, to a low of $20 million a year in the most recent period (2001–04).

In addition to financing specific investments, the Bank also supported Economic and Sector Work (ESW) and provided Analytical and Advisory Assistance (AAA) that culminated in several major sector reports, including *Water and Power Resources of West Pakistan: A Study in Sector Planning* (popularly know as the Lieftinck Report

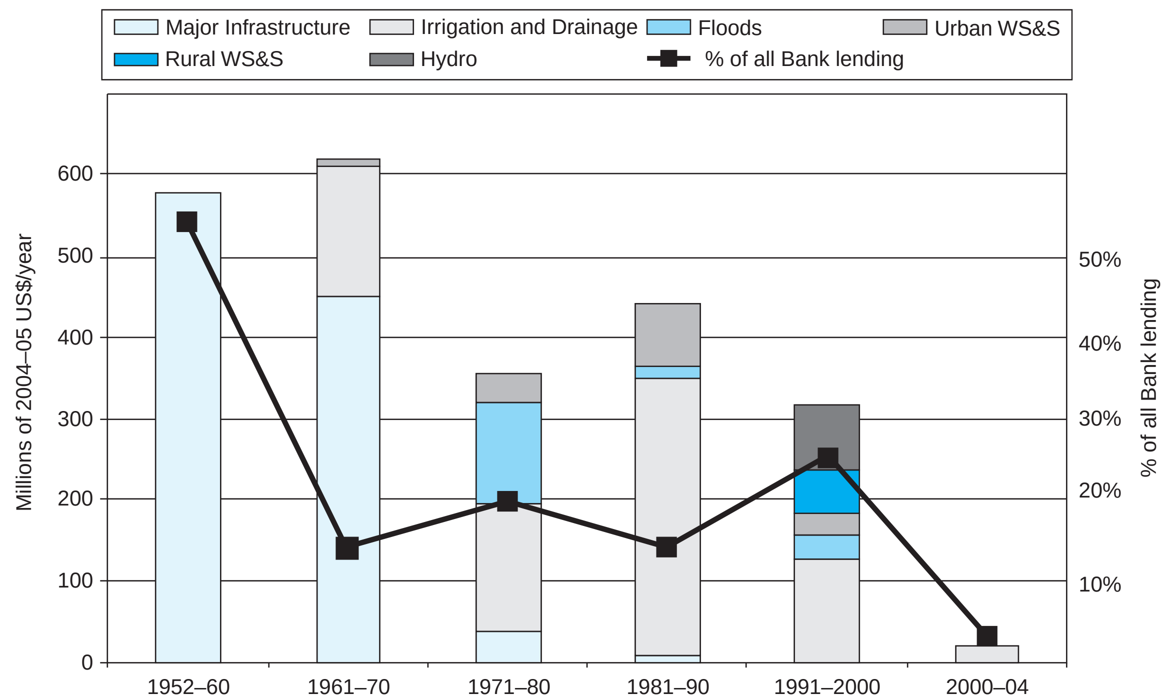
1 This section is based directly on the background paper by Usman Qamar, which draws on the following documents: Agriculture Operations Division, South Asia Regional Office, The World Bank, Project Completion Note: Indus Basin Project 1964 Supplemental Credit, May 1993, Irrigation I Davison, South Asia Project Department, The World Bank, Project Completion Report: Tarbela Dam Project, April 1984.

Operations Evaluation Department, The World Bank, Project Completion Report: Tarbela Dam Project, September 1986, Operations Evaluation Department, The World Bank, Pakistan—On Farm and Command Water Management and Irrigation Systems Rehabilitation Projects, Environment and Social Development Sector Unit, Rural Development Unit, South Asia Region, The World Bank, Pakistan Public Expenditure Management: Accelerated Development of Water Resources and Irrigated Agriculture, Vol. II, January 2004, www.worldbank.org.

2 Including seven IDA Credits for the former East Pakistan for a total amount of US$3,832 million equivalent.

3 Paper 16.

Fig. 6.1: World Bank lending to Pakistan for water-related sectors (1952–2004)



Source: The World Bank, 2004.

1967); *Revised Action Program (RAP) for Irrigated Agriculture* (1979); *Water Sector Investment Planning Study* (1991); *Pakistan—Irrigation and Drainage: Issues and Options* (1994); and *Accelerated Development of Water Resources and Irrigated Agriculture*, prepared as part of the Public Expenditure Review carried out in 2003. In addition, several sector policy and planning studies, including a draft 'National Water Policy, 2002' and a framework for a Drainage Master Plan for the country were prepared through the technical assistance components of Bank-assisted projects, as well as various trust funds managed by the Bank, including the Bank-Netherlands Water Partnership Program.

The evolution of the water sector in Pakistan and the Bank's lending and non-lending assistance can broadly be divided into the following somewhat overlapping time periods.

1960–75—the Post-Indus Waters Treaty Period

Prior to 1960, the Bank's involvement in the sector was limited to seven projects in the then East Pakistan for irrigation, flood rehabilitation, and water supply for a total amount of US$3,832 million equivalent (current prices). Following the Indus Waters Treaty, the focus of investments and the emphasis of Bank assistance was on meeting the water requirements of areas that were earlier served by the eastern tributaries of the river Indus (Ravi, Beas, and Sutlej) whose waters were allocated to India as part of the Treaty. This was imperative to avoid a food grain crisis that could seriously harm the new nation. The 1960s saw the construction of major IBDP works, including the Mangla Dam and a network of barrages and inter-river link canals, and subsequently the Tarbela Dam. It is worth noting that the Bank

Table 6.1: Bank assistance (1960–70)

Sr. #	Financing	Description	Amount US$ (Current)	Amount US$ (2004–05)	Approval Date
1	IBRD	Indus Basin Project	90,000,000	4,617,000,000	13-Sep-60
2	IDA	Khairpur Irrigation	21,154,434	1,085,222,464	29-Jun-62
3	IDA	Indus Basin Project	70,619,397	3,530,969,850	16-Jul-64
4	IBRD	Tarbela Dam Project	25,000,000	977,500,000	2-Jul-68
5	IDA	Khairpur Irrigation & Drainage	14,000,000	519,400,000	23-Jun-70
		Total	**220,773,831**	**10,730,092,314**	

Source: The World Bank data.

did not do an economic analysis of Mangla, because the construction of the dam was deemed to be essential for the survival of the country. Besides its role as the Administrator of IBDF,[4] the Bank supported the IBDP through two IBRD loans and one IDA credit (see table 6.1). The 'twin menaces' of salinity and waterlogging, and the need to provide drainage in many parts of the Indus plains were also recognized at this time. In response to these strategic threats, a public program using tubewells and surface drains was launched to lower the water table and reclaim saline soils. The 1960s witnessed the beginning of Salinity Control and Reclamation Program (SCARP). The Bank supported this program through two IDA credits.

The 1960s might be termed the 'heyday' of the water sector in Pakistan when massive investments in the sector, coupled with the introduction of high-yielding varieties (HYV) of wheat, heralded the 'green revolution'. Agricultural growth, which was sluggish in the 1950s (about 1.4 percent) and less than half the population growth rate, became the key engine of overall economic growth, and there was no major food grain crisis. This enormous achievement was the fruit of the following two major initiatives:

- From the late 1960s through 1975 river diversion capacity was expanded from 67 million acre feet (MAF) at Independence to an annual average of nearly 104 MAF today; the Indus Replacement Works, foreseen in the Indus treaty signed with India in 1960, including the Mangla Dam were completed, and the Tarbela Dam was also constructed. This investment program expanded the Indus Basin irrigation system, increased hydropower generation capacity, and increased cropping intensity on the Indus plains.
- Despite underinvestment in research and development, pricing and subsidy policies set the stage for the introduction of improved and high-yielding varieties of seed from the late 1960s, as both fertilizer and irrigation water availability expanded (green revolution)—from 1970 to 1994–95 the value of wheat production, the staple crop, nearly doubled from 6.476 Mt in 1970–71 to 17.002 Mt in 1994–95.

The timely completion of the mega IBDP is acknowledged as a major feat of efficient project management by Pakistan, international

4 Subsequently the Bank also administered the Tarbela Development Fund.

cooperation, and best practices. The Indus Basin Project Completion Note (May 1993) stated:

'The Indus Basin Works have fulfilled their basic replacement objective (arising from the diversion of water to India) and provided a small increment of water; that the growth in water supply, especially through tubewells, had a significant impact on agricultural production; and that the increase in power supply had been very cost effective.'

Similarly, the Tarbela Dam Project Completion Report (1984) concluded:

'...the entire Indus Basin Project stands as a monument to international cooperative effort, in a large part guided by the Bank. The immense system of replacement works consisting of Tarbela dam, six barrages and eight link canals was constructed during the period 1961–68—two years ahead of the Treaty deadline…No other project of such size and complexity had been constructed in such record time.'

While the IBDP was a success on most accounts, the Tarbela PCR and OED's Project Performance Audit Report (PPAR) highlight some aspects that should have received more attention during the planning stages:

- Tarbela Dam, the last of the IBDP works, was more than a replacement work, as additional water supplies were expected to become available. However, during the planning stage it was unclear as to how this additional water would be integrated in the national irrigation system for best use. Revised water allocation (water rights) among provinces and canal commands were not in place.[5]
- Complementary investments in agricultural development[6] did not receive adequate attention.
- The development of institutional capacity to conduct research and training in Pakistan on water resources engineering and management was not an important area of the Bank's concern.
- The immense effort represented by the IBDP and Tarbela programs inevitably absorbed the major proportion of external aid, as well as significant amounts of domestic resources. It also tended to divert attention away from downstream problems associated with the operation of Pakistan's enormous network of irrigation facilities and lack of adequate drainage infrastructure. As a consequence, over time, the water table underlying the Indus plain rose, leading to serious problems of waterlogging and soil salinity in certain areas.

The Post-IBDP Period (1975–93)

This period can be subdivided into two overlapping time frames:

- 1975–85: Emphasis on addressing waterlogging and salinity problems through a Salinity Control and Reclamation Program

5 The OED PPAR for Tarbela Dam also noted that '... agricultural benefits of Tarbela could be increased considerably if water supplies that are surplus to historical water rights could be allocated according to regional market demand (given enabling drainage investments in saline groundwater areas), rather than according to statute…'. The inter-provincial Water Accord was ultimately signed in 1991.

6 While the Lieftinck Report (1967) had advocated Tarbela Dam as the centerpiece of the IBDP, it had also pointed to the need for coupling water development with agricultural development if the full benefits of water development were to be realized. Complementary programs were to include rehabilitating, modernizing, and expanding the existing irrigation systems, and modernizing agriculture by wider use of technical inputs, improving water regulation practices and on-farm water management, reducing subsidies, increasing water charges, providing drainage and water quality management, and strengthening infrastructural support for agriculture.

(SCARP), and integrated irrigation and drainage interventions (the concern of sustainability of irrigated agriculture was the main driver)

- 1979–93: Implementation of Revised Action Program (RAP) for Irrigated Agriculture—emphasis on system rehabilitation, water conservation, improved management, farmer participation, and sustainability (improved O&M and cost recovery through privatization of public tubewells: 'the SCARP Transition program')

With the expected completion of IBDP and Tarbela Dam in the mid-1970s, Government of Pakistan (GoP) shifted emphasis to resolving waterlogging and salinity problems, and in 1973 launched an 'accelerated program' of waterlogging and salinity control (SCARP), building upon the success of the program of vertical drainage (through tubewells) and surface drains, started in 1960 (for example, SCARP I). Planning studies undertaken in the 1960s reinforced this approach, identified additional areas suitable for SCARP projects, proposed a major system of surface drains to dispose off saline effluent, and emphasized irrigation benefits that could be obtained from canal remodeling and from SCARP tubewells in fresh groundwater areas. SCARPs attempted to lower groundwater levels through tubewell pumping and, to a limited extent, through tile drainage. Pumping from freshwater aquifers provided an additional source of irrigation water, and enabled leaching of salts from saline soils. Over 12,000 public tubewells were installed, and the program was generally successful in controlling waterlogging while supplementing irrigation supplies.

SCARP, however, had its own problems. Its comprehensive approach to area development and emphasis on construction through WAPDA, tended unintentionally to divert attention away from water management, on-farm development, and related issues. Financial and other constraints slowed implementation, and the establishment of large public sector tubewell fields placed an ongoing financial burden on operating agencies (provincial irrigation departments) that seriously restricted funds available for normal maintenance of the surface distribution and drainage system. In addition, this program had technical and operational problems. Tubewell life was less than planned (10–15 years instead of the assumed 30–40 years), and because of plugging of screens and gravel packs, the capacity of most tubewells decreased about 5 percent annually. Water tables were lowered and irrigation supplies supplemented, but efficient management of public tubewells proved elusive.

Furthermore, the addition of Tarbela water, while significantly increasing dry season cropping, tended to aggravate waterlogging problems in certain areas, and brought into focus concerns about overall efficiencies in the use of irrigation supplies. These concerns were heightened further by the demonstration under a USAID-funded research project that water losses in the system, especially at the watercourse level, were significantly higher than had been previously assumed.

The RAP for Irrigated Agriculture (1979)

Increasingly during the 1970s, it was recognized that a more direct approach to the problems of management, maintenance, and efficiency in the operation of Pakistan's irrigation system was required, and further, that such an approach would need to be more closely attuned to the immediate constraints on agricultural production than in the past. Low abiana recoveries,[7] rising SCARP

[7] Until the early 1970s abiana proceeds were sufficient to cover the full O&M cost, and a small percentage of capital cost. However, the then government did not increase abiana rates even in nominal terms and recoveries fell far below O&M expenditures.

O&M costs, inflation, and pay commission awards resulted in major neglect of the surface irrigation system. Deferred maintenance began to accumulate and institutional weaknesses, manifested by poor quality of service delivery, also began to become apparent. By the early 1980s, accumulated deferred maintenance of the irrigation system had reached unsustainable levels. To help evolve appropriate policies and programs to implement such a new strategy to address emerging issues, a UNDP-financed and The World Bank-executed study was mounted to prepare a RAP for irrigated agriculture.

While recognizing that programs to increase availability of water and other inputs will continue to be important, the RAP recommended in 1979 that greater priority be given to complementary measures designed to ensure efficient water use, in particular through farm-level programs, and mobilization of private initiative and capital. The RAP also recommended better coordination between agriculture and water policies, improved water management at the farm and command area levels, discontinuation of new public investments in fresh groundwater areas and privatization of public tubewells, and system rehabilitation. Recognition was given to the capacity of the farmer to respond to appropriate incentives, as well as to the need to generate additional resources in both the public and private sectors to relieve acute resource constraints facing Pakistan.

Specifically, the RAP recommended: (a) investment policies that emphasized quick returns and that complemented existing facilities rather than expansion of irrigated area (rehabilitation, on-farm and watercourse improvements, essential drainage, and agricultural support services); (b) management policies that transferred relevant activities to the private sector (for example, tubewell development in fresh groundwater areas) and that strengthened GoP operating agencies; and (c) pricing policies that recognized continuing resource constraints and the need to provide appropriate efficiency signals to the private sector. The RAP recommendations in a large measure were accepted by GoP and made part of the National Agricultural Policy in 1980.

Bank Assistance: During the 1970s, Bank assistance was devoted to completing the Tarbela Dam, including the remedial works that required special attention. In addition, the Bank approved three drainage projects and a flood damage restoration project.

During the 1980s, Bank assistance focused on implementing the recommendations of the

Table 6.2: Bank assistance (1971–80)

Sr. #	Financier	Description	Amount US$ (Current)	Amount US$ (2004–05)	Approval Date
1	IDA	Flood Rehabilitation project	35,000,000	787,500,000	12-Mar-74
2	IDA	Khairpur-II Irrigation and Drainage Project	14,000,000	182,000,000	24-Jun-76
3	IDA	Flood Damage Restoration	40,000,000	460,000,000	22-Feb-77
4	IDA	SCARP-VI	70,000,000	763,000,000	6-Dec-77
5	IDA	Tarbela Dam Supplement II	35,000,000	381,500,000	28-Feb-78
6	IDA	SCARP Mardan	60,000,000	624,000,000	23-Jan-79
		Total	**254,000,000**	**3,198,000,000**	

Source: The World Bank data.

Table 6.3: Bank assistance (1981–90)

Sr. #	Financier	Description	Amount US$ (Current)	Amount US$ (2004–05)	Approval Date
1	IDA	On-Farm Water Management	41,000,000	323,900,000	16-Jun-81
2	IDA	Irrigation System Rehabilitation	40,000,000	316,000,000	4-May-82
3	IDA	Balochistan Minor Irrigation and Development	14,000,000	110,600,000	11-May-82
4	IBRD	Reservoir Maintenance Facilities	10,200,000	74,460,000	15-Mar-83
5	IDA	Fourth Drainage Project	65,000,000	474,500,000	31-May-83
6	IDA	Command Water Management	46,500,000	320,850,000	29-May-84
7	IDA	Left Bank Outfall Drain—Stage I	150,000,000	1,005,000,000	13-Dec-84
8	IDA	On-Farm Water Management II	34,500,000	231,150,000	6-Jun-85
9	IDA	SCARP Transition Pilot	10,000,000	63,000,000	8-May-86
10	IDA	Irrigation System Rehabilitation II	79,500,000	405,450,000	29-Mar-88
11	IDA	Private Tubewell Development	34,400,000	184,000,000	11-Apr-89
12	IDA	Flood Damage Restoration	40,000,000	158,240,000	11-Apr-89
		Total	**565,100,000**	**3,667,150,000**	

Source: The World Bank data.

RAP. There was a sharp increase in Bank assistance both in terms of number of operations and amounts committed for the sector, involving twelve operations with a total commitment of US$3.7 billion. Besides one operation for improved maintenance facilities for Tarbela, Mangla, and Chashma reservoirs, one flood damage restoration project, and one project for small irrigation schemes in Balochistan, the Bank supported drainage, on-farm water management, system rehabilitation, and privatization of SCARPs in fresh groundwater areas.

In the drainage sub-sector, three Bank assisted SCARPs (Mardan, Khairpur II, and Panjnad Abassia) started in the early 1980s were completed. Further, Bank assistance in drainage was focused on SGW areas and included one project in Punjab (Fourth Drainage), and one in Sindh (Left Bank Outfall Drain, LBOD Stage-I). While the focus of all these projects was on providing drainage relief, they were designed as integrated irrigation and drainage investments that sought productivity improvements in reclaimed areas.

In water management, the Bank supported two OFWM projects and a Command Water Management project. These projects recognized the need for giving greater voice to farmers in decision making at the watercourse level. Supporting legislation in the form of Water Users' Association Acts was promulgated in all provinces.

In system rehabilitation, the Bank supported two successive nationwide projects to rehabilitate the irrigation and drainage system. At the same time, O&M funding was substantially increased with the help of grants from GoP, and periodic increases in abiana charges were covenanted with the provinces. However, institutional and policy changes required to sustain O&M levels and improve O&M planning and effectiveness remained lacking.

The Bank also supported a program for 'SCARP Transition' (disinvesting public tubewells in fresh groundwater areas) on a pilot basis in Punjab to reduce the public sector O&M burden.[8] A project to support private tubewell development in fresh groundwater areas, with shallow water tables, was supported to avoid the need for further SCARPs in FGW areas.

In the 1980s, feasibility and detailed design studies for Kalabagh Dam, the storage project that was envisaged to follow the construction of Tarbela Dam, were also started.

Assessment of Bank Assistance in the Post-RAP Period

While Bank assistance during this period closely followed the RAP recommendations focusing on sustainability of irrigated agriculture and improving water delivery efficiency in SGW areas, the achievements were mixed, as explained below.

The OFWM investments were the most successful in terms of intended outcomes, including substantial 'water savings', and increases in cropping intensities and farm incomes (see excerpts from OED précis). However, from an institutional development viewpoint the achievements were modest. WUAs were generally non-sustainable, mainly because they did not have a continuing responsibility for O&M of the system above the *mogha* (the outlet, as shown in fig. 2.4 on p. 6). The third On Farm Water Management (OFWM) project Implementation Completion Report (ICR) observed: 'For long term sustainability of the irrigation system, participation of farmers in irrigation management is necessary. Their participation could be enhanced if the farmers' organizations have a continuous crucial role in O&M of the system. They should be responsible for distribution of water and collection of revenue resulting from water charges. In Pakistan's irrigation system, this could be achieved by forming FOs at the secondary canal level i.e. distributaries/minors.'

The drainage investments in SGW areas while solving local waterlogging problems, faced sustainability and environmental issues:

- Firstly, besides *off-farm drainage*, these investments also supported investments for *on-farm drainage*—primarily a private good—without requiring beneficiary contribution to capital cost. This gave the wrong signals to farmers that such investments would continue to be supported by the public sector. Furthermore, it downplayed the importance of improved water management to reduce the drainable surplus caused largely by over-irrigation.
- Secondly, except for limited investments in tile drainage, most subsurface drainage was based on large capacity tubewells. This choice of technology, while reducing the initial capital cost, resulted in several problems: (i) farmers could not maintain the large capacity tubewells; (ii) deeper groundwater being invariably more saline than shallower groundwater, environmentally safe disposal of drainage effluent became a problem; (iii) local drainage disposal solutions received inadequate attention[9]; (iv) the focus on vertical drainage discouraged the development of local private industry for tile drainage (PVC resin and pipes, and contractors specializing in laying horizontal pipe drainage) that has been successfully developed on a large scale in other countries, for example, Egypt.
- Thirdly, the projects involving surface drainage (for example, LBOD Stage-I

8 Expenditure on O&M of SCARP tubewells accounted for nearly 50 percent of the Punjab Irrigation Department's annual O&M budget.

9 For example, the option of using evaporation ponds for saline effluent disposal was rejected, based on the results of poorly sited evaporation ponds in SCARP VI. Evaporation ponds have been successfully used in countries such as Australia for disposing saline drainage effluent.

Project) were not designed to handle storm water flooding, nor was a system of flood management (flood warning or alarm system) made a part of the design. This deficiency has emerged as a major issue, particularly in the southern coastal district of Sindh (for example, Badin) where recurring severe flooding has occurred on several occasions.

- Fourthly, most provinces defaulted on covenants requiring increases in water charges. The resulting low recoveries were highly inadequate for O&M, and drainage infrastructure remained the most poorly maintained part of the irrigation and drainage system.

Privatization of SCARPs in Punjab by replacing government owned and operated large tubewells with community owned and operated small capacity shallow tubewells was perhaps the most successful and path-breaking investment supported by the Bank. Firstly, it greatly reduced the O&M burden of the government, thus substantially reducing the O&M cost and recovery gap. Secondly, it broke the myth that waterlogging and soil salinity cannot be controlled by private and community tubewells without compromising small farmers' access to groundwater. Thirdly, it demonstrated that farmers can better meet their irrigation needs if they control the operation of tubewells.

The investments in system rehabilitation no doubt had short-term benefits of reducing incidence of canal breaches, and solving siltation and erosion in 'problem' channels. However, due to the lack of essential institutional changes and adequate O&M, the situation reverted to the pre-rehabilitation situation within three to five years. The rehabilitation investments primarily aimed at restoring the system to its original design without any element of modernization to convert the system from a largely supply driven run-of-the-river system to a more demand driven system[10] intended for more modern agriculture. Additional control and flow measurement structures and an O&M regime commensurate with its requirements were not supported as part of these investments. The latter would have essentially required a more fundamental institutional change with greater farmer participation and incentives as its centerpiece.

OED Observations: In 1992, OED carried out an ex-post evaluation of two OFWM and two ISRP projects. Excerpts from these evaluations are given below:

- As approved, the four projects supported some of the most important priorities established in the RAP. But as implemented, they strayed from the program's agreed strategy:
  - They failed to give highest priority to improvements in saline groundwater areas. In these areas—which have no supplementary well water—the returns to controlling water tables and supplying more surface water are the highest.
  - They came to be dominated by quantitative targets for watercourse improvement, regardless of the likely effects on water supply, waterlogging, and salinity.

10 Generally, the original design criteria of the canal system had evolved to fit availability of water supplies in the rivers, to meet the objective of bringing to maturity the largest possible area of crops with the minimum consumption of water, and to operate at a low cost and with a limited number of technical staff. These resulted in low cropping intensities and low yields. While these irrigation schemes were historically very successful in generating agricultural surpluses at a time of low population densities and few technological demands, they have been less well adapted to the requirements of modern agriculture.

- The water 'saving'[11] impact of the 9,860 watercourses improved under three of the four projects, plus that from canal lining under CWMP, totals about 2.0 million acre feet (MAF), or 2.3 billion cubic meters… Although this is only a little more than half the savings anticipated under RAP, it is nevertheless more than a new surface storage dam at Kalabagh would provide (though that would have power benefits as well). This next proposed main storage site would provide an estimated 3.5 million acre feet at the mogha at a cost of US$3.5 billion (in a 1985 estimate).
- Canal rehabilitation and lining work in practice included significant capacity expansion contrary to the agreed program. This apparently occurred to allow the provinces to absorb additional water becoming available from Tarbela Dam, and to establish rights to that water before a formal allocation agreement took effect in 1991. In areas that could not safely absorb more water, the resulting increases in waterlogging and salinity have caused serious human and environmental problems.
- Program designers had envisaged a farm credit approach, arguing that farmers would find improvements in their watercourses profitable enough to repay loans. But, because of performance problems in the credit system, the improvements relied heavily on construction subsidies.
- Vested interests and the perquisites of project activities distorted the incentives to participants, just as the efficient management of the system as a whole was undermined by political influence and rent seeking.
- The bundling of assistance for the four provinces together in these four projects may have been administratively convenient, and clearly facilitates the Bank's wholesaling of development assistance, but is likely to have reduced the overall impact of the assistance.
- Recent projects have had some worthwhile and widespread poverty alleviation impact, but have also provided at the same time, without any justification, large transfers of public funds to many of the rural elite. Differentiation would permit, among other things, a more efficient allocation of scarce resources, taking relative needs into account.

The Post-Inter-Provincial Water Accord Period (1991–2005)

The beginning of the 1990s was marked by the conclusion of a long overdue Water Accord for sharing the Indus waters amongst the four provinces in 1991. A Water Sector Investment Planning Study (WSIPS) was also completed in 1990 to update the RAP recommendations and prioritize investments. The WSIPS emphasized the need to establish a comprehensive and reliable Data Bank Network for water resources, agriculture, soils, etc. to guide investment planning; revitalize institutional capacity in the provinces for investment planning; establish a sector MIS; improve project approval and review processes; modernize procurement processes; strengthen the local construction and consulting industries; and initiate a training program for institutionalizing integrated comprehensive management of water resources.

However, by 1992 it had become clear that the RAP approach was not resolving the overriding problems of the irrigation system which remained in dire straits with problems similar to many other irrigation systems, including waterlogging and salinity, overexploitation of fresh groundwater, low efficiency in delivery and use, inequitable distribution, unreliable delivery, and insufficient

11 It is important to clarify here that water losses in areas where there are fresh groundwater aquifers are not real losses, as these losses simply recharge the aquifer for later usage. The only real savings in losses are those obtained in SGW areas.

cost recovery system. It was realized that the RAP approach was not addressing the real underlying causes of the problems Pakistan's irrigation system was facing but rather trying to deal with the symptoms. With this realization, the Bank stopped new lending in the sector[12] till a far-reaching new strategy to address the real causes was agreed with the government. In 1994, the Bank completed a major sector study that resulted in the report entitled *Pakistan—Irrigation and Drainage: Issues and Options*. The key findings and recommendations of this report were:

- In Pakistan, as in many other countries, the government treats irrigation water as a public good, whereas it is a private tradable good, for which markets can operate. Lack of well-defined individual property rights and the illegality of sales of surface water severely constrain informal irrigation water markets. Instead of rooting out the barriers to water markets, the government publicly administers irrigation water. Inefficient pricing of water, resource misallocation, rent seeking behavior, and 'illegal' trading is the result.
- The government had not even adequately met the requirements of an administered system. It had failed to make budgetary provisions for operations. Moreover, the public body responsible for irrigation maintenance was separate from (and had poor coordination with) the agency responsible for revenue collection. In the past, administrative discipline was adequate but it had gradually broken down and the cost of irrigation maintenance had vastly increased. Nor were there any measures available to restore discipline.
- Economic efficiency in irrigation delivery and use cannot be achieved because of the lack of right incentives.
- Unlike on-farm drainage, off-farm drainage is a public good. Thus, off-farm drainage will have to be supplied by the government. However, the underlying problem of inappropriate institutional framework will require reforms that will ensure autonomy, transparency, and accountability of present institutional set-up for drainage.
- Any water service that is not a public good should be commercialized, and later privatized.
- Only with market-determined incentives for irrigation and on-farm drainage is a sustained improvement in performance possible. The government needs to remove barriers to a free market in water. Most important, the government will have to draw up enforceable property rights to water, without which any attempt to legalize and commercialize water markets would be futile. Property rights and legalized markets will make the opportunity cost of water transparent, leading to greater efficiency in use.
- The long-term option for the government will be to define individual water property rights, which are necessary to ensure equity in distribution. This would address the problems of tail-enders (that is, those at the tail end of the system who receive little or no water), while relieving pressure on groundwater resources.
- As a first step toward individual water rights, Pakistan may like to aim for communal rights, which are legally and administratively easier to establish. User organizations can then translate these communal rights into enforceable individual rights of their members.

The National Drainage Program (NDP) Experience

While endorsing, in principle, the main elements of the above strategy, in 1995–96 GoP proposed its own model for implementing the reforms that envisaged replacing the provincial irrigation departments (PIDs) with a three-tier institutional

12 Other than emergency assistance for flood damage, and operations already appraised by then.

set-up comprising autonomous Irrigation and Drainage Authorities at the provincial levels, Area Water Boards (AWBs) at the main canal level, and Farmer Organizations (FOs) at the distributary canal levels. PIDAs were to be established in all provinces, while one pilot AWB was to be established in each province with FOs at the distributary canal level. Supporting legislations in the form of PIDA Ordinances were passed and later endorsed by the provincial governments as PIDA Acts. However, the emphasis was on organizations, not incentives and instruments. Water rights and entitlements that were advocated in the Bank's strategy paper were not on the immediate agenda. The Bank accepted the proposed model as a starting point for implementing the reforms as the centerpiece of the, misleadingly named, NDP project assuming that a detailed strategy for implementing the reform model and dealing with difficult political and economic issues would be developed during the course of project implementation.

While a detailed evaluation of the NDP implementation experience is beyond the scope of this paper, suffice it to say that relative to its stated objectives and program targets, the implementation performance of NDP remained more or less unsatisfactory throughout and its outcomes have been modest. The main reasons for this unsatisfactory performance included, *inter alia*:

- Overly complex and ambitious project design that failed to address the realities of political economy embedded in the profound changes the reforms sought.[13]
- Lack of ownership, particularly by the PIDs who saw the reforms as a threat to their existence and monopoly on water distribution, and offered immense resistance and inertia to the changes the reforms sought to bring.[14]
- Lack of champions, both at the working level and at the political level (except in Sindh, and very recently in Punjab following changes in leadership).
- Focus on organizations, not on instruments and incentives.
- Lack of attention to sequencing, prioritization, and the 'rules for reformers'.
- Lack of a detailed strategy for implementing the key elements of the reforms; the PIDA Acts envisaged a 'stroke of the pen' conversion of PIDs into PIDAs but lacked important details[15] for implementing the reform strategy. Furthermore, the Acts did not address the fundamental issues of legalizing water markets, or clarifying communal and individual water rights.
- The Bank's underlying assumption that transition plans, severance packages, and change management arrangements would be defined and developed during implementation did not materialize due to constant distraction by other implementation issues, and battles of turf and jurisdiction among the various participating agencies. Similarly, the expectations that more transparent volumetric measurements, bulk water sales, and water charges based on volume would be introduced during implementation also did not materialize, as they received far lower priority than the easier to implement rehabilitation works.
- From 1999 onwards, the prevailing drought and resulting water shortages dominated the

13 For example, not including the PIDs as participating agencies in the project while seeking to replace them with alternative bureaucracies.

14 Opponents of reforms wanted to create the impression that 'the reforms had failed'; however, the opposing view is that actually the 'agencies failed to reform'.

15 With the exception of Sindh, where the Bank had earlier approved an IDF grant for preparing an institutional development pilot project for the Nara Canal AWB.

water sector debate in Pakistan, and the issues surrounding new storage proposals distracted the government's attention away from drainage and institutional reform issues.

In retrospect, a drainage project covering all the provinces and envisaging a major civil works component was not the right vehicle for implementing reforms that sought to focus on improving irrigation service delivery through participatory management, a system of property rights, and incentives. A more focused irrigation project would probably have been a more appropriate vehicle.

Notwithstanding this overall unsatisfactory rating, the NDP did yield several positive outcomes. First, it helped to clear the backlog of deferred maintenance of the existing system (some parts of the irrigation and drainage system had virtually no maintenance for several years). Second, although the institutional reforms component had a mixed performance, the need for the reforms has been endorsed at the highest levels of the GoP and provinces, and Sindh made commendable progress. Third, it was instrumental in the completion of key policy and sector studies that have paved the way for the introduction of a National Water Policy and a drainage sector strategy for the country. Fourth, the project improved the knowledge base by providing funding for institutions and individual researchers, and contributing international experience through study tours and use of international panels of experts. Fifth, the project promoted farmer participation in the operation and maintenance of the irrigation system. Finally, the project provided a forum for the discussion of long-term options for the sustainable development of the Indus River Basin, and as a consequence, has raised awareness of the importance of sound environmental planning and management.

Other Bank Assistance during the 1990s

Besides supporting the NDP project, Bank assistance included the projects listed below. Besides supporting a third OFWM project, of particular significance was the support for Second SCARP Transition and Punjab Private Sector

Table 6.4: Bank assistance (1991–2000)

Sr. #	Financier	Description	Amount US$ (Current)	Amount US$ (2004–05)	Approval Date
1	IBRD	On-Farm Water Management III	36,300,000	137,940,000	21-May-91
2	IDA	On-Farm Water Management III	47,300,000	179,740,000	21-May-91
3	IDA	SCARP Transition II	20,000,000	76,000,000	4-Jun-91
4	IDA	Fordwah Eastern Sadiqia Irrigation and Drainage	54,200,000	162,600,000	2-Jul-92
5	IDA	1992 Flood Damage Restoration	100,000,000	300,000,000	4-Mar-93
6	IDA	Balochistan Community Irrigation	26,700,000	61,410,000	26-Sep-95
7	IDA	Punjab Private Sector Groundwater Development	56,000,000	112,000,000	11-Jul-96
8	IDA	National Drainage Program	285,000,000	541,500,000	4-Nov-97
		Total	**625,500,000**	**1,571,190,000**	

Source: The World Bank data.

Groundwater Development projects[16] that completed the privatization of the remaining 6,000 SCARP tubewells in FGW areas of Punjab, providing substantial relief to its O&M burden. Other projects included the Fordwah Eastern Sadiqia Irrigation and Drainage Project that successfully established the first pilot FOs in Punjab, who were handed over irrigation O&M and revenue collection responsibility in the Bahawalnagar area of Punjab; a Flood Damage Restoration Project; and a Community Irrigation Project in Balochistan. Although the preparation of feasibility and detailed design (including bid documents) for the Kalabagh Dam were substantially completed, implementation was not started because of environmental and political controversies.

Bank Assistance after 2000 and Post-NDP

Following the mixed experience and outcomes of NDP, the Bank adopted an interim strategy till a new CWRAS is agreed with the government. This interim strategy has identified areas for partnership, and mutually agreed with GoP and provinces on the need to complement the reform agenda with investments in infrastructure. It distinguishes two possible scenarios: the first one formed by interventions that could stand on their own merits and that could reap significant benefits for productivity enhancement, income generation, capacity building at the farm level, and guarantee the safety of existing infrastructure (barrages); the second one ('high case' scenario) would seek progress in the articulation of the reform instruments (enforceable water entitlements and water rights, participation of stakeholders, transfer of responsibility over asset management, accountable institutions, water pricing and cost recovery policies, and environmental flows) so as to justify major interventions in storage, irrigation infrastructure, and long-term solutions to inter-provincial drainage problems. With respect to irrigation, the overall strategy will be to unbundle at the provincial level the support initially provided under NDP, and support the provinces that have demonstrated initial results and commitment.

In line with this interim strategy, the Bank approved On-Farm Water Management projects for NWFP and Sindh that provide support for physical improvements at the on-farm,[17] watercourse, distributary, and branch canal levels as well as for the reforms initiated under the NDP project. In addition, the Bank reallocated funds from the NDP Credit for Drought Emergency Rehabilitation, and more recently approved a project for the rehabilitation of the Taunsa Barrage on an emergency basis.

Recent Sector Work

In 2003, as part of Public Expenditure Review (PER), the Bank carried out a systematic review of public spending in the water sector, and highlighted a series of strategic issues to be addressed by the government and the Pakistani society. The review culminated in Public Expenditure Management Vol. II, entitled *Pakistan: Accelerated Development of Water Resources and Irrigated Agriculture, September 2003.* The main findings and recommendations of this review were:

- Pakistan has been living off the great expansion in irrigated agriculture since the late 1970s when the last major storage reservoir was completed. With the exception of two major drains to serve irrigated areas on the left and right banks of the lower Indus river, investment has been limited since that time mainly to *ad hoc* rehabilitation of canals, drains, and salinity control tubewells.

16 As part of this project, a draft framework for groundwater regulation in Punjab was also prepared.

17 Including introduction of micro-irrigation technologies and piloting of volumetric water delivery and abiana on the basis of volumetric deliveries.

- There is little doubt that water sector investment must increase substantially to meet urgent needs for the modernization of the distribution system, groundwater management, controlling soil and water salinity, as well as improving governance and the accountability of the institutions responsible for irrigation water service. However, investment in infrastructure alone will not meet the challenges—key policy changes, and institutional and governance reforms are at least as important.
- The major strategic issues facing Pakistan in the Indus Basin include soil and water salinity; environmental degradation of the lower river and estuary; inter-provincial conflict over water allocation and management; vulnerability to drought and supply reliability; and pervasive inequity, inefficiency, and low productivity.
- A 'supply side' approach has long been the staple water policy in Pakistan, and as one might expect, new water supply (dams) and new canals dominate the current proposals for investment in the sector. But looking to the future, the combination of high population growth, persistent poverty, lagging growth in rural areas, and the looming constraints on *water resources suggests that water resources development and management in the next forty years will be and must be by design substantially different from the past forty years*. A genuine paradigm shift is needed in the water sector, in which water is 'managed' from the mountain tops to the root zone of the Indus Basin.
- The strategy going forward must:
  - modernize both the water infrastructure and the institutional and governance arrangements for water management, and improve strategic planning and the knowledge base that supports planning, policy analysis, and investment (R&D, information systems)
  - balance short-term and long-term benefits by making investments in both water infrastructure and water management, and in both supply and demand management
  - better integrate irrigation, hydropower, and agricultural development investment programs and policy
  - reflect a more rigorous economic, social, and environmental analysis to ensure that project priorities and plans make the best use of the limited resource and fiscal space
  - be supported by a new consensus on water management and development that avoids the costly political conflicts of the past
  - choose judiciously among investments in supply expansion, system expansion, management, environmental sustainability, productivity, and governance, and then sequencing these over time to achieve a timely and sustainable development program with real and substantial economic and social benefits.

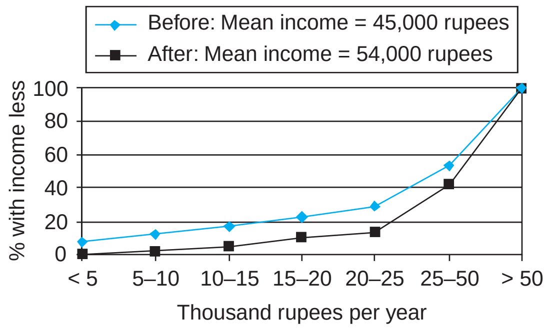
Hydropower

As shown in fig. 6.2, the Bank has had an episodic engagement with hydropower in Pakistan. Hydropower was a major element of the Bank-funded Tarbela Dam (discussed in the earlier section), with 60 percent of all benefits from Tarbela being due to hydropower, and with the value of hydropower benefits *ex post* substantially higher than expected at appraisal.

More recently, the Bank made a loan of US$350 million in 1996 for the successful US$2,000 million Ghazi Barotha Hydropower Project.[18] The

18 The World Bank, 'Implementation Completion Report' for Ghazi Barotha Hydropower Project, June 2004, www.worldbank.org.

Fig. 6.2: Household income of families at Ghazi Barotha Hydropower Project before and after resettlement



Source: The World Bank, 2004.

project was completed on time and on budget. It produces electricity of high value (since peaking power is particularly short) at a very low cost of US 1.7 cents per kwh (compared to an average generation cost in Pakistan of US 6.0 cents per kwh). The rate of return of the project was very high at appraisal and even higher *ex post*—the economic rate of return was 22.5 percent (versus 20 percent at appraisal) and the financial rate of return of 15.1 percent (versus 13.8 percent at appraisal).[19] In addition to its large direct contribution to the Pakistani economy, Ghazi meant that the Bank was involved in a power sector reform program in which WAPDA was to be unbundled into independent generation, transmission, and distribution companies (a process not yet complete). Finally, Ghazi dealt very successfully with complex resettlement issues, which included legacies from Tarbela. Figure 6.2 shows that those who were resettled were much better off after than before the project, with average household income increasing by about 20 percent.

Water Supply and Sanitation[20]

Water Supply and Sanitation (WSS) has been an integral part of the social sector investment portfolio of The World Bank. Starting modestly in the 1960s, the Bank's overall WSS portfolio grew to 9 percent of total commitments in 1979. Subsequently, dedicated lending decreased to about 3 percent, excluding WSS components of nondedicated lending categories. Currently the bank, worldwide, has 100 dedicated WSS projects, and another 150 nondedicated projects with significant WSS components. Lately, interest in the sector has grown because three targets under MDGs depend on improving the coverage and quality of WSS service delivery.

The World Bank's involvement, as well as its experience, in the WSS in Pakistan, has been modest even compared with its overall worldwide engagement in the sector. Starting in the late 1960s, the Bank has financed just five dedicated WSS projects until 1999, five years ago focusing primarily on water supply rather than sanitation. The Bank has not financed any major sanitation project, although there are new projects like the Punjab Municipal Service Improvement Project being appraised with possible Bank involvement in future.

Of the five Bank-supported projects, just one project covered rural WSS. Four projects were in two of Pakistan's largest cities of Karachi and Lahore. The results have been mixed at best, because, according to OED reports:

- Legal frameworks and regulatory mechanisms were absent, and hindered achievement of ambitious project objectives.
- The functions of service provision and regulation were not separated.

19 The World Bank, 'Implementation Completion Report' for Ghazi Barotha Hydropower Project, June 2004, www.worldbank.org.
20 Paper 17.

- Strategies were needed to minimize political interference in operational and policy matters (especially employment).
- Capital cost contributions and cost recovery needed to be improved while protecting the interest of 'the poorest of the poor'. There were opportunities for market segmentation and differential pricing that could be exploited.
- The sanitation aspect in most of the projects was not addressed.

The following is a summary of the Bank-supported WSS projects based on various Bank documents.

Lahore Water Supply Sewerage and Drainage Project (1967–72)

The main objectives of this relatively small Urban Water Supply Project were to rehabilitate and expand water supply, sewerage, and drainage facilities at Lahore, and to help establish an institutional capability to efficiently operate existing facilities and develop capacity for long range program expansion. According to an OED report, revision of the scope and design made evaluation and comparison with original appraisal difficult. Despite difficulties the long-run development objectives of water, sewerage, and drainage were achieved.

Second Lahore Water Supply Sewerage and Drainage Project (1976)

Project objectives were to (a) continue with the improvement and extension of Lahore's water supply, sewerage, and drainage system; (b) develop an efficient public utility organization which would be competent to continue the implementation of a proposed ten-year investment plan; and (c) develop an urban project which IA subsequently helped to finance. According to OED, the project was successful: the main project objectives were met and the physical components implemented. Tariff adjustments helped WASA to make good progress toward meeting revised financial covenants. The project illustrated the need to allow for sufficient time in project implementation schedules for institution building and human resource development. Great emphasis on dealing with physical implementation problems was at the expense of operational aspects. OED noted that Lahore is fortunate to have twenty-four-hour water supply and a comprehensive sewerage system. The service needs continue to grow as the city expands while requests for increase in tariff level are met reluctantly. The situation of Lahore located on a sweet water aquifer and in close proximity to river Ravi with potential recharge is unique, and duplicating this model may be a challenge elsewhere in the country.

Karachi Water Supply and Sanitation Projects (1983–91)

Objectives were to (a) increase Karachi's water supply by 60 MGD; (b) introduce system and household metering; and (c) strengthen Karachi Water and Sewerage Broad (KWSB) through TA and Training. The project helped increase supply between 60–70 MGD. However, success in controlling leakages was limited. Through installation of meters and repairs there was improvement in revenue recoveries from bulk users, but it had less effect on revenue from domestic consumers. The project increased long-term quality and reliability of bulk supply to Karachi. However, KWSB still did not achieve financial sustainability and required subsidy. The project helped strengthen KWSB capacities to manage and execute large projects. The June 2000 OED observations on the project stressed the need for an adequate regulatory framework that provided sufficient management autonomy and a path for reform that guarantees sustainability, limitations of financial covenants and conditionality, and the need to incorporate in project design valuable local experiences, particularly when they specifically address poverty alleviation. Overall, OED evaluated the project outcomes to be unsatisfactory with unlikely sustainability.

Second Karachi Water and Sanitation Project

The main objectives of this follow-up project were to (a) increase potable water supply and reduce water loss; (b) improve the financial viability of Karachi Water and Sewerage Board (KWSB) through increased revenues, cost reduction, and increased operational efficiency; (c) improve the organization and management of KWSB; (d) improve sanitation in the city of Karachi, including its low-income and coastal area by increasing sewerage coverage and sewage treatment capacity.

An OED evaluation states that none of the four objectives were fully achieved: (1) the water supply was increased but no reduction in losses is documented, and (2) the financial viability of the KWSB hardly improved; it survived due to government subsidies throughout the 1990s. The operational efficiency and the intended reduction in water losses of KWSB were impossible to gauge since it chose not to meter domestic consumption. KWSB's organization and management did not improve even after reducing staff from 14,000 to 8,500, and some limited administrative improvements. The water supply quantity and quality are probably worse after the completion of the project because of a rapid population growth in Karachi, and especially among the low-income population. A significant shortcoming was the legal and regulatory framework. An effort was belatedly made at the behest of the Bank to involve a private operator, but in the end these efforts came to nothing.

According to OED, the main lessons learned were that without a fundamental legislative and regulatory reform, including changed incentives and contracting of a private operator, the project was doomed from the start; financial covenants were ineffective if KWSB lacked the authority and means to comply with them; excessive politicization of the tariff setting and of the management added to the difficulties; and the project design should have incorporated more of community participation, especially under the sanitation component where Karachi had gained valuable experience from the well-known Orangi Pilot Project.

Rural Water Supply and Sanitation (1992–95)

This project covered all four provinces as well as AJK. As per OED, 'it is difficult to measure the achievement of general project objective of improving rural productivity and health particularly of women and children and reduce poverty and deprivation in rural Azad Jammu and Kashmir (AJK), Balochistan, and Sindh, since the project failed to develop monitoring and impact indicators. There was success in implementing the hardware components, while the software components were scaled back considerably. In the three provinces, only between half and two thirds of the institutional development assistance funds were actually spent.

The project was the first IDA-financed rural water supply project in Pakistan with a demand-driven approach incorporating significant community involvement—and with contributions from beneficiaries toward capital investments. The new methodology required a change of mindset of public schemes that had proved unsustainable. Indications are that roughly 95 percent of the water schemes built under the project are still operating three years after completion. In terms of shortcomings—the program to expand sanitary excreta disposal programs did not meet the expected acceptance and fell far short of planned achievements.

OED in its review of the project noted the following lessons learned from this experience:

- A demand-driven rural water supply and sanitation strategy based on strong community participation requires a longer time to take root than what is usually offered by one single project. The AJK component performed better than the Balochistan and Sindh components precisely because it enjoyed a century-old tradition of community participation whereas the other two did not.

- Changing the habits of excreta disposal implies a much greater effort than providing water supply. Symptomatically, the water supply investments performed much better than the latrine components.
- Project objectives should be stated in terms that would allow quantitative monitoring of progress towards reaching them.

The Bank's New Water Strategy

In parallel with these reviews of The World Bank's engagement in water in Pakistan, and influenced by them, the Bank developed a new Water Strategy, which was approved by the Board of the Bank in 2003, and set a new direction for Bank engagement in water throughout the world. The main messages of 2003 Water Strategy are:

- Water resources management and development is central to sustainable growth and poverty reduction, and therefore of central importance to the mission of The World Bank.
- Most developing countries need to be active both in management and development of water resources infrastructure.
- The main management challenge is not a vision of integrated water resources management, but a 'pragmatic but principled' approach that respects principles of efficiency, equity, and sustainability, but recognizes that water resources management is intensely political, and that reform requires the articulation of prioritized, sequenced, practical, and patient interventions.
- The World Bank needs to assist countries in developing and maintaining appropriate stocks of well-performing hydraulic infrastructure and in mobilizing public and private financing, while meeting environmental and social standards.
- The World Bank will re-engage with high-reward/high-risk hydraulic infrastructure, using a more effective business model.
- The Bank's water assistance must be tailored to country circumstances, and be consistent with the overarching Country Assistance Strategies.

Subsequently, the Board drew on the main messages—of more aggressive Bank engagement in infrastructure—in setting the parameters for an Infrastructure Action Plan. And recently, the major OED annual review, the 'Annual Review of Project Effectiveness', carries the same message: 'The World Bank should focus on promoting economic growth rather than social policies as the route to reducing poverty… and calling on the Bank to refocus its efforts on infrastructure projects and urban and rural development'.[21]

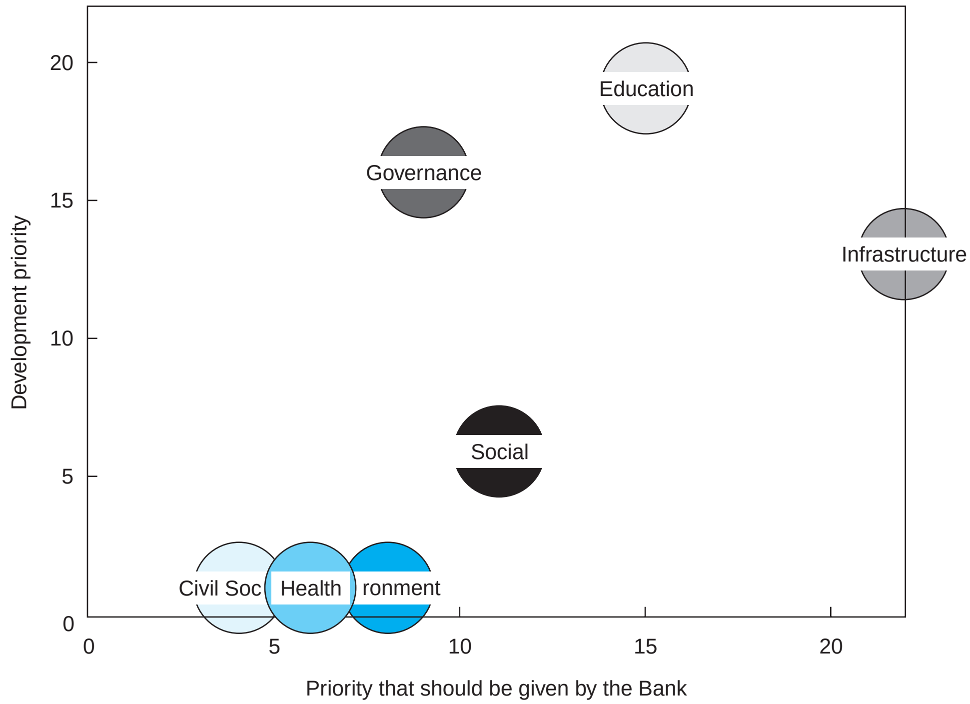
An Indicative World Bank Water Investment Program for 2006–10

The Four Pillars

An important objective of this Report is to be an input into defining the water elements of the framework (known as the Country Assistance Strategy) which will govern the relationships between The World Bank and Pakistan for the period 2006–10. The program described here is 'almost but not quite' final. 'Almost', because there have been extensive discussions between the Bank and the federal and provincial governments of Pakistan over water-related priorities over the past

21 Andrew Balls, 'World Bank under fire on spending priorities', *Financial Times*, 20 May 2005.

Fig. 6.3: The 'global poll' results for South Asia



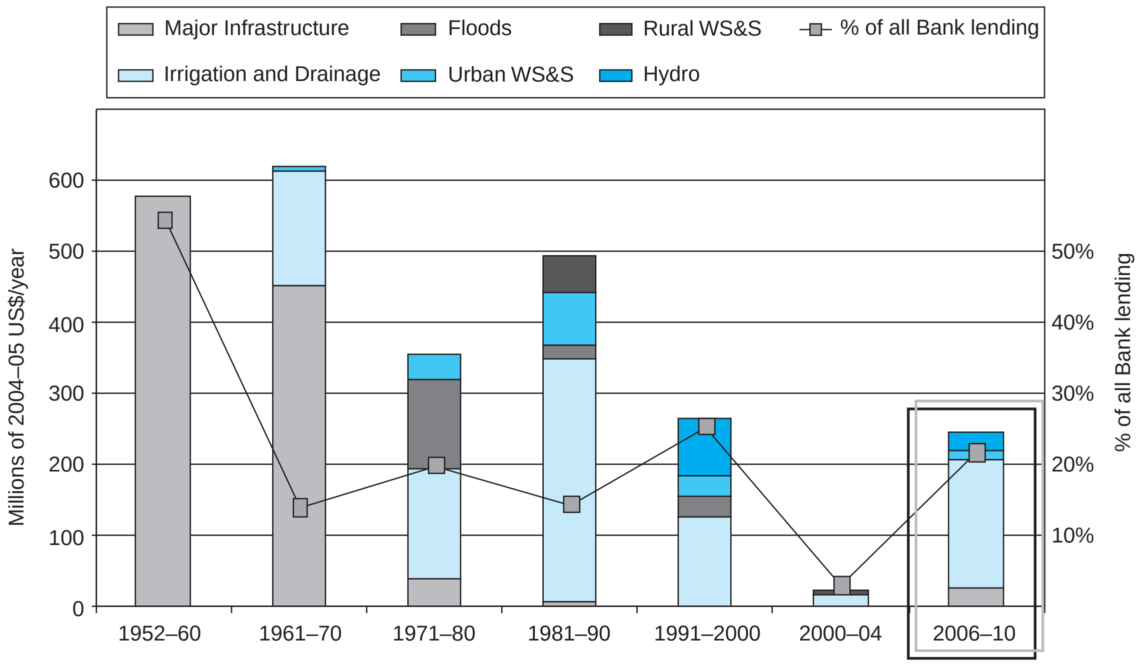
Source: The World Bank, 2003.

eighteen months. The indicative program described here is a product of those discussions and thus one on which there is close agreement, between the government and the Bank. Second, 'not quite', because the details of the 'Government of Pakistan-World Bank contract on water' for the next four years will only be finalized, necessarily and appropriately, over the next several months as Bank management and the Ministry of Finance finalize the overall CAS.

Since 1980, investments in the irrigated agriculture sector (water and agriculture) have been declining, both as a percentage of the total public spending and as a percentage of GDP. In 2003, the total allocation for agriculture and water represented only about 0.5 percent of GDP. The federal and provincial governments and the management of The World Bank all agree that water management is one of the central development challenges facing Pakistan, and that investments in the sector must be increased substantially. The federal government is already demonstrating its commitment in this regard. The allocation for water in Public Sector Development Program (Federal Development Budget) jumped from 20 billion rupees in the fiscal year 2005 to over 35 billion rupees in the fiscal year 2006, representing a 75 percent increase. This is in broad agreement with the findings of a major poll of a wide variety of South Asian stakeholders (fig. 6.3), which concluded that infrastructure, education, and governance were the three areas which were both of high national importance and where the Bank was perceived to have a comparative advantage.

There is also a general agreement that the water sector is an area where the Bank has a long history and a strong comparative advantage. There is, therefore, a general agreement that there will be a major increase in Bank lending for water-related

Fig. 6.4: World Bank lending to Pakistan for water-related sectors—past and prospective



Source: The World Bank data.

activities, with the indicative overall figures shown in fig. 6.4. This would mean that water-related lending for Pakistan would increase about tenfold from the 2000–04 period, and account for over US$1 billion in the coming four years.

Given the diverse set of challenges facing the sector and the large need for resources, Bank support would need to be selective, keeping in view its comparative advantage, other donors' traditional areas of support, and the priorities identified in this Report. The World Bank support would focus on instruments and incentives for reforms rather than simply on organizations, programs, and projects. It would be based on 'principled pragmatism' recognizing that reforms and investments must proceed in parallel, and the best should not be allowed to become the enemy of the good. Broadly speaking, Bank assistance would support four pillars of the water sector, as follows:

Pillar 1: Asset Development and Management

Pakistan has a large endowment (with an estimated replacement value of US$60–70 billion) of water resources infrastructure, most owned and managed by the provinces, and much now quite old. As described in this Report, the condition of this stock of infrastructure is a major cause of concern. In some instances—such as Taunsa and Sukkur barrages—the precarious state of major structures puts the well-being of tens of millions of people at risk. In other instances, the effect is more insidious, with the poor condition of canals and pipes and treatment plants meaning that infrastructure does not produce the services it should, and people have to adapt to unreliable and substandard services.

For these reasons, a major focus of Bank engagement over the next four years will be to simultaneously finance much needed investments in rehabilitation of some critical assets (including barrages), and to work with federal and provincial authorities to develop a more appropriate culture and practice of asset rehabilitation and management. This will include an emphasis on development of Asset Management Plans, which will include an inventory of existing assets, an evaluation of their condition and the requirements for one-time and regular rehabilitation, and for maintenance. Out of this assessment will emerge a set of short- and medium-term priorities for asset rehabilitation and maintenance. The Asset Management Plans will make explicit the requirements (and trade-offs) for public and user financing, and the importance for developing efficient institutional arrangements for rehabilitating and maintaining this infrastructure.

As is evident throughout this Report, most of the water in Pakistan is already allocated. The implicit view of the Bank, accordingly, is that attention should be focused on sustaining the infrastructure that has been built, and improving the productivity of water. A vital part of Bank activity in the past has been on drainage. The Bank will continue to invest, as part of provincial investment programs, in drainage and salt management, and will continue to contribute to the evolution of national and provincial drainage and salt management strategies.

One major issue that is likely to emerge in the next CAS period is possible Bank engagement in developing and cofinancing major new Indus Basin storage and hydropower, if and when the government makes such a decision. As is discussed in detail in this Report, this is a highly controversial issue in Pakistan, in part because of reasonable concerns about the cost and impact of a new dam and the distribution of costs and benefits, in part because of dissatisfactions with the lack of transparency with implementation of the Water Accord, and in part because this acts as a surrogate for a series of weakly related historic and contemporary political grievances. Over the past decade, the Bank has tended to shy away from engagement with such controversial issues because of reputational risks to the Bank (with Bank investments in hydropower, for example, falling by about 90 percent over the course of the last decade). More recently, the Board of the Bank has debated these questions at length (including in the course of discussions on both the Water Strategy and Infrastructure Action Plan). The Bank's borrowers have all said that the Bank is needed precisely where issues are complex and difficult. The broad conclusion is that the Bank must re-engage with such 'high-risk/high-reward' investments when there is a sound case for doing this, and when the Bank has a strong comparative advantage. In the case of possible storage on the Indus, then, the Bank understands fully and exactly how controversial this issue is. But the Bank also believes that new storage is of overwhelming national importance to Pakistan, and that delay makes things more difficult not easier. Accordingly, in discussions with the government it has been agreed that the Bank could be involved in financing a new dam on the Indus if the economic, technical, social and environmental, institutional, financial, and commercial feasibility is established. As the government understands, and as this Report has repeatedly stressed, building a dam is just one part of a set of necessary activities, which include improving the transparency and efficiency of administration of the Water Accord, and making a set of institutional reforms and investments at provincial, canal command, and farm levels to ensure better use of water.

This Report has concentrated heavily on the challenges in the Indus Basin, because they loom so large in Pakistan and because they are so complex. This focus notwithstanding, the Bank's investment program includes investments in infrastructure (mostly in NWFP and Balochistan) in small dams and minor irrigation schemes, and in groundwater management in the barani areas outside the Indus Basin.

In the urban water and sanitation sector, the Bank is likely to finance a project in Punjab, which would implement the recommendations of the ongoing studies, as well as rehabilitation and extension of the delivery systems. If it is not possible to design a long-term concession contract for Lahore, then this loan might also fund investments which would be included in a lease contract.

Pillar 2: Water Resources Management

As stressed throughout this Report, the development and management of the water resources of Pakistan in general is a huge challenge, requiring very high levels of administrative, engineering, and scientific capability. There is broad agreement that over the recent decades the capacity for modern water resources management at both the federal and provincial levels has not evolved rapidly enough to meet the emerging challenges.

Accordingly, over the next CAS period the Bank will give high priority to supporting the development of capacity at the provincial and federal levels. For surface water supplies a major emphasis will be building on Pakistan's platform of defined water entitlements, and making the administration of these more transparent and accountable from the inter-provincial to the user levels. For groundwater, the Bank will support the development of a government capacity for knowledge generation and management, and for policy and implementation of groundwater management. In both cases, there will be an emphasis on incorporating environmental issues (including water quality, wetlands, and environmental flows). An important element of Bank support will be the training of a new generation of multidisciplinary water resources specialists; and will include stimulation of centers of excellence for water resources sciences.

Pillar 3: Service Delivery

Infrastructure is, of course, not an end in itself, but a means to the end of providing users with better, and more sustainable services. In many ways, state water institutions in Pakistan (at both the federal and provincial levels) have not made the transition from the era of development and construction to the era where management of resources and services is the primary challenge. The formal service delivery structures for both irrigation, and water and sanitation services, are exclusively large public enterprises, which operate with little accountability to their users, and with little transparency. Helping start the transition away from this old model to a modern service delivery architecture was the major objective of the (misnamed) National Drainage Program (which emphasized issues of water users' associations, and autonomous provincial irrigation agencies). While achievements under the NDP were (as described earlier) modest, many lessons were learned (about keeping projects focused on a few key objectives, and about the need for encouraging experimentation with different forms of sound institutional reform), and the centrality of the objectives of the NDP remain valid.

Accordingly, the Bank will remain heavily engaged in provincial efforts to improve the quality, efficiency, and accountability with which services are delivered. Specifically, for reasons described in this Report, the Bank will emphasize instruments as much as organizational forms. This will mean an emphasis on the development of frameworks which encourage the entry of new players (including community organizations, and the small- and large-scale private sector), the use of contracts which specify the rights and obligations of providers and users, and benchmarking for all water services. The Bank will put a major emphasis on the nexus of entitlements, measurements, and transparency. This will mean emphasizing measurement and reporting throughout, and the associated investments in measurement devices, information technology, and real-time reporting of what is actually delivered to whom.

Pillar 4: On-farm Productivity

An important distinction between water supply services and irrigation services is that the former are an end in themselves, whereas the latter are simply one input into a multifaceted effort to improve agricultural production. Many of the elements of this challenge (such as credit, marketing and agricultural research, and extension services) are addressed as part of the Bank's overall rural and agricultural program, and addressed in the companion work on those sectors. The Bank's water portfolio, however, has and will continue to go beyond the delivery of water services, and involve investments in on-farm services (land leveling, watercourse lining, introduction of new technologies, etc.) which are essential for agricultural diversification and for improving the amount of crop, income, and jobs produced per drop of water.

Priorities and Sequencing

Pakistan needs to move forward on all the four pillars simultaneously. Priorities and sequencing of investments (short-, medium-, and long-term) should seek to maximize benefits (measured in terms of public welfare) from policy reforms and investments, subject to various constraints (budget, water, and other resources).

In the short term (next one to two years), the focus would need to be on the low hanging fruit under each pillar, which can be harvested at relatively low cost and effort with high returns. These include improving asset management planning; establishing O&M cost sharing principles; investing in critical rehabilitation; high pay-off investments that would improve water use efficiencies; reducing costs; decentralizing irrigation management; ensuring greater transparency in water entitlements and allocations; putting systems and instruments in place; and starting activities that have longer gestation periods, such as planning for major infrastructure, human resource development, and capacity building.

In the medium term (next three to five years), the focus would need to be on items that require further preparatory work and analysis of trade-offs (investments in new reservoirs, system expansion, groundwater management, and research and capacity building).

Finally, in the long term (six to ten years), Pakistan would need to focus on human resource development; reviving excellence in research and development; attaining financial sustainability for the sector; and meeting the Millennium Goals for drinking water supply and sanitation.

The Investment Projects

Over the course of the past year, the government and the Bank have identified an indicative set of projects and programs which Pakistan is likely to ask the Bank to finance. It is agreed that the Bank would provide support through its various lending instruments, including budgetary support for policies and prior actions that address key issues (Development Policy Lending) as well as through specific investment lending for infrastructure and institutional reforms. There is agreement that there will be a major increase in Bank lending for water-related activities, with the indicative overall figures shown in fig. 6.4. This would mean that water-related lending for Pakistan would increase about tenfold from the 2000–04 period, and account for about US$1 billion in the coming four years. The tentative lending program for the next four years would be as follows:

Punjab Irrigation Policy Loan (US$400 million)
This three to four year program would support the reform program in Punjab's irrigation sector built on four pillars: asset development and management; water resource management (including investments in capacity building, knowledge generation and management, and pilot projects for groundwater management); reform of irrigation service delivery; and enhanced on-farm services to increase water productivity. The policy framework could include a medium-term (ten-year) vision of how Punjab wishes to change its management of water resources and irrigation services, including broad outcomes and targets and

short-term targets, of what can be achieved immediately in terms of policy and institutional reforms.

Punjab Municipal Services Improvement Loan (US$65 million) This loan is designed to improve efficiency, coverage, and quality of basic infrastructure/services through: developing an efficient mechanism for allocating public resources for infrastructure; building capacity of government to manage local government performance improvement and of city districts/TMAs for improved urban management, governance, and delivery of urban services; and providing performance-related matching grants for infrastructure repair/renewal. It is likely that water and sewerage services would be part of this.

Sindh Water/Irrigation Sector Improvement Program (US$140 million) The project would improve water productivity through a reform agenda/investments leading to a better management system that would link canal command areas, the distributary, and the watercourse level. Components include: capacity building; civil works; agriculture and irrigation technology; and management and administration.

NWFP—Irrigation Sector Improvement Program (US$70 million) The project would have similar objectives and similar components to the Sindh project described above.

Private Power (Bank Group) Investment (total US$200 million) In view of the projected shortfall in generating capacity (from about 2007–08), there is an urgent need to elicit private sector resources for new/greenfield generation projects. The Bank, jointly with IFC and/or MIGA, would support government efforts to attract private investments for such projects, including potentially both run-of-the-river and multipurpose hydropower projects.

Punjab Water Infrastructure Investment (US$150 million) Several barrages in Punjab require rehabilitation and modernization to address problems arising from deficiencies which could lead to progressive structural failure and serious economic consequences. Besides physical rehabilitation, improvements, and modernization, the project will also support institutional and organizational restructuring and capacity building, and improved O&M regimes.

Balochistan Small-scale Irrigation (US$40 million) The project would develop water resources through restoring and increasing water storage; increasing productivity of water through more efficient use; and developing capacity to formulate a water resources development plan using surface water, groundwater, and watershed management. Components include: water management (with a special emphasis on groundwater); infrastructure for restoring the hydrological balance of Band Khushdil Khan; construction of delay action dams and selected small-scale irrigation projects; on-farm water management; modernization of irrigation systems and subsidies for efficient on-farm irrigation systems and modern irrigation technologies; and institutional development—among farmers, water users, and different levels of the government.

Punjab Water Sector Irrigation Investment (US$100 million) The project would support institutional reforms in water resource management and delivery of irrigation services in specific canal commands of Punjab through an 'incentive-based approach'. Farmers and farmer organizations will play a major role, and would compete for a set of 'rewards' for meeting specified 'entry conditions'. The 'entry conditions' would relate to items like formation of farmer organizations, commitment to implementing water entitlements, provider/ user contracts, and water measurement and monitoring. The 'rewards' would be investments in capacity building, canal modernization, measurement devices, and on-farm services, and possibly an option in which the farmers could choose 'professional management'.

A Federal Water Resources Capacity Building Loan (US$40 million) This project would develop the capacity of the federal government (including the proposed National Water Council and its Secretariat, IRSA, Planning Commission's Water Resources Section, and WAPDA water wing) to become a more effective custodian of the nation's water resources. It will include major investments in knowledge management (including modernization of measuring equipment, decision support systems, and priority applied research); it will include training of a new generation of multi-disciplinary water resources specialists; and will include stimulation of centers of excellence for water resources sciences.

Analytic and Advisory Services

As described throughout this Report, Pakistan is going to have to invest heavily in the generation and management of knowledge. Pakistan looks to the Bank as a major partner for providing global knowledge on modern water development and management. In the past, the Bank has provided such services out of its own resources and by making use of a variety of global trust funds. Given the need to intensify such analytic and advisory services, the Bank is developing, with partial support from the Government of the Netherlands, a multi-year program which would enable the provision of a greatly increased set of advisory, knowledge, and capacity building services to both the federal and provincial governments.

In the important urban water and sanitation sector, the Bank Group has recently become involved in an advisory capacity in Punjab. The International Finance Corporation (IFC) is providing advisory services for Lahore, while the Bank is helping to investigate contractual incentives, financing mechanisms, pricing, regulatory mechanisms, and building capacity to improve urban water and sanitation services in other towns.

The Bank has not been involved in rural water supply and sanitation for some time, and thus has limited knowledge of the sector. Given the importance of this sector for the welfare of the underprivileged, the Bank needs to re-engage. A first step would be a review of the status of the sector and key policies, with a particular focus on the project initiation and design mechanisms, the supply chain, cost recovery, and operations and maintenance arrangements. A major challenge is likely to be the evolution of infrastructure-driven Public Health Engineering Departments.

Evolving Priorities and the Indicative Bank Water Investment Program

The Country Assistance Strategy is not a document which is set in stone, but rather a living document (with an associated set of lending and non-lending activities) which evolves as conditions and knowledge change. The intensive work and discussions which were part of producing this document have, predictably and appropriately, changed perceptions both in Pakistan and the Bank, and brought to the fore several hitherto relatively neglected priorities. In particular, there are two areas that are likely to gain greater prominence than they have in the current indicative CAS plan.

The first of these is urban water supply and sanitation. Pakistan is urbanizing and industrializing rapidly. While irrigation will remain by far the largest user of water, in the future water development and management in Pakistan will no longer be synonymous with irrigation and drainage. There are several dimensions to this shift: more and more water will need to be reallocated from agricultural to urban uses; much greater investments will need to be made in collecting and treating urban and industrial wastes; and major changes will need to be made in the way in which urban services are financed and delivered so that coverage and service quality are improved. To a substantial degree the long history of Bank engagement with water through the irrigation sector in Pakistan has meant that the Bank's view, and the Bank's water-related investments (as shown in fig. 6.4), have not adequately reflected the need for similarly intense attention to municipal and industrial water and wastewater. The discussions stimulated by this Report concluded that this is indeed an area where Pakistan's needs are large and growing, and where the Bank needs to become more engaged. The Bank will do this by initiating detailed analytic work on the area. It is likely that a product of this work will be a program of Bank investments in municipal and industrial water and wastewater which is more substantial than that reflected in this Report.

The second area of relative Bank neglect that emerged during discussions on this Report is that of hydropower. Again, in part stimulated by the discussions around this Report, the Bank will start a process of more specific assessment of the role of hydropower (micro, mini, and large, both through run-of-the-river and storage projects) and the potential for greater Bank involvement.