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Iraq
Country Water Resource Assistance Strategy

Addressing Major Threats to People's Livelihoods

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Iraq: Country Water Resource Assistance Strategy: Addressing Major Threats to People's Livelihoods

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Acronyms and Abbreviations

AAA	Analytical and Advisory Activities
BCM	Billion Cubic Meters
CWRAS	Country Water Resources Assistance Strategy
ECIRP	Emergency Community Infrastructure Rehabilitation Project
FAO	Food Agriculture Organization
GDP	Gross Domestic Product
GEF	Global Environment Facility
ICID	International Commission on Irrigation and Drainage
IDA	International Development Association
IDBIRP	Irrigation and Drainage Basic Infrastructure Rehabilitation Project
IFARPID	Iraq Framework for Agricultural and Rural Policy and Institutional Development
INPIM	International Participatory Irrigation Network
IPTRID	International Program for Research in Irrigation and Drainage
IRMO	Iraq Reconstruction Management Office
ITF	Iraq Trust Fund
IWMI	Irrigation Water Management Institute
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
KM	Kilometer
KRG	Kurdistan Regional Government
MENA	Middle East and North Africa
MMPW	Ministry of Municipalities and Public Works
MoA	Ministry of Agriculture
MoEN	Ministry of Environment
MoF	Ministry of Finance
MoH	Ministry of Health
MoPDC	Ministry of Planning and Development Cooperation
MoWR	Ministry of Water Resources
MW	Megawatts
NDS	National Development Strategy
NGO	Non Governmental Organization
PMT	Project Management Team
PCO	Project and Contracting Office
PDS	Public Distribution System
TDS	Total dissolved solids
UN	United Nations
UNDG	United Nations Development Group
UNESCO	United Nations Educational, Scientific and Cultural Organization
USACE	United States Army Corps of Engineers
USAID	United States Agency for International Development
WB	World Bank
WHO	World Health Organization

Executive Summary

Overview

Objectives. This country water resources assistance strategy (CWRAS) has three objectives:

- First, provide an overview of the past and current status of water resources management and development practices in Iraq, and identify the challenges in managing the demands on these resources.
- Second, help the Bank and other donors prioritize among the various investment and technical assistance programs requested by the Government of Iraq, which is facing the enormous challenge of rehabilitating a substantial, but rapidly deteriorating, hydraulic infrastructure.
- Third, advise Iraq on how to balance its efforts between the needs of short-term rehabilitation/reconstruction and those of longer-term infrastructure and institutional development, using economic criteria.

Recommendations. This report addresses these objectives in two parts. The first part, which is largely descriptive, reviews existing conditions and summarizes Iraq's considerable accomplishments over the past decades in developing and managing water resources. The second part investigates challenges and priorities—how to balance the needs of short-term reconstruction and the long-term infrastructure and institutional development requirements. Overall, the report recommends interim donor assistance to the Government of Iraq through support for a combination of policy work, technical assistance, and priority investments, as follows:

- Through a series of targeted Analytical and Advisory Activities (AAA), evaluate the demand and supply for water and recommend policy instruments for the interim. Notable determinants of demand are agricultural and food policies, energy policies, water-pricing policies, and water rights regimes; less obvious are the demands for sustainable environmental flows for marshland integrity.
- Provide a technical assistance program for capacity building within the water sector, targeted at international, national, sub-national, and community levels. Given that much of Iraq's renewable waters come from transboundary sources, this technical assistance program would initiate knowledge sharing and begin to build trust among the riparians. International good practices also suggest that water be managed at the lowest appropriate level, thus including provincial and community levels. This technical assistance will help the government in piloting mechanisms by which water supply and irrigation service providers are made accountable to users of those services. In the longer term, this would be scaled up to introduce procedures that involve communities in decision-making at different stages of the project and policy cycle.
- Using an output-based approach, target investments in priority rehabilitation and modernization to achieve vivid and immediate improvements in dam safety, in the irrigation and drainage network, and in urban water supply and sewerage. For instance, decisions on investing in rehabilitation/modernization of water distribution infrastructure should be contingent upon an assurance to achieve tangible and immediate results of water security and employment creation. Similarly, decisions on investing in wastewater infrastructure should be contingent upon an assurance to achieve measured water quality improvements.

The challenge of water in Iraq's reconstruction

Historic context. Historically, water development in Iraq has been driven more by hydraulic engineering than by the economics of water use. Iraq's centralized, control-oriented institutional arrangements have resulted in weak accountability to users, and a dependency on government financing with limited attention to service standards, thus weakening infrastructure and contributing to widespread poverty. Further, the prolonged neglect of regional diplomacy on water has made Iraq's transboundary water resources very vulnerable. Iraq's water resources and services are in crisis, with dramatic effect on the incomes and health status of the people. The impulse during such a human and economic crisis is to invest in infrastructure, given the degraded nature of Iraq's water assets. However, the global experience with post-conflict situations shows that such crisis provide opportunities to innovate on policies and institutions in a way that is conducive to long-run sustainability.

Strategic Vision. The *National Water Master Plan*—an update to *Iraq's Strategic Vision for Management of Iraq's Water Resources*, currently under preparation by the Ministry of Water and supported by USAID—will identify the baseline information on the physical nature of Iraq's hydrologic and hydraulic system and provide recommendations. In the interim, this report recommends priorities for donor engagement. The report, together with active consultation with the Ministry of Water Resources, will serve as a basis of discussion with the donor community for continued support to the Government of Iraq.

Institutional priorities

Centralized control. Currently, there are opportunities to realign the water sector's institutional and operational framework. The government, with donor support, needs to make immediate efforts to improve governance and the demand management agenda. The laws that govern water echo the centralized nature of Iraq's water administration. Water planning and allocation decisions are managed from the center, with very limited cooperation among the various delivery agencies, and with virtually no user involvement. Similar to the conditions of an oil-driven economy, trunk-water assets in a hydraulic economy such as Iraq's require some degree of centralized management, e.g., of large dams and main water conveyance systems.

Integrate and decentralize. However, the future institutional structure of the water sector affords opportunities for an integrated yet decentralized decision-making process insofar as it pertains to:

- Developing an integrated approach to water, with inter-ministerial coordination in planning and investment decisions;
- Introducing procedures for providing water services based on user demand, leading to more financially autonomous service providers in both irrigation and water supply and sanitation; and
- Managing water resources and water service functions at the lowest appropriate level, be it a region, province, river basin, municipality, or community/water user association (whichever is relevant for a particular function).

Managing at the basin level. With donor support, it is incumbent upon the Government of Iraq to balance international, national and sub-national interests in water. The government should manage water within the context of a river basin's hydrological boundaries, as opposed to

political boundaries, and through institutions that reflect stakeholder interests. Various institutional options have been adopted in different parts of the world, involving the creation of water-specific inter-ministerial organizations, basin agencies, and water-user associations. With donor support the government should evaluate these options and select the model that best suits Iraq's sociopolitical context.

Balancing supply and demand. In the medium term, the government also needs to adopt an integrated approach to balance supply and demand considerations for water. On the demand side, the most important determinant of water demand has been the expansion of irrigated agriculture, and a comparatively smaller determinant, though a priority, has been the demand for water supply and sanitation. In addition, a neglected but equally important aspect is environmental demand, required for periodic inundation to sustain the marshland ecosystem. On the supply side, the key concerns are the increasing abstractions by upstream riparians and the high supply losses. Currently there is too little water serving too many competing demands. Costs are also rising, and temporal, spatial, and/or sectoral shortages could occur in different parts of the country. Early action is required to manage both demand and supply in order to ward off a water resources crisis in the medium term.

A number of actions can be taken. On the demand side: incentive-based instruments should consider the use of water pricing, tradable water rights, design of positive and negative incentives through governmental water financing policies, and policies outside the water sector (agricultural policies, macroeconomic policies on agricultural trade and food security). On the supply side, the first set of priorities is to improve the security and efficiency of the current supply system for both irrigation and water supply, and operationalize its capability for inter-basin water transfer from the Tigris to the Euphrates. Technical measures include improvements in on-farm water management practices, changes to less water intensive cropping patterns, increases in cropping intensity, and improvements in farming practices such as fertilizer use or choice of varieties to increase productivity per unit of water. At the transboundary level, technical, economic, and diplomatic initiatives would improve the value of water flows to Iraq. The USAID-supported *National Water Master Plan* will provide the elements for an integrated water plan balancing future supply and demand and will set out a range of policy, institutional and investment options on both the supply and the demand side.

Consequences of no action. Failure to assess the supply and demand trade-offs will have negative implications. This includes impacts on water quality, land salinity, and the marshlands. In addition to the decrease in quantity of water resources available to Iraq, water quality is also deteriorating rapidly, affected by return flows from irrigation projects upstream in Turkey and Syria and from within Iraq. Salinity increases seriously downstream the rivers during summer, particularly in the Euphrates, where water becomes no longer usable for cropping. Water quality is further degraded by discharging untreated sewage into the rivers, reported to be one million tons a day. The concentration of pollutants far exceeds national and international standards. Declining water quality has had deleterious impacts on Iraq's farmlands and agricultural productivity. As for the Mesopotamian marshland, for over 5,000 years the Marsh Arabs resided in these wetlands, which are important economically and ecologically and are of global environmental significance. In the past, the marshes absorbed up to 16 BCM per year of water but over the last thirty years about 90 percent of the marsh area has dried up due essentially to three factors: reduction in river flows caused by increased upstream diversion, the change in the river regime from a periodic flood regime to a managed flow regime, and drainage works undertaken by the government in the early 1990s. The conservation/restoration possibilities depend primarily on water availability, and restoration would need to proceed systematically. In

addition to the marshlands, the in-stream environmental flows required to maintain existing habitats is estimated at 3 BCM per year.

Recommendations for institutional strengthening. In review of the aforementioned challenges and priorities, the World Bank recommends that donors assist the Government of Iraq specifically in the following activities for capacity building and institutional strengthening:

- Finance the second phase of the National Water Master Plan (for which the first phase, nearing completion, is financed by USAID).
- As the preparation of the National Water Master Plan progresses, build on the institutional recommendations outlined in the Plan, as they pertain to piloting priority activities, including the piloting needed for managing water resources/services at the lowest level.
- Prepare an analytical economic assessment of the water sector that covers supply and demand issues for agriculture, energy, and municipal services, and provides policy recommendations.
- Conduct appropriate training to build capacity to support an integrated approach to water at the national inter-ministerial level, including inter-ministerial coordination in investment planning and budgeting; and build decentralized capacity to provide equivalent support at the provincial and community levels (government request).

Transboundary concerns and investing in international cooperation

Basin characteristics. Over fifty percent of the flows in the Tigris and Euphrates Rivers originate in the upstream riparians. The quantity of Euphrates water flowing into Iraq is decreasing. The primary cause is Turkey's massive GAP project, still under development. In addition, Syria is planning further large-scale water infrastructure development. These projects will likely reduce Iraq's share of the Euphrates from the present 19-21 BCM on average per year to approximately 9 BCM per year – and less in a drought year. Falling water levels will affect hydropower generation. Water available for irrigated agriculture will diminish, particularly in the more fertile Euphrates valley, and degradation of agricultural land due to salinization could increase. In addition, the ecological balance in the Euphrates basin will be further disturbed, and water quality will deteriorate even further.

Promoting transboundary cooperation. Decreasing water flows in the two river basins will have a significant impact on water resources and subsequently on people and the economy. Currently, there is no overall agreement binding the three riparians. The Government of Iraq needs to assess the political economy and possible institutional mechanisms in order to develop a strategy for transboundary cooperation. A Joint Technical Committee that previously existed should be reconvened or, if there is no agreement to set up a formal process, lower-key alternatives can be pursued, such as simply sharing data or setting up a joint research institution to build confidence between riparians. This may be a first step towards integrated basin planning so that investment and management can be progressively optimized to take into account basin-wide externalities. Reaching agreement over water will reduce risk and encourage economically optimal investment for all riparians.

Recommendations for transboundary cooperation. In securing water resources from upstream riparians, this report recommends, as a priority activity:

- That donors support the riparian governments in taking initial efforts toward engaging all riparians to design and implement a technical data exchange program.

Rehabilitation priorities

Criteria for rehabilitation. In this immediate emergency phase, the government should consider two factors for infrastructure rehabilitation: 1) priorities need to be based on cost effectiveness criteria, for example, cost per unit volume of water saved, or cost per hectare of land irrigated or drained; and 2) investments made today should not prejudice possible future decisions on supply or use. As such, any rehabilitation decisions should be based on the preliminary findings of the National Water Master Plan.

Priority rehabilitation. This immediate phase provides an opportunity for change and for defining and testing new institutional approaches, such as employing labor-intensive approaches where possible (to generate local employment), or by consulting users on the priorities for rehabilitation (to foster accountability). In terms of priority rehabilitation, the focus is on dam safety, hydropower and flood control. Iraq's seventeen large dams and barrages are its most precious hydraulic asset. Many years of inadequate financing have left them poorly performing and possibly dangerous. Many large dams need rehabilitation, and six are reported to be in critical condition. Given the strategic importance of water storage for Iraq's economy, the donor community should proactively support the rehabilitation of such assets at risk.

Hydropower. Output of hydropower has been low in recent years, often at 30-50 percent of the full capacity. Physical installations are in poor condition and there is a growing problem of inadequate water flow. Hydropower releases need also to be optimized with other economic and environmental uses. Installed capacity is about 2,400 MW, equivalent to 17 percent of national installed electricity generation capacity. However, current generation is well below capacity; in December 2005, MoWR reported a "major power generation crisis," with output fluctuating between 700 MW and 1200 MW. For the future, new hydropower capacity is planned that would double hydropower output, although contribution to overall power needs would remain relatively small, under one fifth, in the face of rapidly rising demand. The ongoing preparation of the USAID-supported Master Plan will help Iraq to prioritize its water flow management by sector and lay the basis for decisions on whether further hydropower investment is a priority at this stage.

Water supply and sanitation. Iraq's National Development Strategy places water supply & sanitation (WS&S) at the top of the government's priorities, starting with rehabilitation or reconstruction of WS&S facilities, and government has drawn up an emergency investment program for the coming ten years. The recent pattern of underinvestment and poor management is being reversed through a program targeted at key bottlenecks in WS&S while also planning for a decentralized, demand responsive and financially self-sustaining utility approach in the future. In terms of WS&S, the key challenges include tackling the dramatic drop in coverage and service standards in WS&S and the consequent decline in living standards and health status; these are the focus of the World Bank supported *National Water Supply and Wastewater Sector Study*. One of the challenges will be how best to protect low income water users in rural and urban areas, while enabling the water utilities to transform themselves into commercially viable enterprises. In the long term, the sector needs to adjust the legal framework to facilitate private sector participation in WS&S.

Flood control. As for flood control, despite Iraq's extensive hydraulic network, flood risks remain substantial due to lack of flood control in the Great Zab River, and lack of appropriate modeling and forecasting tools.

Recommendations for infrastructure rehabilitation. In review of the challenges and priorities, this report recommends World Bank and donor interim assistance in the following priority activities for infrastructure rehabilitation:

- Support basic rehabilitation of critical water resources infrastructure, specifically priority dams at risk and dilapidated irrigation and drainage networks, based on the findings from existing government and USAID-supported assessments.
- Support reconstruction of municipal facilities and restoration of service levels, based on the findings from the World Bank supported National WS&S sector study currently under preparation.

Modernization priorities

Status of the agriculture sector. Iraq has developed much of its irrigation potential, over 3 million hectares of agricultural land that contribute 10 percent to overal GDP, and 35 percent of Iraq's non-oil GDP. Irrigated agriculture is the largest consumer of water but it is used rather inefficiently. Irrigation technologies, from pumping stations to tertiary canal networks, are degraded due to lack of maintenance, while drainage networks have contributed to soil salinization and water logging. Due to the government's interventionist agricultural policies since the 1980s, economically agricultural outputs have not been commensurate with investments.

Challenges in the agricultural sector. In terms of irrigated agriculture, the key challenge includes modernizing the agricultural sector. As the government moves towards a market-oriented economy, the World Bank supported Agriculture Sector Capacity Building Project will address institutional strengthening while priority investments are needed to modernize the agricultural sector. The rehabilitation of existing systems is systematically underway by the government; however, targeted investments for efficient water saving agricultural practices are necessary. Investments piloted at targeted sub-national levels will later extend to priority regions, conducive to a growing market economy.

Recommendations for modernization. In review of the challenges and priorities for modernizing irrigated agriculture, this report recommends:

- World Bank and donor interim assistance to Iraq to invest in economically-viable modernization of off-farm and on-farm systems, at targeted provincial sites agreed-upon with MoWR and Ministry of Agriculture.

Expected outcomes from donor support

Through targeted priority investments in institutional capacity building and physical infrastructure, the World Bank and the donor community could provide support to enable the government at the national and sub-national levels, together with pertinent stakeholders, to increasingly take responsibility for planning and managing water resources. An inclusive decision-making process, based on the principles of decentralization, stakeholder participation, demand management, and environmental sustainability, will be progressively realized through a

strengthened governance structure at the most appropriate level: from(1) the community and provincial levels, by engaging all stakeholders affected by management decisions, to (2) the international level, by ensuring that riparian cooperation on both the Euphrates and the Tigris facilitates the mutual interest of all riparians.

Chapter 1: Conditions contributing to the challenges in the water sector

1.1 Historic and economic context

Historic development of Iraqi water resources. Historically, water has played a vital role in the life of Iraq. Irrigation in the country dates back to 5500 BC; one of the earliest human civilization in Mesopotamia depended on irrigated agriculture. The Tigris and Euphrates rivers caused havoc through periodic flooding but receding water left back fertile alluvial sediments, creating a vast and rich agricultural plain. In the modern era, water development began in the late Ottoman period late 16th century. Successive governments have progressively invested national oil wealth in a vast and complex water infrastructure and services designed to control the floods, generate hydropower, develop a modern intensive irrigated agriculture and bring water supply and sanitation to the Iraqi people.

Economic benefits of water development in Iraq. These ambitious water-related developments have harnessed much of Iraq's water resources, contributing significantly to the economy, including generating a fifth of electric power and irrigating over 3 million hectares of agricultural land, which contribute 10 percent to the GDP, thus constituting 35 percent of Iraq's non-oil GDP. A rural population of about 8 million depends on irrigated agriculture. In the 1980s, Iraq's agriculture contributed about 20 percent to the national employment; the level of water supply and sanitation services of Iraq was amongst the best in the region; and reducing flood risk has saved urban and rural communities from the ravages of frequent inundations.

1.2 Recent deterioration in Iraq's water sector

These benefits have, however, come with costs. The benefits of permanent irrigated agriculture however have had environmental costs: waterlogging, land salinization, and decreasing water quality. The benefits of flood control have degraded the wetland environment dependant on periodic floods. Some costs are the result of contingent policy choices. Water development driven by hydraulic engineering rather than by the political economy created a disconnect in water services and an increase in risks. Farmers, for example, hardly appear better-off despite massive investments in water infrastructure. Institutions managing water services in Iraq are characterized by weak accountability, centralized policy, and limited commitment to service standards. Moreover, neglecting the regional water-diplomacy has significantly increased the risks posed by Iraq's dependence on transboundary resources.

Iraq has also witnessed a disastrous decade in water, as in every other aspect of its national life. Political, military, and economic events have undermined the progress previously achieved, weakening the infrastructure and causing widespread poverty. Iraq's water sector and the services derived from it are in crisis. The water resource management capacity is severely impaired. The water flows in rivers at the frontier have reduced. The in-country supply losses are now less than half. The quality of water has been deteriorating, contaminated by saline return

flows and sewage. Hydropower generation is often as low as one-third the capacity. About 40 percent of the traditionally irrigated area is out of production, three quarters of lands are degraded by salt, and yields and production are at levels below those in 1960s. Water supply and sanitation coverage has dropped by a third, potable water quality is execrable and supply is highly intermittent. Some 70 percent of sewage is untreated, and one million tons of raw sewage is discharged to rivers daily. The marshlands at the confluence of the Tigris and the Euphrates, famed as the cradle of civilization and unique ecology, is a vestige of its former glory.

Human development has suffered. Almost all human development indicators in Iraq have deteriorated markedly over the past decade, including poverty, health standards, life expectancy and literacy. Income per capita of US$940 in 2004 was a quarter of what Iraqis enjoyed 25 years ago. Poverty has worsened and unemployment is estimated to be at least 30 percent. The water crisis is accentuating the burden on incomes, living standards and health status of the Iraqi people. The hydropower gap contributes to the overall shortfall in electricity. Erratic irrigation services and increasing waterlogging and salinization affect crops and aggravate the poverty of farm households. Rural employment has plummeted and 30 percent of farmers are reported to have abandoned farming. Only 20 percent of Iraqi households currently have access to safe drinking water. The health problems from poor water quality overburden the already stressed health system.

1.3 Addressing the challenges

The CWRAS strategic approach. This report devotes as much attention to questions of institutions and hydro-political policies as it does to infrastructure and physical investment. The chapters review the status of water resources, identify the challenges and priorities, and explore the strategic options within the water sector. The CWRAS provides an interim measure of priority actions and intends to benefit from the findings and outputs from the National Water Master Plan as part of an updating process of the *Strategic Vision for Management of Iraq's Water Resources* (detailed in Chapter 2, Box 2.1). As such, strategic options, for the interim, are defined within the immediate reconstruction needs focusing on targeted institutional needs, transboundary cooperation for water security, and infrastructure rehabilitation. As Iraq's reconstruction progresses, development scenarios are outlined for longer-term, which can be adapted as information becomes available and circumstances change.

The CWRAS approach identifies strategic priority investments. Based on a series of background reports prepared for this report, the CWRAS defines the existing conditions and identify the challenges; the technical information and analysis of the challenges are detailed in a series of annexes. Specifically, Chapter 2 provides an overview of current institutional arrangements with sectoral institutional issues, while also exploring the institutional and policy issues of transboundary water resources and international cooperation. Chapter 3 summarizes Iraq's water resource endowment in terms of the natural resource and of the existing hydraulic network for harnessing the resource. Chapter 4 reviews the complex issues and the trade-offs for managing flood control, generating hydropower and sustaining the environment. Chapter 5 reviews the status in the irrigated agriculture sector. Chapter 6 focuses on the water supply and sanitation sector. Chapter 7 summarizes the challenges and priorities within the water sector; while Chapter 8 defines the development agenda for the sector, reviews government policy, and recommends scenarios for strategic donor assistance.

Chapter 2: Water resource institutions

2.1 Institutional framework for water resources management

Iraq's water administration is heavily centralized, oriented towards excessive control while neglecting service. Centralized institutions have a historical background. Land reform from the 1950s to the 1970s replaced private property owners with small landholders lacking skills, capital and institutions for irrigated agriculture, dependent on government support. Massive state investment for large storage and irrigation works in the 1970s and 1980s resulted in government control of water services, including water allocation and distribution. The centralized control was politically attractive to the ruling party, with farmer cooperatives functioning more as the lowest-rung of the party than as farmer representatives.

This centralized governance system is reflected in the laws currently governing water. There are centralized laws and regulations on various aspects of water resources. For example, in the case of irrigated agriculture, the law obligates all farmers benefiting from the irrigation schemes (developed by the state) to comply with the agricultural program set by government. They must pay fees - and penalties for infractions - but do no have much rights accorded to them by law. Ministry "surveillance staff" and cooperatives "oversee" water management. Efforts are needed, as part of sectoral coordination, to modernize the laws governing water resources.

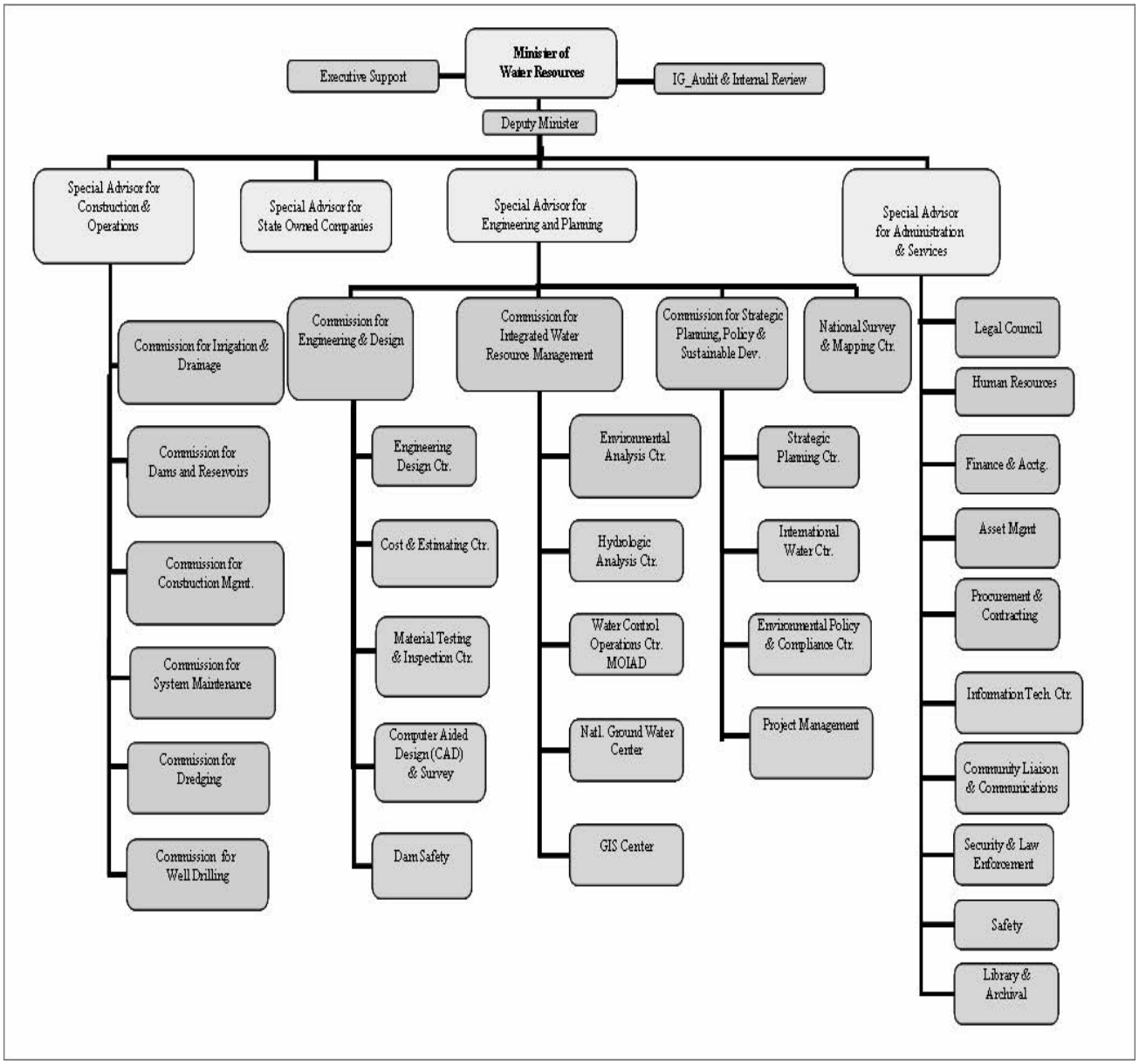
In the new Government of Iraq, the Ministry of Water Resources (MoWR) is responsible for water management. The MoWR is a successor to the former Ministry of Irrigation. The MoWR is organized into a series of functional "Commissions", directorates and centers (see an indicative organigram in Figure 2.1). The responsibilities of MoWR include water planning, water allocation, the construction, operation and maintenance of facilities for bulk water supply, flood prediction and mitigation. MoWR operates dams, reservoirs, hydropower stations, irrigation and drainage pumping stations, barrages and regulators. MoWR has about 12,000 staff, and is making an effort to enhance its capacity. One hundred buildings of the Ministry have been rehabilitated, a computer network links the staff, and training facilities constructed at Suleimania and Baghdad. In addition to the operations, MoWR is currently managing about 500 new investment projects and several major studies. USACE is assisting MoWR at capacity building under a UNESCO sponsored training program. The dominant theme of the training is to strengthen capacity for integrated approaches to water resources management. The components are:

- technical capacity building in water resources assessment;
- building managerial capacity to help formulate the national water master plan;
- the establishing of a new training center in Basra;
- piloting research projects and studies on integrated approaches; and
- initiating a transboundary water resources management program.

Groundwater administration. The National Groundwater Centre, which is a part of the Commission for Integrated Water Resources Management, is responsible for quantitative and qualitative groundwater resources assessment and for developing the hydrogeological database.

MoWR has divided Iraq into ten groundwater zones, and is carrying out hydrogeological surveys for each of them. In the desert blocks, surveys have been largely completed, concluding that more wells could be sunk in specific aquifers. For example, 900 additional wells could be sunk in Wadi Batin. There was no information, at the time this report was prepared, on groundwater administration procedures (e.g., registry, issuance of drilling permits, monitoring through observation wells, well census, transferable rights, water sales, etc).

Figure 2.1 Indicative organigram of the MoWR

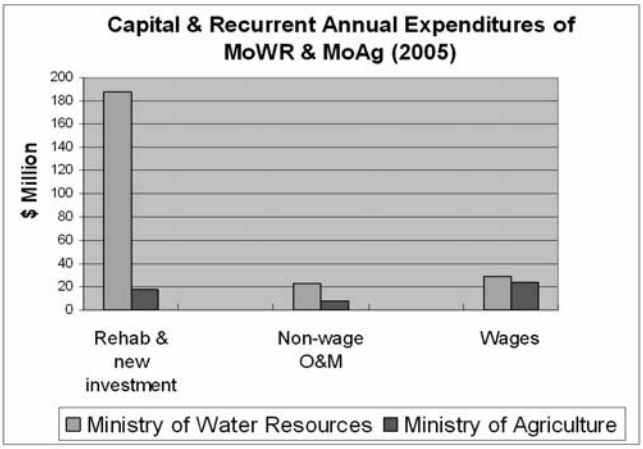


Sector development and management show weak cooperation between agencies and virtually no user involvement. Cooperation is weak between MoWR as the supplier and the user agencies, such as Ministry of Agriculture, Ministry of Electricity, Ministry of Municipalities and Public Works, and the Ministry of Environment. A number of integrated projects in the 1970s and 1980s combined water management and crop production services, but the typical

relationship was that of MoWR as the senior partner to MoA. The same pattern is observed in other major irrigation dependent countries in the region, such as Iran and Egypt. The size of MoWR's budget, which is ten times that of MoA, underlines the relative status of these two agencies. An equally vital aspect of user involvement for sector governance, the situation is probably much worse. With a management approach driven by supply consideration, there has been no serious attempt to establish accountable, decentralized water institutions or counterpart user organizations empowered by responsibilities and rights.

MoWR's budget allocation is predominantly for capital expenditure and financing for operation and maintenance is limited. MoWR's budget for 2005 was $225 million, about half-percent of its GDP (adjacent Figure 2.2)[1]. The budget allocation demonstrates a major emphasis (80 percent) on investments for rehabilitation and new structures (80 percent), with only 10 percent of the budget allocated to wages and another 10 percent to operation and maintenance. In fact, the operation and maintenance expenditures, including wages, amount to about $13/ha, which is low by the standards of systems of comparable management complexity.

Figure 2.2 Public expenditure in water resources and agriculture



The MoWR manages water planning, coordination, and allocation. Currently there are a number of problems with coordination in the various water sectors with respect to water quantity, timing of release and quality. The Commission for Integrated Water Resources Management functions under MoWR, bringing together expertise from hydrology, hydrogeology and environment departments. Within the Commission, the Water Control Operations Centre is responsible for monitoring the daily discharge volumes in the river system and for programming the operation of dams, reservoirs, barrages and regulators. The programming is coordinated with the Electric Power Administration responsible for hydropower generation, and with the Dams and Reservoirs Operations Commission under MoWR responsible for the operation and maintenance of bulk water delivery facilities. USACE and UNESCO are concentrating at capacity building particularly to address collaboration and coordination. The USAID-supported National Water Master Plan, to update the *Strategic Vision* now underway will provide an objective basis for assessing capability and define multi-sectoral coordination requirements. With US support and financing, MoWR is launching a five-year phased study process to develop a National Water Master Plan to update the, *Strategic Vision for Management of Iraq's Water Resources* (Box 2.1). The process will:

- Inventory and document available water resources;
- Identify current needs and forecast future needs;
- Update the current water plan and develop an implementation strategy.

[1] Analyzing the expenditures of the water supply and sanitation sub-sector requires further data.

The preparation of the master plan was tendered in 2005 and started in 2006. A first phase (over 18 months) will complete the water resources assessment, evaluate flood risk, and develop models and options for policies, programs and projects. The first phase will produce "sector concept plans" for water supply and sanitation, hydropower, irrigation and drainage, environment and flood control, and then reconcile sector needs with coordinated, basin-wide, multi-purpose concept plans. A second phase, expected to take an additional three years, would prepare the selected options for implementation. The study proposal provides for an integrated approach, coordinated with national institutions, and with the prospect of preparing the ground for data exchange and possibly even joint analysis with upstream riparians (Turkey, Syria and Iran).

Box 2.1 Strategic Vision for Management of Iraq's Water Resources

The National Water Master Plan, supported and financed by the US, is assisting MoWR in a five-year study process to develop a national water plan, updating the *Strategic Vision for Management of Iraq's Water Resources*. The process will: inventory and document available water resources, identify current needs and forecast future needs, and update the current water plan and develop an implementation strategy.

Began in 2005, the first 18-month phase, with information and data input from all ministries affected by the water sector, will define the baseline conditions of Iraq's hydrologic network. The rivers and aquifers of Iraq supply water for irrigated agriculture, for hydroelectric power, for domestic and industrial use, and for environmental needs. The rivers also provide transport lanes for the movement of bulk cargoes across the country. But the varying flow from year to year, and within each year, complicates water management and Iraq has taken action over the years to build a substantial water infrastructure, including dams, barrages and canals, to enable a better management of water distribution. Much of the current water infrastructure construction was based on the findings and recommendations of a comprehensive water planning study the *Strategic Vision for Management of Iraq's Water Resources* that was completed MoWR in the early 1980's. With advances of technology, and changes in the economic and social environment that have taken place since the *Strategic Vision* was published, Iraq now needs to update this strategy to provide guidance on priorities for new investment taking into account the current hydrology of the rivers, the new economic situation of agriculture, and population movements.

With support from the US government, MoWR has already launched a first phase of this update covering the assembly of all critical water related information into an electronic database that can be shared by the different government agencies involved and making a start on an assessment of future needs. This first phase is expected to be completed by the end of 2006. A second phase, involving analysis, assessment, and recommendations must now follow when financing for it can be obtained. This second phase will take 2-3 years. It will provide Iraq with an investment road map for the future, and water management tools to optimize current water use.

Source: World Bank consultant & USAID.

Developments on both the supply and demand side make it imperative to analyse Iraq's water resources position afresh and to prepare a new water resources plan. The basis for water planning and development for the last twenty years has been an exhaustive study of water resources and land development published in 1982, which proposed a development plan for water for the period 1975-1995. This substantial study[2] conducted by government has driven policy, investment and water management for two decades. Now many of the premises of the plan have changed. While only some of the proposed investments have been completed, the water resources availability and quality have deteriorated, the agricultural economy has suffered a

2 USSR V/O Selkhozpromexport. 1982. General Scheme of Water Resources and Land Development in Iraq. Ministry of Irrigation, Baghdad.

downturn, and the challenges of both irrigation and water supply and sanitation are less in expansion than in restoring service levels and improving quality under a new economic and governance framework.

2.2 Institutional framework for managing agriculture and irrigation

Agricultural institutions. Until the time of the 1958 revolution, the role of government in Iraqi agriculture was limited to building some water control structures on the major rivers. Water conveyance and all on-farm irrigated agricultural production was a private enterprise. Following the revolution, successive land reforms brought the government closely into the organization of the rural economy and society, and the resources from oil enabled the state to become a major investor in the provision of both water and agricultural services. The role of the state was expanded for the political expediency of centralized control, which continued to increase over the years. Thus, by the new millennium, Iraqi government was controlling and directing the agricultural production. The Ministry of Agriculture (MoA) was responsible for assigning cropping patterns to the farmers to produce "strategic crops", for distributing input rations at subsidized prices, and for marketing outputs at controlled prices. The MoA exercised control through Agricultural Directorates in each province. In addition, there were 12 state boards and companies for various purposes that worked under MoA.

The tasks of the MOA include:

- Manage land tenure, especially lease contracts, which govern tenure of lands redistributed under land reform;
- Secure production contracts with farmers, which specify what is to be grown, the related entitlements to subsidized inputs and output prices to be received from the state marketing monopolies;
- Market inputs and outputs, including the provision of agriculture inputs to all farmers and organizing the purchase of outputs by the state monopolies; and
- Distribute subsidized equipment such as tractors and water saving equipment.

At the local level, the various rules and regulations on irrigation and agriculture were determined and supervised by the local Agricultural Committee comprising of relevant government officers in the sub-district. This committee included representatives of both MoWR and MoA. The committee included the local police chief. However, the lone "farmer" representative in this Committee was the head of the cooperative, and who also happened to be a member of the ruling party and paid for his service by the government. Thus, the farming community were excluded in the local decision making process.

Also, consequent to the state's commanding role, there was limited private sector or NGO activity in the delivery of agricultural services. Private marketing and processing activities existed at the margins of dominant government support, vigorous only in sectors like fruits and vegetables where state regulation were ineffective. Since 2003, conditions have begun to change, with improvements in yields and production, and a greater share of cereals being sold in the open markets. However, information was not available for this report to adequately assess the nature and trajectory of the changes underway.

Organization at the producer level and social capital. The authority of traditional farmer organization has eroded by the events of last century. The lineage groups, which traditionally farmed tribal lands with mutual cooperation, were marginalized first by the actions of sheikhs in the 1920s who registered tribal lands as private estates. Then, succeeding land reforms initiatives

fragmented and individualized the lands. Finally, the redistribution and tenure reform accompanying modern irrigation development further weakened the lineage groups. It is doubtful, therefore, if the traditional institutions have any vitality left to be useful now.

Current farmer institutions, in all likelihood, lack social capital because they were formed as an extension of erstwhile ruling party. Although about 43 percent of Iraqi farmers are reported to be members of cooperatives or village associations, these institutions are unlikely to enjoy the confidence of farmers for representing issues of mutual interest.

Operation and maintenance of irrigation and drainage projects. MoWR is responsible for irrigation management through its offices at the districts and sub-districts. At the level of distributory canals, typically commanding 900-1250 ha (3500-5000 dunums), an official, called the "irrigation foreman", is responsible for water distribution.

Water service charges were instituted by Law 112 of 1986, which was intended to create more farmer responsibility for operation and maintenance. Charges are levied at a flat rate of 750 ID per dunum of "reclaimed" (i.e. drained) land, and 500 ID per dunum of non-reclaimed land. The collection adds up to less than $2/ha, which is not even one tenth of the amount MoWR spends annually on operation and maintenance. On a volume basis, these charges are equivalent to 1 US cent for every 50 m3 consumed, amongst the lowest water service charges in the world.

The operation and maintenance expenditure of MoWR is financed by the central government budget. Although this allows services to continue, such subsidies have strong disadvantages: irrigation O&M becomes dependent on fiscal and political factors unrelated to the needs of the irrigation sector, decisions on allocation of the budget are taken administratively by officials independent of any local voice, service levels are unrelated to farmer contribution, and agencies are not accountable to farmers for water service delivery.

2.3 Institutional and legal background for international cooperation

International cooperation for transboundary water resources management. The basic principles of integrated water resources management (IWRM), fundamentally requires international cooperation when basins extend beyond political boundaries. The basic principles of IWRM the lessons in transboundary cooperation, and how these lessons and principles might apply to Iraq's situation are detailed in Annex 5.

There is no global agreement between Iraq, Syria and Turkey for allocating water resources from the Euphrates and Tigris. Despite a long history of contacts on the Euphrates (Box 2.2), existing water sharing arrangements between the three parties are the subject only of bilateral protocols. Detailed in chapter 3 the upstream riparians control much of the upstream water. Turkey has assured Syria 15.75 BCM (i.e. 500 cubic meters per second at the border) of Euphrates water annually. Syria has engaged to pass on to Iraq 58 percent of the Euphrates water entering Syria, with a minimum guaranteed flow of 9.1 BCM. A multilateral pollution abatement agreement was signed in 1978 but it has never been implemented. Iraq's dependence on the upstream riparians is further discussed in Chapter 3. The lack of cooperation between the three riparians has prevented the development of an integrated water management plan for the entire basin, and creates particular risk for Iraq as the downstream riparian of a diminishing and increasingly uncertain flow.

Box 2.2: The history of cooperation on Euphrates waters

Historically, the Euphrates and Tigris were domestic rivers within the Ottoman Empire. With the dissolution of the empire and the emergence of Syria and Iraq as independent countries, the rivers acquired international status and new treaties and protocols were established to govern the allocation of water resources. The Lausanne Treaty of 1923 mandated the formation of joint committees between Turkey, France (for Syria) and UK (for Iraq) to resolve problems of allocation and management of water resources in the Euphrates and Tigris, including issues such as construction of dams. The issues were to be resolved by mutual agreement, with arbitration resorted to only as the last option. The spirit of the Treaty was strengthened by bilateral protocols between Turkey and France in 1930.

In 1946, Turkey and Iraq signed the Friendship and Neighborly Relation Agreement, which obliged Turkey to report to Iraq any plans to utilize the water of Euphrates and Tigris and also gave the right to Iraq to construct dams in Turkish territory for improving the flow of Euphrates in to Iraq.

In 1980, a Joint Technical Committee on Regional Water was created by Turkey and Iraq on the basis of the 1946 protocol and Syria joined the Committee subsequently.

In 1987, a bilateral Syrian-Turkey protocol resulted in Syria being assured by Turkey of at least 500 cubic meters per second of water from the Euphrates at the Syrian border. This worked out to an average annual flow of 15.75 BCM.

A Syria-Iraq discussion in 1989 resulted in assurance to Iraq of 58 percent of the water resource of the Euphrates entering Syria while Syria retained 42 percent, with minimum average annual flow of 9.1 BCM into Iraq.

As differences existed between the countries on the issue, these allocations were provisional arrangements until a lasting solution was found. The Joint Technical Committee last met in 1996 at Damascus.

Source: Strategic framework for managing international watercourses in Iraq

Chapter 3: Iraq's water resources

3.1 The natural water endowment

Iraq's geographic context. Iraq is bordered by Kuwait, Iran, Turkey, Syria, Jordan, and Saudi Arabia (Map 1 Annex 1). The country slopes from mountains over 3,000 meters (10,000 ft.) above sea level along the border with Iran and Turkey to the remnants of sea-level marshes in the southeast. Much of the topography is mostly broad plains; reedy marshes along Iranian border in south with large flooded areas. The mountains in the northeast are an extension of the alpine system that runs eastward from the Balkans into southern Turkey, northern Iraq, Iran, and Afghanistan, terminating in the Himalayas. Average temperatures range from higher than 48^{o}C (120^{o}F) in July and August to below freezing in January.

The climate in most of Iraq is subtropical and semi-arid. Rainfall distribution is temporally and spatially uneven (Map 2 Annex 1). Rainfall occurs between October and May with the highest precipitation levels between December and February. Average annual rainfall is estimated at 154 mm, but ranges from less than 100 mm in the south (60 percent of the country) to 1,200 mm in the north-eastern mountainous region. The mountainous region of northern Iraq receives appreciably more precipitation than the central or southern desert region. Rainfed agriculture is practiced only in the more temperate northeast of the country. In the plains, where most of the population lives, there is very little rainfall and agriculture is dependent on irrigation. While the winters are cool, summers are hot resulting in a high rate of evaporation in the Southern plains (10 to 17 mm per day in the summer).

The Tigris and Euphrates rivers provide Iraq with an abundance of water resources. Both rivers originate in the eastern mountains of Turkey and enter Iraq along its north-western border with Turkey and Syria. The two rivers transcend the country, the Euphrates flows for about 1,000 km and the Tigris for 1,300 km, and they confluence just north of Basra. Downstream from their confluence, the river is known as Shatt al-Arab, a tidal channel, which flows 190 km before joining the Arab Gulf. Iraq's hydrologic network is illustrated in Map 3 of Annex 1.

The Euphrates watershed area (579,314 km^2) encompasses areas of Iraq (49 percent), Turkey (1 percent), Syria (17 percent) and Saudi Arabia (13 percent); within Iraqi territory the river is fed only by seasonal runoff from the wadis. The Tigris watershed area (371,562 km^2) encompasses parts of Iran (47 percent), Iraq (38 percent), Turkey (14 percent), and Syria (0.3 percent). Within Iraq the Tigris River receives water from three main tributaries, the Greater Zab, Lesser Zab, and Diyala, which originate in the mountains of eastern Turkey and north-western Iran and flow in a south-westerly direction until they meet the Tigris detailed flows included in Table A2.1, Annex 2. The two rivers converge in southern Iraq where the great alluvial plains of the Tigris and Euphrates river system comprise more than a quarter of Iraq's surface area, in which topographically, the region is extremely flat. Under natural conditions, the region was a rich wetland and subjected to annual flooding.

Natural flows are ample but historically quite variable. Over the period 1971-2003, the river systems have aggregated an annual flow ranging from a minimum of 44 BCM in a drought year to 77 BCM in a good year. The mean in recent years has declined to 68 BCM from 79 BCM in

earlier years (Table 3.1). For the purposes of this report, the range of 59-75 BCM is taken as the annual water resources likely to be available to Iraq.

Over the last 30 years, the inflow of the Euphrates to Iraq has averaged 19-21 BCM, constituting 30 percent of Iraq's water resources. Flows have varied widely between years (10 BCM-50 BCM). The average flow since major upstream development began in the early 1970s has been lower than the average of 30-35 BCM in the preceding period (1932-1970). The Tigris contributes, on average, 48 BCM. Of this, two thirds (about 33 BCM) originates outside Iraq with 27 BCM (55 percent) originating in Turkey, and 6 BCM in Iran (12 percent).

Table 3.1 Iraq's water resources (mean)

1932-1970

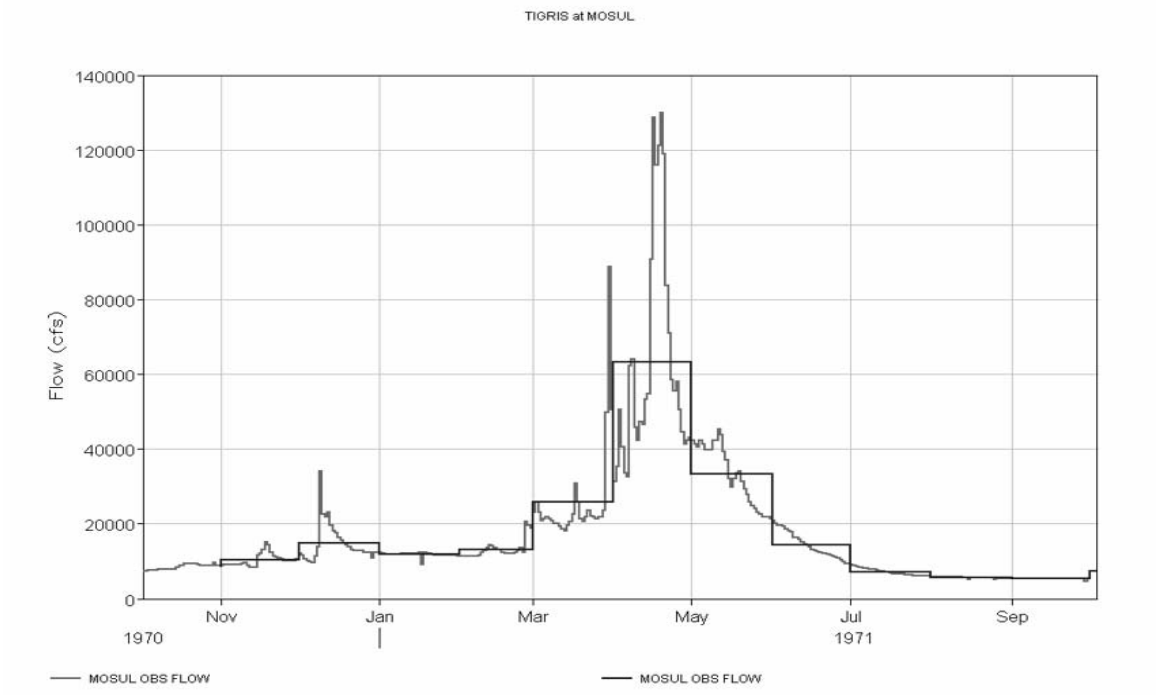
Water source	BCM
Euphrates	30
Tigris	48
Groundwater	1
Total	**79**

1971-2003

Water source	BCM
Euphrates	19
Tigris	48
Groundwater	1
Total	**68**

Peak flows do not coincide with agricultural water needs, thus storage is needed. The annual flood peak in the rivers occurs in late winter or early spring as a result of snowmelt or the combination of snowmelt and rainfall in Turkey and Iran. Approximately 50 percent of annual run-off in Turkey into the Euphrates and Tigris takes place in just two months (April and May). These peaks are too late for winter crops and too early for summer crops. Hence, full use of the water potential for agriculture requires considerable inter-seasonal and multi annual storage facilities. Figure 3.1 illustrates a representative annual hydrograph for the Tigris River.

Figure 3.1 Typical water year hydrograph (Tigris River)

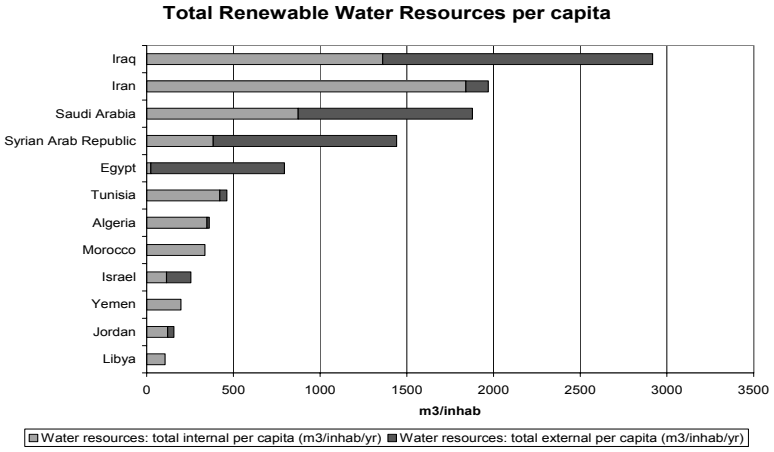


Groundwater represents a minor water resource. Good quality groundwater exists in the foothills of the mountains in the northeast of the country and in the area along the right bank of

the Euphrates. The safe yield of these aquifers is estimated at about 1.2 BCM annually, about 2 percent of the nation's annual water budget. Some of the groundwater resource remains to be developed. Elsewhere in the country, groundwater exists but salinity is far too high for agriculture.

The water endowment of Iraq is high by regional standards. Iraq has more per capita water than other countries in the region (Figure 3.2). It has, for example, 50 percent more than Iran, four times the level of Egypt, and ten times the per capita resource available to Yemen. This favorable endowment of water has historically been sufficient for Iraq's water resource needs. The per capita availability in 1990 was 3,688 cubic meters per year against a demand of 2,367 cubic meters.

Figure 3.2: Comparing regional Endowment (in cubic meters per inhabitant/year)



Over half of Iraq's water resources are inflows from neighboring countries. As noted early a significant percent of Iraq's water resources originates outsides its political boundaries. These external inflows account for about three quarters of Iraq's renewable water resources. The Euphrates, with a mean flow of 19 BCM receives 100 percent flow from outside Iraq's borders (94 percent of the flow from Turkey and Syria contributes the remaining 6 percent), while the Tigris, with a mean flow of 48 BCM receives approximately 55 percent of its flow from Turkey and 12 percent from Iran (Table 3.2).

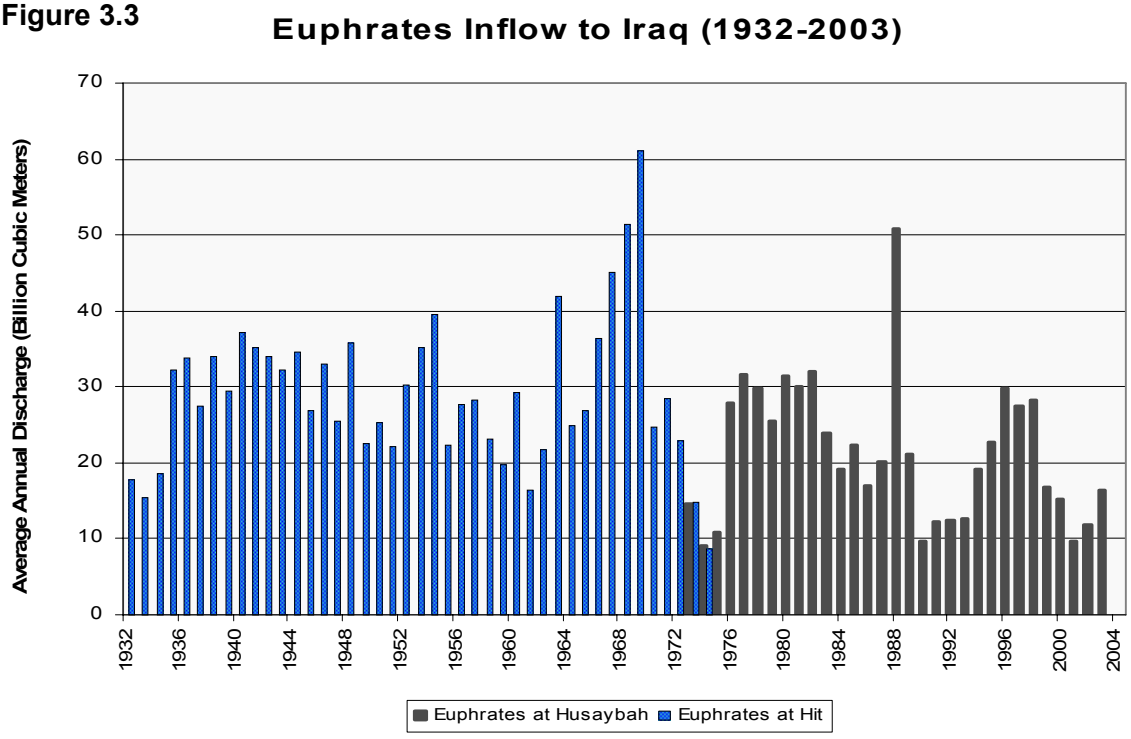
Such a high rate of dependence on external water is not an unusual situation in the region. Across MENA, two thirds of all Arabic speaking people depend on rivers flowing from non-Arab countries. For example, Egypt and Syria both have high dependency on external water resources. However, as experienced with other rivers in the region – the Nile in Egypt and the Aras in Jordan – dependency necessitates cooperation between the riparians on development and management of the resource.

Table 3.2 Iraq's water resources (mean BCM)

	Current Mean flow (BCM)	**Mean flow from outside Iraq (BCM)**	**% from outside**
Euphrates	19	19	100 %
Tigris	48	32	67 %
Groundwater	1		-
Total	**68**	**51**	**75%**

Along the Euphrates, decreasing quantities of water are flowing into Iraq and this quantity will decrease even further. Euphrates inflows to Iraq have declined from an average of 30-35 BCM in the period 1932-1970 to an average of 19-21 BCM 1971-2003, as illustrated in Figure 3.3. In several of the years since 1970, flows fell to as little as 10 BCM, 30 percent of the previous average and below any annual level previously recorded. Some of the low flows are in part attributable to low precipitation in the watershed, but the more significant factor is due to upstream development, particularly in the period from 1972 to 1975, which saw the initial filling of the Keban Dam in Turkey and the al Thawra dam in Syria. It is likely that this declining flow trend will continue as Turkey and Syria complete ambitious irrigation development that will place a growing burden on the river[3].

Figure 3.3



[3] The Euphrates River issues are based on the background paper prepared by the World Bank *Strategic framework for managing international watercourses in Iraq*

The upstream development contributes to the water depletion. The primary cause of the Euphrates water degradation is due to the Southeastern Anatolia Irrigation Project (Turkey's GAP project), which begun in the 1970s and is still under development. Virtually all the hydropower units are completed and the huge reservoirs are filled - Ataturk Dam alone can hold over two years equivalent of the entire natural flow of the Euphrates. In July 2003, hydro production was 96 percent of capacity. However, the major impact on downstream water resources will be felt in the coming years, due to the irrigation program, which is still under preparation. Currently the irrigation infrastructure is only 13 percent complete, and irrigated area is presently only 15 percent complete,[4] while irrigation diversions from the Euphrates in Turkey are only at 20 percent of the planned levels. Syria also has major development plans and hopes to double the area irrigated from the Euphrates to 740,000 ha, increasing net diversions from 5 BCM at present to 10 BCM. At full development, the Turkish and Syrian projects could reduce Iraq's share of the Euphrates from the present 19-21 BCM average to just 9 BCM – and less in a drought year Iraq's share of Euphrates water would drop from 75 percent to 28 percent. Iraq's current use of 15 BCM per year of Euphrates water, would no longer be all available; current irrigated land would go out of production and water quality would dwindle. Reduced environmental flows would have further significant impacts on the water network and marshlands and further environmental degradation would ensue. In Annex 2, Figure A2.1 illustrates the water depletion through time and diminishing transboundary flows in the Euphrates are shown in Figure A2.2, while Tables A2.2 and A2.3, provide a comparison of the current flows and irrigated hectares with those when full upstream development has taken place.

Decline in Euphrates water poses a number of problems for Iraq. Water available for irrigated agriculture will diminish. Demand for water in Iraq has temporarily slackened but is likely to increase as the economy revives. Low water availability will become a constraint to farming, and degradation of agricultural land due to salinization could increase as lower water flows in the Euphrates reduce the water available to leach out salts. In addition, the ecological balance in the Euphrates basin will be further disturbed. Already in-stream flows are reduced and the marshes have largely dried up. Lower flows will make these problems worse. Falling water levels will also impact hydropower generation from the Haditha dam on the Euphrates – a problem experienced, for example, in December 2005. Finally, the quality of water in the Euphrates is likely to deteriorate even further. Already, a large quantity of salts and farm chemicals are being washed into the river by return flows. Today, the three countries together use approximately three million tons of fertilizer in the basin, with Turkey contributing two-third of the total. As upstream irrigation consumes more fresh water and returns more drainage effluent, concentrations of contaminants and salts will increase steadily. Costs to agriculture and domestic water supply will mount, and health and environmental problems will worsen.

Upstream development on the Euphrates brought the risk of regional conflict. In 1973-5, during the simultaneous filling of the Keban and al Thawra dams, water supplies diminished dramatically and tension between Iraq and Syria sharply escalated. Only the mediation of Saudi Arabia with Soviet assistance prevented any further conflict.

Currently, there are no equivalent "Tigris River" problems. The natural flow of the Tigris is 21 BCM per annum and tributaries within Iraq add 27 BCM Assuming Turkey and Syria eventually develop their proposed irrigation projects in the Tigris basin to the full planned potential, the annual average flow into Iraq will reduce to 16.5 BCM. This will reduce the water available to Iraq from an average 48 BCM to an average 44 BCM. This is about one and a half times current usage in the basin. Thus, even after full exploitation by upper riparian countries,

[4] 215,000 ha is complete of the 1.44 million ha planned at full development

there could be sufficient water in the Tigris adequate to irrigate additional 1 million ha, so in effect, no "Tigris problem".

3.2 Iraq's hydraulic network

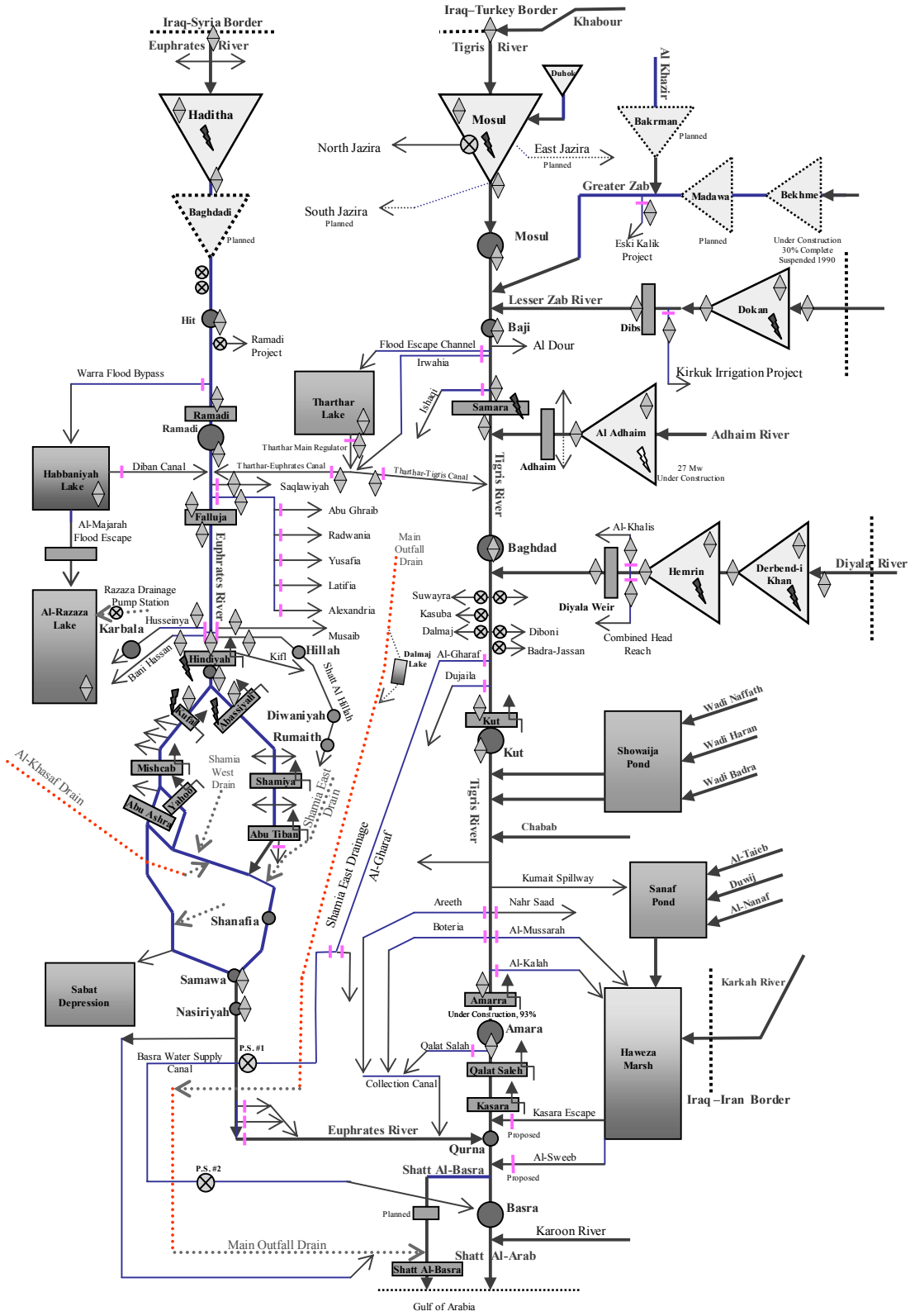
Iraq's natural endowment has dictated the course of hydraulic development and management. The development of Iraq's water resources was motivated by the need to make economic use of the resource and to safeguard against economic and environmental risks. The objective was to even out flood flows in order to make predictable and manageable supplies available for irrigated agriculture and hydropower. Iraq has, therefore, invested on dams and storage structures over its major watercourses, together with downstream irrigation infrastructure. The resulting hydraulic infrastructure is a complex, capital-intensive system demanding high maintenance expenditure and highly skilled management capacity. The complexity of this system is discussed below. The Figure 3.4 is a schematic of Iraq's intricate water storage and control system from the upstream riparians to the Gulf of Arabia.

Major water hydraulic infrastructure consists of a series of dams and barrages. The seasonality of the river flows; its damaging floods and the arrival of flood peaks at inopportune times in the agricultural calendar have driven the long history of water impoundment behind barrages in Iraq. Major reservoir dams are located on both rivers and on the tributaries of the Tigris (Table 3.3). The big dams are multi-purpose (hydroelectric, irrigation, flood control). Smaller dams have been built to supply water to cities and irrigation schemes.

Table 3.3 Iraq's dams and their storage capacity and hydropower generation

	Euphrates (BCM)	Tigris (BCM)	Other	Hydropower (MW)
Dams prior to 1977		**13.8**		
- Dokan Dam		6.8		400
- Derbendi Khan Dam		3.0		240
- Hemrin Dam		2.3		50
- Adhaim Dam		1.6		
Dams constructed since 1977		**11.6**		
- Mosul Dam		11.1		750
- Haditha Dam, Qadisia	8.2			660
- Badush		0.5		
- Desert dams			0.5	
TOTAL	**8.2**	**25.4**		**2100**

Figure 3.4 Schematic Diagram for Water Storage and Control System in Iraq



At the end of the 1970s, Iraq had 14 BCM of storage behind dams. A major construction program in the 1980s was designed to triple the capacity to over 50 BCM. The program consisted of:

- The construction of the Mosul dam (formerly called the Saddam dam) on the Tigris north of Mosul with 11.1 BCM capacity;
- The Haditha dam at Qadisia on the Euphrates with 8.2 BCM capacity;
- The partially completed Bekhma dam on the Greater Zab with 17.1 BCM capacity (the construction was abandoned after the Second Gulf War);
- The Badush dam on the Tigris river with0.5 BCM capacity; and
- Several desert dams with a total storage of about 0.5 BCM capacity.

The Al-Adom dam on the Tigris River, with a capacity of 3.8 BCM, is under construction. The total on-river storage capacity is currently about 33 BCM, with 25 BCM on the Tigris and 8 BCM on the Euphrates. In comparison, Egypt's High Aswan Dam impounds about 80 BCM of water. All major dams in Iraq generate hydropower excepting the small Adhaim and Badush dams on the Tigris.

Iraq has also developed vast off-river storage to hold flood waters. Diversions from the Tigris allow huge volumes of flood waters (85 BCM) to be stored in the vast Tharthar Depression within the Tigris basin is capable of holding entire two years of flow in the Tigris. Canals have been constructed that could channel water to the Euphrates or back to the Tigris further downstream. But, the Tharthar Depression is naturally saline and is increasing in salinity due to evaporation. Consequently, the value of its water for subsequent use is diminishing. Thus far, the Depression has functioned largely as a sink. A second natural off-river storage reservoir is the Habbaniya Lake (3.3 BCM), which is filled from upstream Euphrates water and drained back into the Euphrates further downstream. In addition to the seven reservoir dams and two off-river storage reservoirs, Iraq has 19 on-river barrages (12 on the Euphrates, five on the Tigris, and two on the Tigris tributaries) to raise the level of the water for diversion purposes.

Off takes, pump stations, canal systems. Historically, farmers used simple diversion structures to draw irrigation water from the rivers to distribute them over the lands near to the river. Modern water control strictures were established starting in 1913 with the Hindiyya Barrage on the Euphrates. From the 1920s, the introduction of lift pumps allowed farmers to extract water and irrigate lands further away. With the construction of the major dams, more controlled supplies of gravity flow water have been available. The current bulk water distribution network includes 45 main regulators to regulate the main irrigation channels and divert water to branch canals. There are about 27,000 kilometers of canals for water distribution. About two thirds of Iraq's irrigation system is gravity fed, through major canal systems controlled either by river intakes, diversion weirs, or off-takes directly from reservoirs. About a third of off-takes are pumped from rivers and major channels, with about 100 major pumping stations.

The hydraulic network is susceptible to major risks, many of which have manifested in recent years. The hydraulic network requires a centralized integrated management of the infrastructure. The complex interactions between the upstream and downstream riparian of the system and competing demands for hydropower, agriculture, municipal and industrial use necessitates integrated management approach, supported by sustained investment and operational efficiency. Over the years Iraq has responded to this need by creating a centralized management and control institutional structure. However, several risks have arisen from the centralization:

- The current centralized management of headworks, contributes to an institutional culture based on supply side considerations, with scant regard for service to the users. This attitude is reflected in the current pattern of investment and institutional responsiveness of Iraq's water sector. Perpetuating the supply side, inevitably necessitates trade offs. Providing adequate water for intensive agricultural production has also increased salinization of the soils. Hydropower generation and irrigation compete because of issues related to timing of flows and resource depletion due to high rates of evaporation from reservoirs. A trade off also occurs between the benefits of regulation and storage and environmental needs for in-stream flows to conserve marshlands.

- The second risk is that a complex, centrally managed system is highly sensitive to political, military and economic crisis at the national level. Iraq's water management has suffered enormously from its political and economic crises over last several years, contributing inefficient operations and maintenance of infrastructure.

- The third risk relates to its Iraq's high dependence on transboundary water resources, initially planned and constructed for dependable and regular upstream flows. As a downstream riparian, Iraq is vulnerable to the actions of upstream riparian. With upstream diversion from Euphrates increasing, and to a lesser extent also from the Tigris, Iraq's vulnerability is increasing. Iraq now faces the hydropolitical challenges to secure its water resources.

3.3 Water sector withdrawals and water uses

There is a high demand on water resources from different sectors. In addition to the water needs for hydropower generation or for managing sustainable ecosystems, water withdrawals for agriculture, domestic and industrial uses, were 42.8 BCM in 1990, the last year for which data are available. Out of this, 92 percent was used for agricultural purposes, 3 percent for domestic supplies and 5 percent for industrial uses (Table 3.4). The estimates for 2003/4 have been made assuming about 12 percent higher water diversion and roughly the same sectoral distribution. Withdrawal is expected to range between 47-52 BCM while the resource availability is expected to range between 59-75 BCM.

Table 3.4: Water withdrawals by sector[5]

	1990 BCM	**%**	**1998-2002 BCM***	**%**	**2003/4 (estimated) BCM**	**%**
Withdrawals for:						
▪ Agriculture	39.4	92 %	39.4	92	46.0	90 %
▪ Domestic	1.3	3 %	1.4	3	2.1	4 %
▪ Industrial	2.1	5 %	2.0	5	3.6	6 %
Total withdrawals	**42.8**	**100 %**	**42.8**	**100%**	**51.7**	**100 %**

*Source: FAO Aquastat 1998-2002

Iraq has an elaborate drainage network. Drainage pumps are used to lift effluent water into the main outfalls, and thence to main drains. To reduce the return of the heavily saline water to

[5] Environmental uses are not counted in the table. The environment is generally considered an "in-stream user" rather than a water withdrawing sector, as it receives return water from all water-using sectors, especially agriculture. The Euphrates used to provide the marshlands with about 10 BCM/year.

the rivers, Iraq constructed the 565 km long "Third River", a main outfall drain, which has the capacity to collect drainage waters from more than 1.5 million ha of irrigated land (Box 3.1). The Third River conveys the drainage water directly to the sea.

Box 3.1: Iraq's Third River – the Main Outfall Drain

The Main Outfall Drain (formerly called the Saddam River) functions as a main out-fall drain. Running between the Tigris and Euphrates rivers, it can collect drainage waters from more than 1.5 million hectares of irrigated agricultural land stretching from north of Baghdad right down to the Gulf. The length of this major outfall drain, which was completed in 1992, is 565 km, with a design discharge of 210 m^3/s. The outfall drain exits out of the plains between the two rivers through a siphon under the Euphrates river in the Nasiria area and outfalls into Shat Al-Basra, another man made canal, which itself outfalls into the Gulf. This main outfall drain is one of the most significant drainage channels to be constructed in the last fifty years and will ensure that much of the drainage water will be able to reach the sea without polluting the main watercourses.

Chapter 4: Managing water resources

4.1 Iraq's water demand

Determinants of water demand. As illustrated earlier, the current gross water diversions in Iraq are approximately 50 BCM annually. Although this is lower than the renewable water resources available to Iraq each year (59-75BCM), other consumptive uses drive up potential demand to about 75 BCM/annum (Table 4.1).

Table 4.1: Water Diversions 2003/4 (BCM/annum)

Irrigation	46.0
Water supply	6.0
	52
Hydropower	10.0
Environment	3.0
Marshes	10.0 to 16.0
	75 to 81

The most important determinant of water demand has been the expansion of irrigated agriculture – but current agricultural demand is lower than the potential. Irrigation water withdrawals in 1990 were about 39 BCM. Recent FAO estimates suggest irrigation consumptive use in 2003/4 was about 22 BCM, equivalent to 44 BCM of water diverted, assuming 50 percent overall irrigation efficiency[6] (this is a liberal estimation and actual efficiency may be as low as 25-35 percent). If withdrawals for irrigation have indeed increased, it is probably not because of increased agricultural activity but because of declining efficiencies. These levels of current water use are below potential demand. It is estimated that of Iraq's 3.5 million ha of land developed for irrigation, only about 1.9 million ha have been cropped in recent years. If all the developed area were cropped in any year, and if efficiencies were improved to the levels assumed when irrigation schemes were designed, it is estimated that irrigation demand would reach 50 BCM. The demand would be greater in case the efficiency did not improve. Seasonal timing is also an important component in irrigation water demand, with peak demand occurring in the summer months.

Demand for water supply and sanitation is a comparatively small component in the water balance – but a priority one. Water withdrawals have gone up but losses have increased. Demand for water from the water supply and sanitation sector, currently thought to be about 5 BCM annually, is constrained as supply infrastructure has gone out of service and as demand from the industrial sector has shrunk with the progressive idling of industrial capacity. The constraint in demand has been partly offset by increased system losses.

Hydropower demand is a question of timing of flows and of consumptive use through evaporation. Hydropower demand is in part simply a question of timing. In principle, releases for hydropower need to be planned so that they also meet downstream irrigation and water supply needs. It is reported that declining flows in the Euphrates have affected hydropower production and that releases for hydropower have reduced water required by irrigation. Hydropower "demand" also includes consumptive use through evaporation from reservoirs; it has been estimated that this use can be as high as 10 BCM a year, which is 15 percent of Iraq's available water resources.

[6] Gross water efficiency – that is, the percentage of water diverted that is used beneficially by crops – is currently estimated at 50%, well below the estimated gross efficiency of 60-63% in 1968-72.

Environmental demand is a function of the ecological requirements of minimum stream flow and of periodic inundation of the marshes. Environmental demand is a fixed minimum required for ecological conservation of habitats. The demand for in-stream flows, including both strictly environmental needs and navigation needs, is estimated at 3 BCM/annum. The volume of water needed to restore the marshes has been estimated at 16 BCM/annum at maximum. As environmental demands are largely downstream of all other demand, they become de facto a residual. Timing is an important consideration for marsh inundation, as it requires large volumes of water in a concerted surge to flood the marshland.

Balancing supply and demand. With water resources available to Iraq ranging between 59-75 BCM, the withdrawal for direct use seems easy to meet (49 BCM; refer to Table 4.1). But, when reservoir evaporation losses (up to 10 BCM), in-stream environmental needs (about 3 BCM), and marshland conservation requirements (up to 16 BCM) are considered, total demand – at up to 78 BCM - exceeds supply. These estimates do not take into account return flows from irrigation (typically 30 percent, and thus equivalent to 13 BCM) or from water supply and sanitation, but the exclusion is justified because reflows from drainage and waste water discharge is so severely contaminated that they are not suitable for economic or environmental use. Several empirical observations confirm that Iraq is fast approaching the limits of exploiting its water resources. In late 2005, water shortages were experienced for cropping and for leaching. A hydropower crisis resulted from an unexpected low flow in the Euphrates, with output dropping from 1200 MW to 700 MW. The marshlands, once the tail end of the riparian and a generous recipient of Mesopotamian water, have now mostly dried up. MENA is the world's most water scarce region. Overall, MENA region is arid with less water per person, than any other region in the world. Iraq's share of water is an external source, and its management challenge is transboundary in nature. In a global assessment, MENA has the highest percent of surface waters stored in reservoirs, within the region. Iraq has the largest share, with 67 percent of share of freshwater stored in reservoirs. Though Iraq has made significant investments in water storage for water security variability in rainfall can lead to dams not functioning as intended[7]. The implications are that:

a) Iraq is now vulnerable to fluctuations in supply, except to the extent water storage smooth out flows;
b) Costs are likely to rise, and temporal, spatial or sectoral shortages may occur;
c) Longer-term impact on water supply by development in upstream riparians is an issue of considerable concern; and
d) Strategic planning, investment and institutional development will have to focus on restricting water budget by improving the efficiency of supply and use, including demand management.

Demand is likely to rise – and supply to dwindle further. Economic recovery, particularly in the agricultural sector, could drive up demand. Water balance projections indicate that if Iraq restores all its equipped irrigation area to production, total water demand, excluding any allocation for marshland conservation, would be 73 BCM. This is the upper range of current water availability at 59-75 BCM, and excludes any provision for the restoration of the marshlands ecology.[8] On the supply side, it is likely that the volume of water available to Iraq will dwindle

[7] MENA Flagship Report: Making the Most of Scarcity (draft, 2006)
[8] This estimate is based on a paper prepared as a background to this report "Estimate of water requirements for agriculture in Iraq" (Dr. Y.A. Choudhry, October 28th, 2005, for the World Bank), which projected water requirements for agriculture based on ten different scenarios.

as Turkey and Syria increase diversions. Of course, water balance projections are dependent on a multitude of factors and are sensitive to error. However, the message is clear: if nothing changes and Iraq returns to the pattern of water use implicit in the current infrastructure and water management practices, water stress will become a chronic condition.Early action is, therefore, required to manage both demand and supply in order to prevent a water resources crisis in the medium-term.

On the demand side, there are multiple changes possible in Iraq. Current demand management in agriculture promotes low value cropping and inefficient water use. Directed cropping patterns, input subsidies and output marketing tied to the production of basic "strategic crops" lock farmers into production with low value addition per unit of water. Water use inefficiency is also imposed by the irrigation technology designed for flood irrigation. Very low water service fees provide no incentive to farmers to optimize water use. Iraq must emphasize irrigation efficiency to avoid water stress.

Incentive-based instruments to achieve a change include the use of:

- water quotas between and within districts decided at the lowest appropriate administrative level, where water-user organizations can manage the quotas;
- financial incentives – either negative or positive – to encourage efficient water use;
- macroeconomic policies on agricultural trade and food security to reflect Iraq's comparative advantage for high value, water efficient production.

Technical measures for farmers to save water include:

- improvements in on-farm water management practices;
- changing to less water intensive cropping patterns;
- increasing cropping intensity;
- improvements in farming practices, such as fertilizer use or choice of seed varieties that increase productivity per unit of water

At the level of irrigation schemes, water service would be improved for reliable delivery, corresponding to farmer needs. At the basin level, water demand should be harmonized with upstream riparians by promoting, for example, crops whose water need does not correspond to the needs of crops in upstream riparians.

On the supply side too, a range of options are available. The first line supply options are in improving the security and efficiency of the current supply system. Underinvestment and lack of maintenance has led to widespread deterioration of water resources infrastructure. Early attention is needed to repair Iraq's 17 main dams and barrages. At 50 percent supply efficiency, irrigation canals are currently losing some 20 BCM a year to largely saline groundwater, drains and sinks. The trunk water distribution network needs early rehabilitation to clear channels (the cost is estimated at $1.5 billon). Improving water supply efficiency is clearly the least expensive means to increase supply and should be given priority, ahead of new impoundment or diversion projects.

Beyond efficiency, Iraq may consider further impoundment projects to increase water storage. The Bekhma dam on the Greater Zab is the last incomplete major dam project. Iraq had already spent $700 million on this dam when work hade to be suspended. About $1.5 billion is needed to complete the dam. Another low-cost improvement to supply would be for Iraq to operationalize its capability for inter basin water transfer from Tigris to Euphrates to take advantage of greater water availability in the Tigris and the more fertile lands in the Euphrates basin. At the

transboundary level, technical, economic and diplomatic initiatives would improve the value of water flows to Iraq through better timing, quality and perhaps also quantity.

4.2 Dams and dam safety

Iraq's seventeen large dams and barrages are its most valuable hydraulic asset. However years of inadequate financing have left them poorly performing and possibly dangerous. A joint technical assessment of the dams and barrages on the Tigris and Euphrates Rivers by government and the United States Army Corps of Engineers (USACE) in June 2003 identified some of the rehabilitation needs of large dams, and reported that six are in dangerous condition.

For example, the condition of the multipurpose Mosul dam gives the highest cause for concern. Built in the 1980s on the Tigris upstream of Mosul city, the Mosul dam (formerly called the Saddam dam) is a 120 m high earth fill dam with a storage capacity of about 11 BCM. The dam was built on gypsum rock foundations, which are highly soluble. When the dam was filling in 1986, substantial seepage (1400 litres per second) was recorded. It is estimated that 0.66 kilograms of mineral per cubic meter are washed out from the foundations every day. A flood study indicates that if the dam collapses, Mosul city would be submerged under a 10-20 meter wave within four hours. In view of the risk, construction of a flood attenuation dam was started about half way between the dam and Mosul city. However, construction was abandoned in 1993. There are other possible technical solutions. A stop gap grout curtain has been applied, and a slurry trench could be run through the dam foundations (3.5 km) to stem the seepage. The cost is estimated at $150 million. The first step is to organize a dam safety inspection for assessing the condition of the dams, and to carry out a program of structural and seepage investigations.

4.3 Hydroelectric power

Iraq's total installed hydropower capacity is 2,400 megawatts (MW), from four dams on the Tigris and one on the Euphrates (referenced earlier in Table 3.3). This capacity compares to the 2,100 MW capacity of the Aswan High Dam in Egypt. Iraq's hydropower capacity is 17 percent of current total electricity generating capacity of 14,100 MW. National electricity demand is in excess of capacity. In Baghdad, the current demand is estimated at about 3,000 MW, but it can reach a potential of 8,000 MW. Demand is expected to rise as the economy recovers. The shortfall in generating capacity reached 4,000 - 4,500 MW in the summer of 2005.

Output of hydropower has been below capacity in recent years. Reports from MoWR in December 2005 estimated output between 700 MW to 1,200 MW, only 30-50 percent of the installed capacity. The declining flows in the Euphrates have reduced the Haditha dam (660 MW installed capacity) to only incidental generation. The largest installation, the Mosul dam on the Tigris (750 MW), may not be able to operate at full capacity as there are problems in dam foundation and the plant lacks maintenance.

The suspended Behkma dam project on the Greater Zab is designed for generation of a further 1,500 MW, adding 60 percent to the existing capacity. Other projects under consideration include the Mandawa regulation dam on the Greater Zab below the Bekhma dam, which could generate 570 MW. The proposed Bakerman dam on the Khazer would generate 67 MW, and the Badush Phase II dam on the Tigris could add a further 170 MW. All of these projects taken

together have the potential to bring Iraq's total hydropower capacity to about 4,700 MW. However, although this would double actual hydropower generation, the contribution to overall power needs would remain relatively small, at less than one fifth, in the face of rapidly rising demand.

The challenges and issues in hydropower. Hydropower issues in Iraq are confronted by three interdependent issues and challenges:

- First, there are problems with the physical installations. Structural problems with the dams will have to be addressed on priority. A decade of neglect in maintenance has created a backlog of rehabilitation needs. Clearly, maintenance and rehabilitation would restore existing capacity.

- Second, there is the problem of declining water flow in Euphrates and Tigris. Iraq's interest lies in maximizing flows and in negotiating transparency in the timing of flow. Iraq's hydropower management is, therefore, directly linked to transboundary agenda – and ultimately to a transboundary technical process for managing flows optimally at the basin scale.

- Third, water flows have to be managed better between competing users within Iraq. MoWR has seasonal operating plans for the reservoirs. A winter schedule runs from November to May, and a summer schedule from June to October. The plans are set to meet multiple objectives; flood control, water requirements for irrigation and water supply, hydropower needs, and water storage (with the objective of storing adequately by the end of the winter plan in order to have as much water as possible for summer irrigation). The plans are adjusted for three "typical years": dry year, normal year, and wet year. However, uncertainties over the amount of precipitation, snow melting and diversions in the upstream riparian states make actual reservoir operation problematic.

In addition, lack of coordination between the Iraqi agencies concerned – MoWR on the supply side and MoA, Ministry of Electricity, Ministry of Municipalities on the demand side - contribute to sub-optimal use of Iraq's water resources. Ideally, all needs should be reassessed and operating policies revised to maximize economic value and give transparency and certainty to downstream users.

Iraq should reassess the flow needs of different sectors and locations and revise the operating rules of the system, while simultaneously working for transboundary information sharing. In the longer term, as water becomes scarcer, there is likely to be stronger competition for water between hydropower and other uses. Iraq will have to decide whether hydropower needs have higher priority over municipal and industrial needs or the needs for irrigation. The energy pricing will be an important factor influencing this decision. In the past, distortions have arisen from the low costs of fossil energy and the low consumer tariffs. If fossil fuel prices rise in the medium term, hydropower may look more attractive as a source of energy.

The National Water Master Plan will examine alternative future flow options, and alternative operating policies that consider the needs of different users. The study will also review the scope for new hydraulic and hydropower facilities; this part of the study needs to be placed in the context of overall energy planning and pricing. The Master Plan will thus help Iraq to prioritize its flow management by sector and prepare revised operating policies.

4.4 Water quality and land salinity

Water quality is deteriorating. Water quality in the Euphrates is affected by return flows from irrigation projects in Turkey and Syria, and is expected worsen as irrigated land is added. Within Iraq, much of the return flow is now drained into the Arab Gulf through the Main Outfall Drain, but considerable saline return flow enters the river system. On the Tigris River, the quality is further degraded with flood flows diverted into off-stream storage in the highly saline Tharthar Lake, and later returned to the river system carrying salts washed from the lake.

Irrigation practices since historical times have contributed to salinization of farmland. Not only do increased salts accumulate in the soil profile but water quality directly impacts crop yields. Anecdotal evidence indicates that crop yields in the upper reaches of the rivers are five times higher than the lower reaches. Salinity in the downstream stretches of the river system worsens during the summer, particularly in the Euphrates. For example, the total dissolved solids (TDS) in the Euphrates increases from 600 mg per liter at the Syrian border to 3000 mg per liter in the lower reaches near Nasiriyah. Similarly, in the Tigris, TDS increases from 280 mg per liter at the border with Turkey to 1500 mg per liter at Amara. TDS levels above 1000 mg per liter, water is not suitable for most crops. The Euphrates quality improves partially by inflows of better quality water from the Tigris diverted through the Samarra-Irwahia canal and the Kut-Gharraf canal diversion.

Water quality degradation also occurs because raw, untreated wastewaters from domestic and industrial sources are discharged into the rivers. Currently, the quality of water in the Tigris and its tributaries from Syria and Iran is comparatively good, but degrades downstream with irrigation return flows and with major sewage and industrial inflows, including massive discharge from Baghdad. Damaged and rundown wastewater treatment facilities, which often treat both domestic and industrial wastewater, are partially operational. Further, the destruction of sewage treatment infrastructure during Iraq's wars has resulted in tremendous untreated discharges, particularly into the Tigris. Some industrial installations (e.g., refineries) have their own treatment plants but these are generally not working conditions[9] . Total discharge of untreated sewage into rivers is reported to be one million tons a day, and the concentration of pollutants far exceeds national and international standards (Table 4.2).

The responses to challenges on water quality need to be prioritized. A more comprehensive understanding of the relationship between river basin management and water quality issues is required. Specifically, the water quality-monitoring network should cover all flowing streams and canals, drains, marshes, reservoirs, groundwater aquifers, etc, and develop broad plans for future interventions for addressing present needs; Iraq must also develop a national rehabilitation program to mitigate problems from both domestic and industrial discharges. In the short-term, the sewage contamination problem needs to be tackled for addressing sanitation issues. The inter-related problems of water quality and irrigation should be addressed as part of the package for rehabilitating irrigated agriculture. Beyond these, Iraq will need to develop regulatory capacity for covering waste and wastewater, including institutional measures such as standards, permits and charges, and investment.

[9] Woerden F. and Berkel J. (2004) Environmental Pollution in Iraq Assessment and Abatement Strategy Note, for the World Bank.

Table 4.2 Indicative Data on Iraq Water Quality

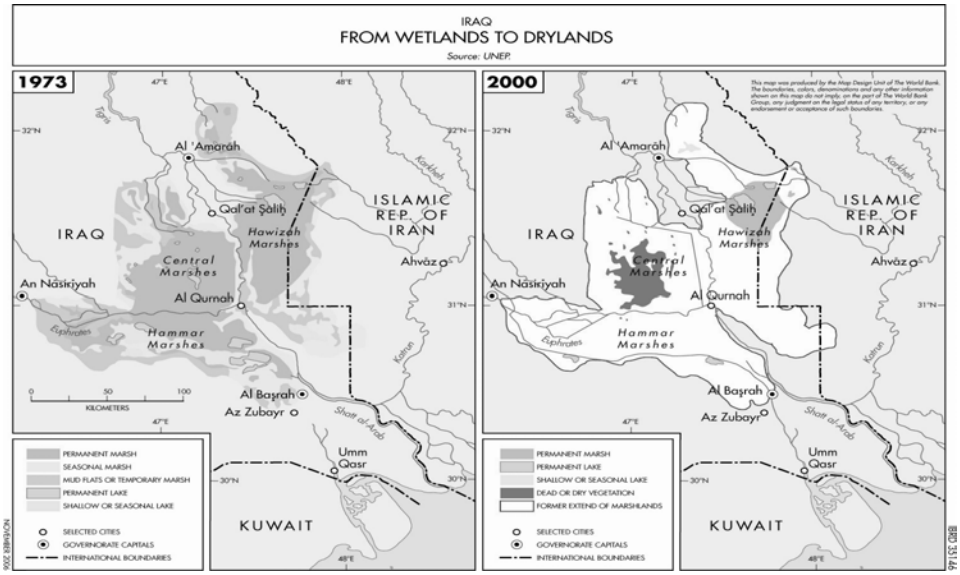
Compound	Unit	Standard	Tigris	Euphrates Ambar	River Thi Qar
Total Coliform (TC)	TC/100 ml	500-10,000 (EU)	130-52,000	15,000-110,000	1,000-10,000
Faecal Coliform (FC)	FC/100 ml	100/2,000 (EU)	30-170,000	-	-
Total Suspended Solid (TSS)	mg/L	-	30-280		
Dissolved Oxygen (DO)	mg/L	> 5 (EU)	-	6-9	6-9
Sulfate (SO_4)	mg/L	250 (EU, US-EPA, WHO)	100-230	250	840
Chloride (Cl-)	mg/L	250 (EU, US-EPA, WHO)	40-90	180	950
Temperature	C		12-28		

Source: Woerden F. and Berkel J. (2004) Environmental Pollution in Iraq Assessment and Abatement Strategy Note, for the World Bank

4.5 Water and the environment

The Mesopotamian marshlands are unique ecological features. The Mesopotamian marshlands are unique ecological features at the confluence of the Tigris and Euphrates. They fall into three distinct areas: Hawizeh Marsh in the north, fed by the Tigris and Karkheh rivers, the Central (Qurnah) Marsh, which lies between the Tigris and the Euphrates, and the Hammar Marsh to the south, traditionally fed by the Euphrates (Figure 4.1). These three marshes were once contiguous and covered 20,000 km^2.

Figure 4.1 Mesopotamian Marshlands



At their full extent, they were able to absorb inflows of over 16 BCM annually. The marshes were formed by flood flows from the Tigris and Euphrates, and were also fed by the Karkheh

river from Iran; water spilled out from these rivers forming inter-connected lakes, mud flats and wetlands. Further downstream, the Euphrates, Tigris and Karun rivers merge to form the Shatt al Arab River, which drains into the Arab Gulf. As tides averaging 3m can run up the Shatt al Arab into the Euphrates and Tigris, and then into the marsh and wetland systems, the water quality of the marshes varies in brackishness.

The marshes are important economically and ecologically to all peoples of this area and are of global environmental significance. For over 5000 years the *madan*, the Marsh Arabs, made these wetlands their home, building an economy and lifestyle centered on the ecology of the area. The wetlands ecosystem is rich in bio-diversity, supporting giant reeds, wetland rice cultivation and many species of plants, fish and animals (Box 4.1).

Box 4.1: The marshes were a balanced ecology

The desiccation of the marshes has resulted in extinction of many animal species living in the region. Important species no longer found in the region include African Darter, Sacred Ibis, Dalmatian Pelican, Imperial Eagle, Jungle Cat (Felis chaus), Smooth-Coated Otter (Lutra perspicillata maxwellii), and Grey Wolf (Canis lupis). The marshlands were also a transitional home to shrimps from the Arab Gulf, which migrate annually from the sea to the marshes and back. The marshes were also home to migratory birds in their annual winter sojourn. Giant reed was common to the region and the *madan* harvested the reeds for their economic value. The outlying wetlands of the marshes were utilized for rice cultivation, the staple food of the *madan*.

Source: Background report on Mesopotamian marshlands

Marshland desiccation is attributed to several factors. Environmental flow is the water regime provided within the river basin to maintain water for ecosystem balance against competing interests of water users[10]. The environmental flows within both the Tigris and Euphrates rivers have been increasingly modified, in the past as well as in the recent periods through impoundments by dams and weirs, extractions for agriculture and urban supply, inflows of drainage waters, and flood control structures. Restricting environmental flows adversely affects the ecological and hydrological services provided by water ecosystems. Specifically, in the last three decades, nine tenths of the extensive marsh area has dried up. Worst affected are the Central and Hammar Marshes, which have shrunk by 94 percent and 97 percent respectively. Only the Hawizeh Marsh largely retains its original marshland characteristics. Deterioration of the marshlands primarily resulted from changes in environmental flows due to increased upstream diversion, changes in the river regime from periodic flooding to a managed flow regime, and most recently, installation of drainage works undertaken by the Iraqi government in the early 1990s.

While damming has caused reduction of flow in the rivers, the inter-annual and seasonal variability of flow has also contributed to the decline of the marshes. The ecology of these marshes depended on flood pulses washing in huge volumes of water, but the building of upstream dams has resulted in flow equalization. The even flow patterns of today cannot spill over to saturate the marshes. Damage to the drainage of the marshes was deliberately engineered for crushing the Marsh Arab rebellion at the time of the first Gulf War. A combination of economic sabotage and the action of security forces drove out more than 40,000 *madan* from their traditional home in the 1990s.

[10] The National *Water Master Plan* underway will include a review of flow requirements and the development of conceptual models of flow-biota relationships. This process should determine how environmental ecological needs should be factored in to Iraq's water resource management.

Marshland conservation and restoration depends primarily on water availability. The desiccation of these important human and natural habitat marshlands has attracted global attention and the possibility of focused efforts at marshland conservation and restoration. The feasibility of marshland conservation and restoration depends primarily on the available quantity and quality of water. In principle, the Hawizeh and Central marshes are best suited to conservation and restoration as the Tigris and Karkheh drain into them and are less polluted and have higher flow. The Hawizeh Marsh is still largely intact and could be conserved if water continues to be available. It has a high ecological value and is the last remaining integral human and natural marshland system in Iraq. Sections of the *Central Marshes* should also be restored, but the Hammar Marsh is now a vast salt pan. Consequently soil salinity is probably too high for large-scale restoration.

The challenges to marshland conservation and restoration require a step by step approach. Conservation and restoration are probably technically feasible if water is available, but the techniques and costs have yet to be determined. There are a number of bilateral donors and conservation organizations engaged in the marshland conservation.[11] However, coordinated efforts are needed to optimize the restoration and conservation interventions. Coordinated efforts will largely be dependent upon understanding the hydrologic regime and water management decisions.

4.6 Flood control

As discussed earlier, Iraq has an extensive hydraulic network. The construction of the major dams has broken the cycle of destructive flooding, and the system of flood management in Iraq is now integrated into the reservoir operating system. However, significant risk remains and operational concerns necessitate reexamination and development of enhancement measures. The main risk is from the Greater Zab, because Baghdad and other major urban centers lie in the flood path. This adds to the importance of completing Bekhma Dam, in the absence of alternative flood-regulation measures.

Upstream, hydrologic system analysis and forecasting tools are needed to form flood control plans and to support real time operations. This requires better hydrological monitoring within Iraq and enhanced cooperation with upstream riparian, in order to secure timely exchange of data on reservoir storage levels and operating policies. The MoWR has initiated a donor-supported program for installation of the needed hydrological monitoring stations.

Regulation has reduced the flow downstream resulting in increased sedimentation and reduced channel capacity to pass flood flows. The risk to Baghdad, in particular, is heightened by the reduced capacity of the Tigris due to sediment deposit resulting from the altered flow regimes associated with upstream flood diversions to the Tharthar Reservoir. The N*ational Water Master Plan* will assess the flood risk to Baghdad and other urban centers, reviewing the hydrology of watersheds and historic flood patterns, the performance of existing facilities and policies and the hydraulics of the river channels, as well as modeling the economics of the risks of damage.

[11] Birdlife International, Canada-Iraq Marshlands Initiative, USAID, and the Italian and Japanese governments

Chapter 5: Irrigation and Drainage

5.1 Water use in irrigated agriculture

Irrigated agriculture is the largest consumer of water, but use is inefficient. Water use in agriculture is currently estimated at about 44 BCM per year as indicated earlier in Chapter 3, constituting 90 percent of total abstractions. With the exception of about 1 BCM groundwater, the irrigation water is abstracted by diversion from rivers and distributed through an extensive system of barrages, irrigation canals, and on-farm channels, and as noted earlier approximately half of the diverted water is lost in conveyance. In addition, on-farm water use efficiency is also low.

Iraq has developed much of its irrigation potential. The total land suitable for agriculture (11.1 million ha) is about 25 percent of Iraq's area. Of this potentially agricultural land, about 40-50 percent (i.e., between 4.25 million ha and 5.5 million ha) is considered irrigable. The irrigable lands are largely on the riverine plains. These plains receive scanty rainfall and agriculture depends almost entirely on water diverted from the rivers. The remaining cultivable land, located in the northeastern plains and mountain valleys, is largely rainfed.

The area equipped for full or partial control irrigation was estimated at 3.5 million ha in 1990. Of this area, the part irrigated by surface water was estimated at 3.31 million ha. Of the area equipped for irrigation, 67 percent is in the Tigris basin, 30 percent in the Euphrates, and 3 percent in the Shatt Al-Arab basin (Figure 5.1 and Table 5.1).

Figure 5.1

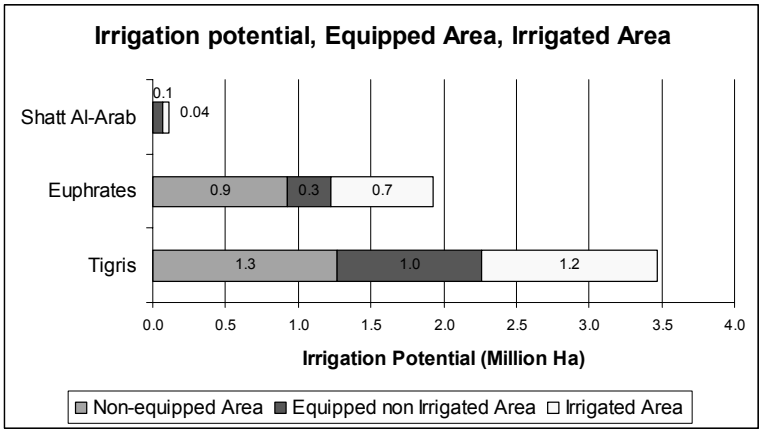


Table 5.1: Irrigation potential, irrigation-equipped area, and recently irrigated area

	Potential		Area equipped for irrigation		Irrigated in 1993	
Basin	**Mn ha**	**% of total potential**	**Mn ha**	**% of potential in basin**	**Mn ha**	**% of eq. area**
Tigris	3.45	63 %	2.20	64 %	1.2	55 %
Euphrates	1.94	35 %	1.00	51 %	0.7	70 %
Shatt Al-Arab	0.11	2 %	0.11	100 %	0.04	36 %
	5.50	**100 %**	**3.31**	**60 %**	**1.94**	**59 %**

Source: potential and equipped area 1990 figures; recently irrigated area 1993 figures

In very general terms, the Tigris basin has better quality water, while Euphrates basin has better quality land. About two thirds of the irrigable land in the Tigris basin is equipped for irrigation, and about half in the Euphrates. Overall, Iraq has developed about 60 percent of its irrigable land. This level of development is consistent with achievements by other countries in the MENA region (regional average is 62 percent) and with other countries having strong irrigation

economies (India 64 percent, China 70 percent). Exceeding this level of irrigation development is likely to increase costs and decrease soil capability, rendering investment less viable. Only about 7 percent of the area equipped for irrigation is supplied by groundwater sources (220,000 ha in 1990), with some 18,000 wells operating. Less than 1 percent (8,000 ha) is equipped with micro-irrigation.

Development in the last century was slow initially but accelerated after the oil boom. In the first half of the twentieth century, run of the river irrigation was developed, either simply by a channel dug on the river banks or by a series of barrages and weirs for raising water levels to facilitate off-take. In the vicinity of Baghdad, the Euphrates lies at a higher altitude than Tigris, so water can flow naturally across the plains and drain into the Tigris. From the 1920s onwards, pump irrigation was also developed by large landholders along the margins of the rivers. At a later period, irrigation also expanded in the upland plains of the north around Kirkuk and on the terraces at the upper end of the flood plains where salinity was less of a problem. From the 1970s onwards, the oil boom fuelled a vast state investment program in irrigation schemes with lined canals and a network of outfall drainage channels.

Irrigation development has not improved land productivity much. Agriculture in Iraq has traditionally been very extensive, with land productivity amongst the lowest in the world. Cropping intensities were low and water management practices rudimentary. Over the last three decades, considerable investment in modern irrigation and drainage has created potential for higher cropping intensity and productivity.

However, this potential has been only very partially realized. Land management practices have generally remained extensive throughout the modern period, and have deteriorated considerably over the last ten years. Cereals yields have not changed much in the last forty years (Table 5.2).

Table 5.2: Cereals yields in Iraq 1961-2003 (kg/ha)

	Wheat	Rice
1961-70	756	2,876
1971-80	835	2,806
1981-90	853	2,835
1991-2003	697	1,895
1961-2003	*799*	*2,350*

5.2 Irrigation technology and performance

Off farm and conveyance structures. The infrastructure has broken down on a wide scale. Headworks have operated for a long time without maintenance or proper management plans. Most pumping stations were built in early 1970's - only three are relatively new. An estimated US$1.5 billion was spent under the Oil-for-Food program to replace worn-out components but recent reports are that over 500 large irrigation and drainage pumping stations are in a bad state. Most are severely run down, and some can no longer be repaired.[12]

The primary, secondary and tertiary canal networks are also degraded due to lack of maintenance. Deterioration of canal linings, outgrowth of weeds and sedimentation has reduced conveyance capacity significantly. Under the Oil for Food program, heavy equipment for canal cleaning was procured, but these were inadequate to arrest the deterioration of the system. The war of 2003 and the following break down of civil law and order further contributed to the destruction of many of the sector's existing assets.

[12] In FY2003, the donors provided emergency funding to replace 31 pumps and ancillary equipment to prevent impending breakdown of the system.

On-farm infrastructure and water management. The traditional irrigation method in Iraq of flooding the land with water is an extensive method that overcomes problems of unevenness of the land and does not require costly furrowing or grading. The disadvantages are waterlogging, salinization and low efficiency – on average only 40 percent of the water applied is beneficially used by the plant in evapo-transpiration (meaning: net crop consumption of water). Traditionally farmers managed the accumulation of salt by leaving land fallow every alternate year, which allowed the water table to drop, and rainfall to leach out salts. But with greater water availability from modern irrigation schemes, and fragmentation of large estates into smaller parcels, farmers abandoned the alternate year fallows, resulting in accumulation of salts. The land reclamation projects undertaken in the 1980s helped improve on-farm irrigation efficiency with land planning and land leveling. The use of graded border and furrows and levelled basins, combined with good irrigation practices, can increase efficiency as high as 70 percent.

5.3 Drainage and land reclamation

The drainage problem. Most of Iraq's terrain is very flat, which makes the plains susceptible to flooding and hinders drainage. Low permeability is predominant in the upper soil horizons, and the groundwater table is typically near the surface due to restricted natural drainage outflow. Poor draining soils above a high water table rapidly become waterlogged. All the pore spaces up to the soil surface are saturated and crop growth is stifled. Salinization results when undrained water evaporates from the soil profile leaving the accumulated salts (Box 5.1).

Iraq's irrigation water is not naturally saline. The problem has arisen from the combination of over-irrigation, poor drainage, and high evaporation rates. The increasing salinity of irrigation water is exacerbating the problems[13]. The salinity in the downstream stretches of Tigris and particularly in the Euphrates River is very high during the summer. This is proving particularly an impediment to rice cultivation.

Box 5.1: Salinization and waterlogging

Soil salinization results from accumulation of soluble salts in the upper parts of the soil profile due to salts deposited from irrigation water, or by evaporation of irrigation and groundwater through capillary action, particularly in fallow areas.

Waterlogging occurs where natural or artificial drainage does not exist and is caused by over-irrigation, seepage from canals, overflow from rivers and canals in addition to tidal actions in coastal areas. The waterlogged soils are characterized by the complete saturation of all pore spaces up to the soil surface either permanently or intermittently, depending on the seasonal fluctuation of the groundwater table and the extent of drainage available.

The drainage system and reclamation of salt affected soils. Iraq has developed viable and economic solutions for "reclamation" of affected lands. The technology developed include heavy leaching by 5-25,000 m^3 water for flushing out accumulated salts, constructing buried field drains, open collector drains and outfall drains. The leaching is usually associated with reclamation cropping using salt tolerant crops, to bring salinity levels down. Following this, normal cultivation commences, which includes continuous doses of a leaching fraction added to

[13] The Ministry of Water Resources estimates that in 1995 about 17 million tons of salt were transported through the drainage system to the Gulf.

the irrigation water dose. This may increase by 15-30 percent the regular irrigation water dose. Land reclamation can efficiently be combined with land leveling and planning, which provide even surface and gradient needed for efficient furrow irrigation. A reclamation program begun in 1978 was designed to reclaim over 700,000 ha, at an average cost of $2,000/ha. Drainage pumps are used to lift the effluent water into the out-falls, which convey the water to the Main Outfall Drain (Iraq's "third river", referenced in Box 3.1), and into the Shatt al Arab.

Degradation of the drainage system. The drainage system is incomplete. It is estimated that about 500,000 ha are served by open drains and collectors and about 375,000 ha are equipped with in-field sub-surface drainage. Thus, less than one quarter of Iraq's area developed for irrigation is equipped for drainage. In addition, the functioning of the drainage system has deteriorated considerably. Many drains are blocked, and many of the drainage pumps used for lifting effluents into the outfalls have broken down.

The incomplete state of the drainage system and the breakdown of its management, combined with increases in the salt load from upstream effluents, have led to soil salinity and waterlogging now affecting three quarters of the irrigated area.[14] Salinization and waterlogging have reportedly contributed to the abandonment of about 1.5 million ha, which is 40 percent of the area developed for irrigation. The worst affected areas are the plains between the Tigris and Euphrates in the centre and south, including the governorates of Wassit, Missan, Kabala, Babylon, Baghdad, Diyala, Najaf, Thiqar and Basra.

5.4 Irrigated agriculture

Sector Performance. If production figures are reliable, the contribution of irrigation to the growth of agricultural output does not appear commensurate with the high investment and subsidy the state has given. Over a forty-year series of national cereals production data, it is hard to see the growth in output normally associated with a controlled water source (Table 5.3). Despite extensive irrigation development, agricultural output has long been unable to keep up with the growth in domestic demand. In the 1950s, Iraq's agriculture was able to supply all the cereal requirements of a much smaller population[15], and was an exporter of barley and dates. By the 1960s, agriculture was trailing demand, and imports accounted for about 15 percent of the food supplies, increasing to 33 percent in the 1970s and to over 50 percent in the 1980s. It is estimated that if all areas equipped for irrigation were returned to production, domestic agriculture is currently capable of meeting only about 30-40 percent of national cereal requirements. The protracted crisis of the 1990s affected irrigated agriculture severely.

Table 5.3 Cereals production in Iraq 1961-2003 (000 MT)

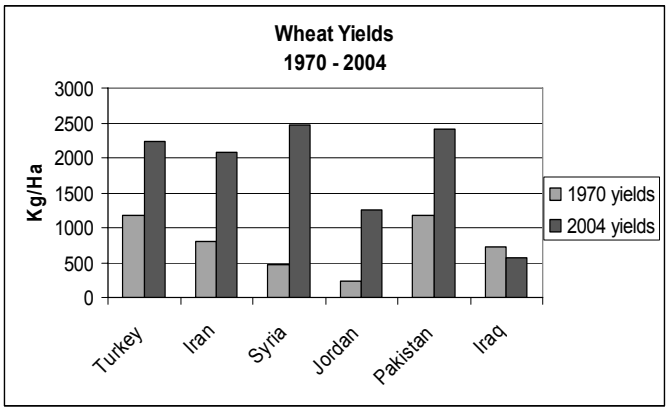
	Wheat	Rice
1961-70	988	204
1971-80	1,115	172
1981-90	896	163
1991-2003	1,092	234
Average 1961-2003	*1,055*	*188*

[14] Recent estimates are that 4% of the irrigated area is severely saline, 50% medium saline, and 20% moderately saline.

[15] See, Federal Research Division of Library of Congress, "Country Studies" Iraq in website, www.countrystudies.us/Iraq/. According to one estimate, the average population of Iraq from mid-1950s to mid-1960s is 6 to 8 million people: see website, www.library.uu.nl/wesp/populastat/Asia/iraq.htm

Crop yields have declined significantly and productivity of the main cereal crops—wheat, barley, and rice – is lower today than forty years ago referenced earlier in Table 5.2. Iraq's yields have been declining over a period when yields in neighboring countries have generally doubled (adjacent Figure 5.2). The yield of dates, the premier tree crop of Iraq, has dropped from 32 kg/tree to about 10 kg/tree. Details of Iraq's agriculture and its economic implications are further detailed in Annex 3.

Figure 5.2: Crop yield in Iraq *vis a vis* other countries



The effects of the agricultural policy regime. From the 1980s, government interventionism and crippling controls created massive distortions throughout the supply chain. Controls focussed on strategic crops, all of which are largely grown as irrigated crops: wheat, maize, cotton and sunflower. The objective of the policy was to ensure that farmers produced crops that were in high demand at prices that kept basic products affordable. The mechanism was a series of controls over the whole supply chain, from determining cropping patterns, to subsidizing input use, to selling to state agencies at below import parity levels.

5.5 The farming population

Characteristics of the farming population. Iraq's rural population lives in more than 10,000 villages with an average population of 465 persons with about 48 households per village. On average, villages in the center and southern governorates are located approximately five kilometers from a paved road, 19 km from input markets, 20 km from fruit and vegetable markets, and 32 km from wholesale grain markets. Farms vary in size between two and twelve hectares (10-50 dunums).

Irrigation and the poor. Poverty is prevalent in rural areas, with 1.6 million of the chronically poor (25 percent of the total) living in the countryside and per capita incomes in rural households averaging less than half the MDG Target 1 of $1 a day: annual per capita incomes in the rural centre and south average $153, in the north just $112 (source: FAO Database). These income levels are far below average GDP per capita levels, which are in excess of $900 per head, a startling indicator of Iraq's failure to devise an agricultural economic system, which shares the benefits of oil income equitably with its rural population. Unemployment and underemployment are pervasive, and all indicators of human and social development are worse for rural areas than for towns (Table 5.4).

A recent study estimated that more than half of Iraq's poor farm households would directly benefit from improvements in the irrigation economy, and international experience confirms that irrigation development can have a high local multiplier effect and a significant impact on the poor. In Brazil, irrigation schemes covering 85,000 ha created over two jobs for every hectare farmed, and a further four jobs in downstream activities and through the multiplier effect from the incomes generated. In total, half a million new jobs were created. In the West Delta Irrigation

Project in Egypt the development of about 100,000 ha of irrigated lands is expected to lead to settlement of between 800,000 and 1 million people, including on-farm and off-farm labor, businessmen, service providers and their families. An exhaustive new study by the Irrigation Water Management Institute (IWMI) of 26 irrigation schemes across six countries in Asia found that income inequality and poverty rates were consistently lower for irrigated areas.

Table 5.4: Human and social development

Human and social development parameters	percent rural	percent urban
Access to safe sanitation	4	47
Access to safe water	24	60
Paved road to house	10	52
Literacy	50	70
Primary enrolment	69	83
Lowest income quintile nationally	26	18
House with firearms	47	22

However, the impact of irrigation on the poor has to further analyze. For example, Iraq's rural poor have much smaller land holdings. Hence, improving all irrigated areas may not have particularly progressive effect on the poor. In fact, as the poor are generally tail-enders, or farming marginal land, the effect might be regressive. Under such circumstances, irrigation could still have a beneficial impact on the poor, both directly and through employment creation and stimulation of the local economy, if it can be targeted at the areas with the highest concentration of the poor. For example, households in Mutthana and Thi Qar governorates have the lowest disposable income and the highest concentration of vulnerable households.

Another effective form of targeting is to select the type of investments that is most pro-poor. For example, in a poor dominated governorate like Tameem, which relies on rainfed agriculture, matching grants for water harvesting or supplementary irrigation in rainfed farming could be efficient pro-poor investments. Investing on improvement of drainage could positively impact poor as most of the poor farmers are at the tail end of the systems where drainage problems accumulate.

Chapter 6: Water supply and sanitation

6.1 The municipal and industrial water and sanitation sector

Prior to the Gulf War in 1991, the water and sanitation services in Iraq were fairly robust. Access to potable water was 95 percent in urban areas with an average supply of about 330 liters per person per day in Baghdad and about 250 liters per person per day in other cities. Rural water coverage was 75 percent with an average supply of about 180 liters per person per day. Access to sanitary services was 75 percent in urban areas (25 percent connected to sewerage systems and 50 percent with on-site septic tanks) and 40 percent in rural areas.

After 1991, the water and sanitation sector has declined considerably. Aging infrastructure, poorly maintained equipment, leaking water and sewer networks, acute understaffing, low technical capacity and poor morale are some of the key problems in the sector. Unsafe drinking water and unhygienic sanitary practices have increased incidences of water-borne diseases at an alarming rate, and are responsible for malnutrition, morbidity and mortality of infants and children under five. Nearly 40 percent of children attending health centers suffer from gastro-intestinal diseases. It is estimated that water and sanitation related diseases are responsible for about 25 percent of all deaths of children in Iraq.

Local water and sanitation financing and operations. Operations are almost entirely financed from the central government budget and are managed by the local Directorates of the Ministry of Municipalities and Public Works (MMPW). The Ministry controls the area under 15 governorates of the centre and south, covering a total population of about 19 million. In the north, the Ministry of Municipalities of the Kurdistan Regional Government (KRG) manages water supply and sanitation in the three northern governorates, with a total population of about 3.7 million. In Baghdad, the municipality is responsible for water supply and sanitation, catering approximately 5.5 million inhabitants.

6.2 Problems and their causes

Water Supply. Potable water coverage and service have deteriorated markedly. Recent data indicate a substantial deterioration in access to safe and stable drinking water, particularly in urban areas. In contrast to the near complete urban coverage prevailing before 1991, the current access is estimated at about 73 percent. Similarly, coverage in rural areas has dropped from around 75 percent to 40-45 percent. Water service in most cities is now limited to a few hours in a day and is of poor quality.

The supply system suffers from high technical and commercial losses, contributing to low operational efficiency. The current production capacity is 6.8 million cubic meters per day[16] (equivalent to about 240 liters per capita per day). However, the efficiency of the supply system is only 32 percent of the production, with water losses constituting two-third of the water pumped and treated. The actual amount of potable water reaching customers is about 2.17 million cubic meters per day. For over half of the connected population, the supply is extremely unreliable, with households not receiving water for days at a time. The high level of losses stems from the

[16] MMPW, "Water and Sanitation: Prioritized Projects to be Funded by International Donors," The Dead Sea, Jordan, 18-19th July 2005.

deteriorating condition of the water treatment facilities, physical damages from recent wars and the attendant civil pillaging, the ageing municipal network, the lack of proper maintenance over past decade and a half, and electrical power cuts of up to 12-16 hours per day.

Water Quality. The quality of drinking water in Iraq does not meet the World Health Organization or national water quality standards. The causes are decline in the quality of raw water drawn from rivers, the perilous state of water treatment plants and the operational problems linked to distribution. Surface water in Iraq, the primary source for drinking water, is severely polluted, particularly in the centre and south. Water treatment plants are mostly dilapidated and barely operational. For limiting the risk of contamination, residual chlorine levels are set at very high levels (at 0.5 mg/litre). The race to meet demand has led to by-passing of elevated tanks and the direct boosting of water into the distribution system. Low pressure and discontinuous water supply have increased the risks of contamination, especially in areas with high water table such as Baghdad and the southern governorates. These problems are further aggravated in rural areas where the community is responsible for operation and maintenance.

Wastewater. Wastewater collection and treatment facilities are only available in a few large cities and coverage is substantially lower than potable water service coverage. Only 14 cities out of a total of 252 urban centers have wastewater treatment plants. Wastewater treatment capacity is currently 350,000 cubic meters per day (equivalent to about 12 liters per capita per day), enough to serve about 8 percent of the population. Wherever sewage collection exists, connection rates range between 20-40 percent. Most of the existing sewerage systems require extensive replacement, rehabilitation and upgrading. Broken-down pumping stations have resulted in clogging of sewers causing backflows of sewage into streets, homes, hospitals and schools. Leakages in networks are causing sewage to seep back into the water supply system. About 70 percent of wastewater is discharged untreated into the river system. Most of the untreated wastewater runs into shallow surface channels, illegal connections to the storm water networks or, in many cases, directly into rivers and lakes. The river system receives untreated waste from more than 20 million people, three quarters of the total population of Iraq. About one million tons of raw sewage is discharged into the rivers daily.

Main causes of the problems. There has been no recent investment in the system. No new water supply or sanitation project has been undertaken since 1989, and the investment budget has been very limited. Currently, the uncertainty about availability of donor funds and budgetary allocations from the Government has slowed the pace of rehabilitation. The budget has provided, on average, less than half of the minimum required for operation and maintenance. As a result, the levels of operation and maintenance have been low, with directorates lacking equipments, machineries and spare parts.

As recently as 2005, the sector lacked budget for restoring service standards. National budget allocations for drinking water, sanitation and municipal services in the years 2004 and 2005 have approximated US$200 million. About one third of this amount was directed towards operation and maintenance of the system while the balance two thirds were towards new investments. This translates into about $10 per capita, far below international standards.

Water tariffs are extremely low, whilst operational costs are rising fast. Domestic water in Iraq is heavily subsidized, with tariff below one US cent/m3. The average annual revenue per connection is about 9,300 ID ($6). In most areas, water consumption is not metered. Although meters are installed in most households in Baghdad, 90 percent of these are out of order. Revenues cover 2-5 percent of the costs of operation and maintenance of the water and sanitation

systems. Recent attempts (in early 2005) by the MMPW and the Ministry of Finance (MoF) to reduce subsidies have not been successful and this situation is likely to persist in the near future.

A decade of crisis in the country has eroded human capital in the sector. Directorates lack trained technical and management staff to operate and maintain water and wastewater facilities. There is no budget for training, although some minimum training is being carried out abroad (mostly in Jordan) with the support of international agencies, such as the UN, JICA, WHO and USAID. The World Bank is providing the Ministry of Public Works technical assistance for a national water supply and wastewater sector study (Box 6.1).

Box 6.1: Overview of the National Water Supply and Wastewater Sector Study

The provision of water and wastewater services in Iraq has become of critical importance over the past few years because of the troubled political situation, successive wars, international sanctions, and mismanagement of resources. No new projects have been implemented since 1986, resulting in inefficient water and wastewater systems in terms of both capacity and quality. The current situation can be described as critical and needs immediate intervention to provide clean drinking water and adequate sewage services and to improve health and environmental conditions. Iraq's water supply and sanitation problems are more related to infrastructure rather than scarcity of resource. With a continued worsening of water supply, both in quantity and quality, and demand trends and water policy and investment performance, water supply has become a crisis with severe impacts on health and the environment. Therefore, the World Bank, upon the request of the Ministry of Municipalities and Public Works (MMPW) and together with other donors, is trying to extend support to Iraqis to establish sound and efficient water and wastewater services, which address the most pressing immediate needs, and involve the implementation of proper sector planning. The overall objective of the sector study is to enhance water supply and wastewater services in Iraq in terms of quantity, quality, and coverage. This objective would be achieved through the development and eventual adoption of: i) appropriate sector strategies and policies statements, ii) pertinent options for restructuring sector institutions, iii) a medium term investment program to enhance current services, iv) an emergency plan for efficient asset management, and v) an indicative sector-wide financing plan.

Source: World Bank Terms of Reference for technical assistance in water supply and sanitation

At the institutional and structural level, the fundamental problem is the lack of financial and managerial autonomy needed to run water supply and sanitation as a business. The local Directorates of the MMPW are unable to operate as self standing, profit making entities because of the centralized administrative approach to service provision and because low tariffs make financial viability impossible. The top down organization structure inhibits development of a service orientation or customer responsiveness approach. Little attention is paid to environmental issues and stakeholder participation, particularly that of women stakeholders.

Chapter 7: Challenges and priorities for water resources management

Complexity of multi-dimensional challenges to water resources management. In reviewing the status of existing conditions, obvious challenges and issues result from the multi-dimensional demands on the water sector. Further complicating the situation is the limited availability of water within Iraq, and its dependency on the upstream riparians. The challenges identified and the priorities defined are in terms of immediate actions or longer-term actions that are more appropriate through time. A detailed analysis of the challenges and priorities for immediate and long-term activities to address water resources management, in dominant sectors, and the Iraqi government's intent to address them, are detailed in Annex 4 while Table 7.1 provides a summary of those challenges and priorities.

Table 7.1: Summary of Challenges and Priorities

Challenges/Policy Concerns	Priorities
Water Resources Management	
• A dysfunctional water governance system • A need to balance national and sub-national interests • A deteriorating water balance • Dilapidating infrastructure and the risk of dam failure with catastrophic flooding • Declining water quality and degenerating water dependent ecosystems.	In the interim, immediate priority is to achieve rapid targeted improvements in supply management, including targeted rehabilitation of key assets. In the early post conflict period, work should start on the governance and demand management agenda. In the medium-term, an integrated approach to balancing supply and demand is required.
Agriculture and Irrigation	
On the *irrigation* side: • A widely dysfunctional water service unaccountable to users. • A chronic structural problem with waterlogging and salinization On the *agriculture* side: • A distorted incentive framework. • An array of state managed agricultural services, which have largely broken down • A governance structure characterized by a deteriorated administrative apparatus.	In the interim, immediate-term, rapid short-term improvements in the modernization of irrigation and drainage network. The medium to long-term governance and institutional agenda should reflect principles of decentralization, autonomy and farmer empowerment. The medium to long-term decisions on the role of the agricultural in the overall economy will be required in order to set future irrigation investment policy. The medium to long-term, criteria for public investment in the medium and long-term need to be set.

Water Supply and Sanitation	
• The dramatic drop in coverage and service standards in domestic supply and sanitation • The consequent decline in living standards and health status	In the interim, immediate-term, a first priority is focus on restoring services.
International Waters	
• Upstream riparian development of water resources is a growing threat to Iraq's water resource. • There is no overall agreement binding the three riparians.	In the interim immediate term, define the institutional and technical needs for cooperation

Chapter 8: The water development agenda and strategic actions

8.1 Iraq's development agenda

Iraq's development agenda for water resources compliments the priorities identified in the Iraq's National Development Strategy, detailed in Annex 6, emphasizes the future for a sustainable water sector requires good governance, market based and private sector-led growth, and diversification away from dependency on oil. This interim CWRAS provides a framework to understand better the status of Iraq's water resources within the context of the multi-dimensional demands on the water sector. Further complicating the situation is the limited availability of water within Iraq, and its dependency on the upstream riparians. The complexity of water resources management in terms of storage, allocation, and use must take into consideration hydropower, urban, irrigated agriculture, and environmental demands.

The CWRAS serves as a guiding document for priority investments supported by the donors and the World Bank. The World Bank and other donors have been engaged in the MENA's water sector. Current coordination efforts with other donors, and supporting arguments for the World Bank and donors continued engagement in Iraq's water sector are detailed in Annex 7.

In this immediate emergency phase, the government should take two factors into consideration for infrastructure rehabilitation: 1) priorities need to be based on cost effectiveness criteria, for example, cost per unit volume of water saved, or cost per hectare of land irrigated or drained, and 2) investments made today should not prejudice possible future decisions on supply or use. As such, any rehabilitation decisions await the preliminary findings of the National Water Master Plan. However, to respond to the Iraqi government request this immediate phase, provides an opportunity for change and empowers the Iraqi government to define and test new institutional approaches, such as, employing labor-intensive approaches where possible (to generate local employment); or by consulting users on the priorities for rehabilitation (to foster accountability) accountability); or by extending national interests beyond political boundaries and foster international cooperation; while at the same time addressing immediate rehabilitation needs.

8.2 Strategic approach to address the challenges

An evaluation of the challenges and priorities, in collaboration with Iraqi counterparts, defined the strategic options, for interim engagement includes a) immediate reconstruction needs focusing on rehabilitating and modernizing key assets, b) building institutional capacity to create mechanisms to balance the interest between various stakeholders, and c) supporting international cooperation on transboundary resources. Annex 4 elaborates the evaluation process, in the management, agriculture, and WS&S sub-sectors, and discusses opportunities for the immediate and longer term; however, the immediate action, within these sub-sectors, are defined within this chapter and summarized in Table 8.1.

Through a series of policy notes, consultations with Iraqi counterparts and engagement with a broader group of stakeholders in the country the next three years will develop a coherent program of assistance, with a policy framework enabling a realistic evaluation of demand and supply for water services. The underlying logic is that demand for water is very much driven by factors outside and inside the sector: the overall policy environment towards agriculture and energy, plus the specific water financing and institutional rules. Notable determinants of the demand are

agricultural policies, energy policies, water-pricing policies, revenue sharing mechanisms, and water rights regimes, less obvious are the demands for sustainable environmental flows for marshland integrity. These policies directives should suggest mechanisms by which water supply and irrigation service providers are made accountable to users of those services. In the longer-term, this involves introducing procedures that involve communities in decision making at different stages of the project and policy cycle.

On the supply side, targeted investments in priority water infrastructure rehabilitation and modernization investments are necessary to achieve immediate improvements in dam safety, in the agricultural network, and in urban water supply. Investments in water security can therefore be guided by:

- Rehabilitation of essential water infrastructure;
- Critical wastewater infrastructure based on performance criteria (i.e. through measured water quality improvements);
- Irrigation rehabilitation led by suitable incentives for investing in water-conservation technologies;
- Drainage infrastructure rehabilitation necessary to restore productivity of farmlands; and
- Engaging in an international process of sharing data and know-how with the other riparian states in the euphrates-tigris basin.

The CWRAS provides a framework for a strengthened institutional environment to enable the Iraqi government at the national and sub-national levels together, with effected stakeholders effectively take responsibility in making the appropriate decision to plan for and manage water resource. In terms of terms of the strategic priorities for support to the water sector six broad areas are suggested:

- First, investments in rehabilitating essential trunk infrastructure (dams and primary canals) that form the backbone of the Iraqi hydraulic infrastructure.

- Second, investments in rehabilitating essential water supply, sanitation, irrigation and drainage infrastructure the disruption of which has directly affected the welfare of communities.

- Third, support agricultural modernization in pilot areas to illustrate good and cost-effective practices.

- Fourth support through analytical and advisory activities develop a new water policy framework, along with governance and institutional reforms that focuses on water resources management and demand management, along with completion of the Iraq water resources master plan.

- Fifth, support the government's efforts to build decentralized capacity to plan and manage water infrastructure, and build accountability of water service providers to service users.

- Finally, facilitate a process of building collaboration between Iraq and the other riparian countries on the Tigris-Euphrates river systems, so that benefits from sharing the water resources are shared within the basin.

Expected outcomes from donor support

Through targeted priority investments, the World Bank and the donor community could provide support to enable the Iraqi government at the national and sub-national levels together, with pertinent stakeholders increasingly take responsibility in making the appropriate decision to plan for and manage water resources. An inclusive decision-making process, based on the principles of decentralization, stakeholder participation, demand management, and environmental sustainability, will be progressively realized through a strengthened governance structure at the most appropriate level: (1) from the community and provincial levels, by engaging all stakeholders affected by management decisions, and to (2) the international level, by ensuring that riparian cooperation on both Euphrates and Tigris would facilitate the mutual interest of all riparians.

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Table 8.1 Summary of water sector challenges to engagement

Challenges / Policy Concerns	Priorities	Options for Engagement	Links to On-going Work
Water Resources Management			
• A dysfunctional water governance system • A need to balance national and sub-national interests • A deteriorating water balance • Dilapidating infrastructure and the risk of dam failure with catastrophic flooding • Declining water quality and degenerating water dependent ecosystems.	The immediate-term priority is to achieve rapid short-term improvements in supply management, including targeted rehabilitation of key assets. In the early post conflict period, work should start on the governance and demand management agenda. In the medium-term, an integrated approach to balancing supply and demand is required.	- Finance the second phase of the National Water Master Plan (for which the first phase, nearing completion, is financed by USAID). - As the preparation of the National Water Master Plan progresses, build on the institutional recommendations outlined in the Plan, as it pertains to piloting priority activities, including the piloting needed for managing water resources/services at the lowest level. - Prepare an analytical economic assessment of the water sector, as it pertains to supply and demand issues for agriculture, energy, and municipal services, and provide policy recommendations. - Conduct appropriate training to build capacity to support an integrated approach to water at the national inter-ministerial level, including inter-ministerial coordination in investment planning and budgeting; and build decentralized capacity to provide equivalent support at the provincial levels (government request).	MOWR Water Master Plan, and update to the *Strategic Vision for Management of Iraq's Water Resources*
Irrigation and Drainage			
On the *irrigation* side: • A widely dysfunctional water service unaccountable to users. • A chronic structural problem with waterlogging and salinization On the *agriculture* side:	- For the immediate-term, rapid short-term improvements in the irrigation and drainage network are essential. - The medium to long-term governance and institutional agenda should reflect principles of decentralization, autonomy, and farmer empowerment. - Decisions on the role of the	- Support basic rehabilitation of critical water resources infrastructure, specifically priority dams at risk and dilapidated irrigation and drainage networks - Invest in economically-viable modernization of off-farm and on-farm systems, in targeted provincial sites agreed-upon with MoWR and Ministry of Agriculture.	MOWR Investment Plan Framework for Agricultural and Rural Policy Institutional Development (WB) ECIRP (WB) Community Action

Challenges / Policy Concerns	Priorities	Options for Engagement	Links to On-going Work
• A distorted incentive framework. • An array of state managed agricultural services which have largely broken down • A governance structure characterized by a deteriorated administrative apparatus.	agricultural in the overall economy will be required in order to set future irrigation investment policy. - Criteria for public investment in the medium and long term need to be set.		Program and ARDI (USAID) FAO projects in irrigation, drainage, and Seed Industry
Water Supply and Sanitation			
▪ The dramatic drop in coverage and service standards in domestic supply and sanitation ▪ The consequent decline in living standards and health status.	In the interim, **immediate-term**, a first priority is focus on restoring services.	Support reconstruction of municipal facilities and restoration of service levels based on the findings from the World Bank supported National WS&S sector study currently under preparation.	Drinking Water and Wastewater Investment Program based on National Development Strategy (NDS, 2005) MMPW Organizational Restructuring Plan
International Waters			
▪ Upstream riparian development of water resources is a growing threat to Iraq's water resource. ▪ There is no overall agreement binding the three riparians	For the immediate term, define the institutional and technical needs for cooperation.	Support the riparian governments in taking initial efforts toward engaging all riparians to design and implement a technical data exchange program	-

References

Kolars, John and William Mitchell, *The Euphrates River and the Southeast Anatolia Development Project*, Southern Illinois, University Press, 1991.

Background Reports

1. Overview Of Water Resources Management Issues
2. Irrigation , Drainage And Land Reclamation
3. Hydraulic And Hydro-geological Characteristics Of The Water Resources System
4. Organization Of An Community Participation In Water Management
5. Impact Of Food And Agricultural Policies in Water Security In Iraq
6. Tranboundary Waters
7. Mesopotamian marshlands
8. Targeting Poverty In Irrigation And Drainage Rehabilitation
9. Water Supply and Sanitation Surveys

Annexes

Annex 1: Maps

1. Physical Geography
2. Rainfall Distribution
3. Rivers and Lakes

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Annex 3: Agriculture and the Economy

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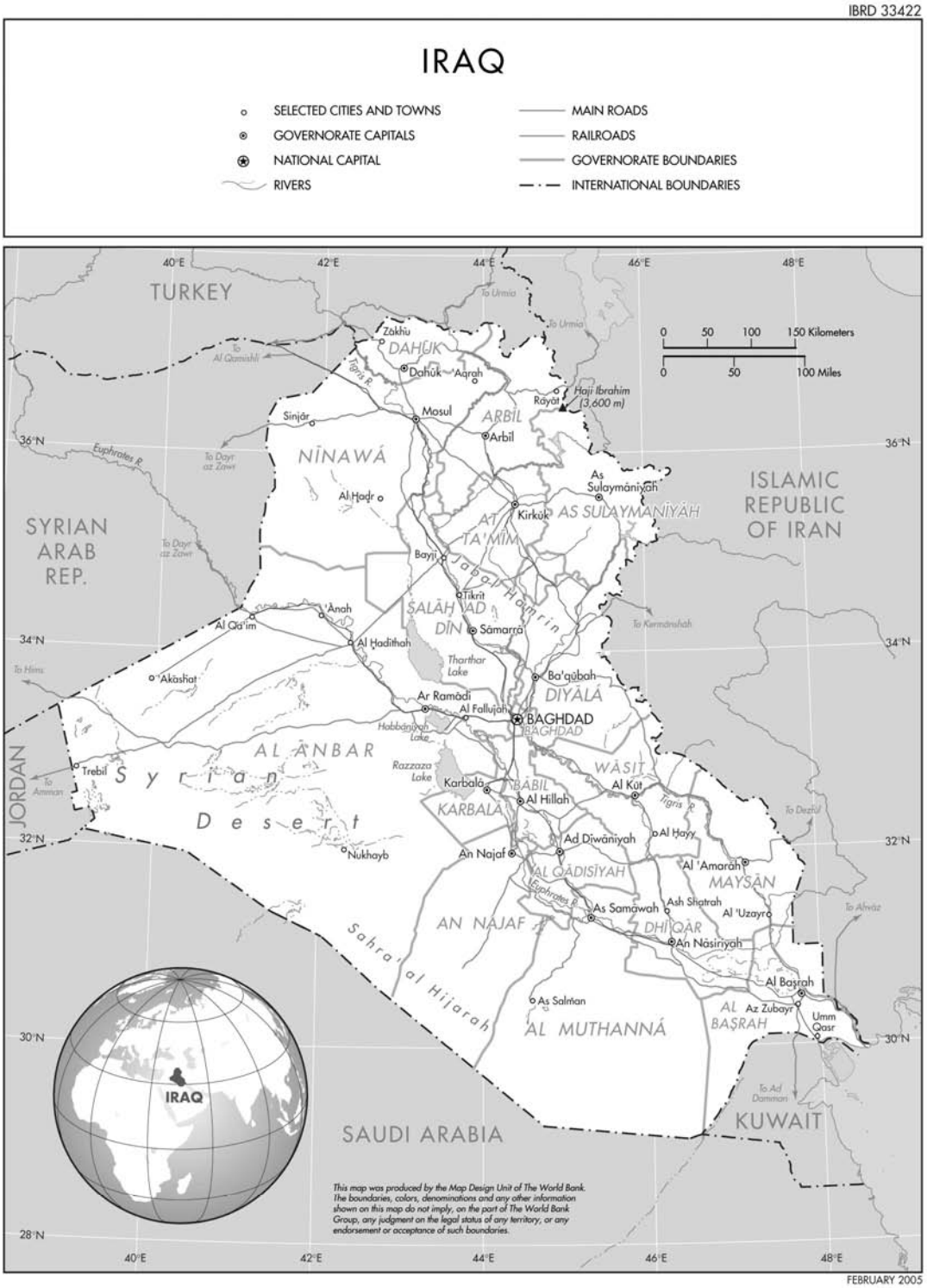
Annex 5: IWRM & Lessons in Transboundary Cooperation

Annex 6: Iraq's National Development Strategy

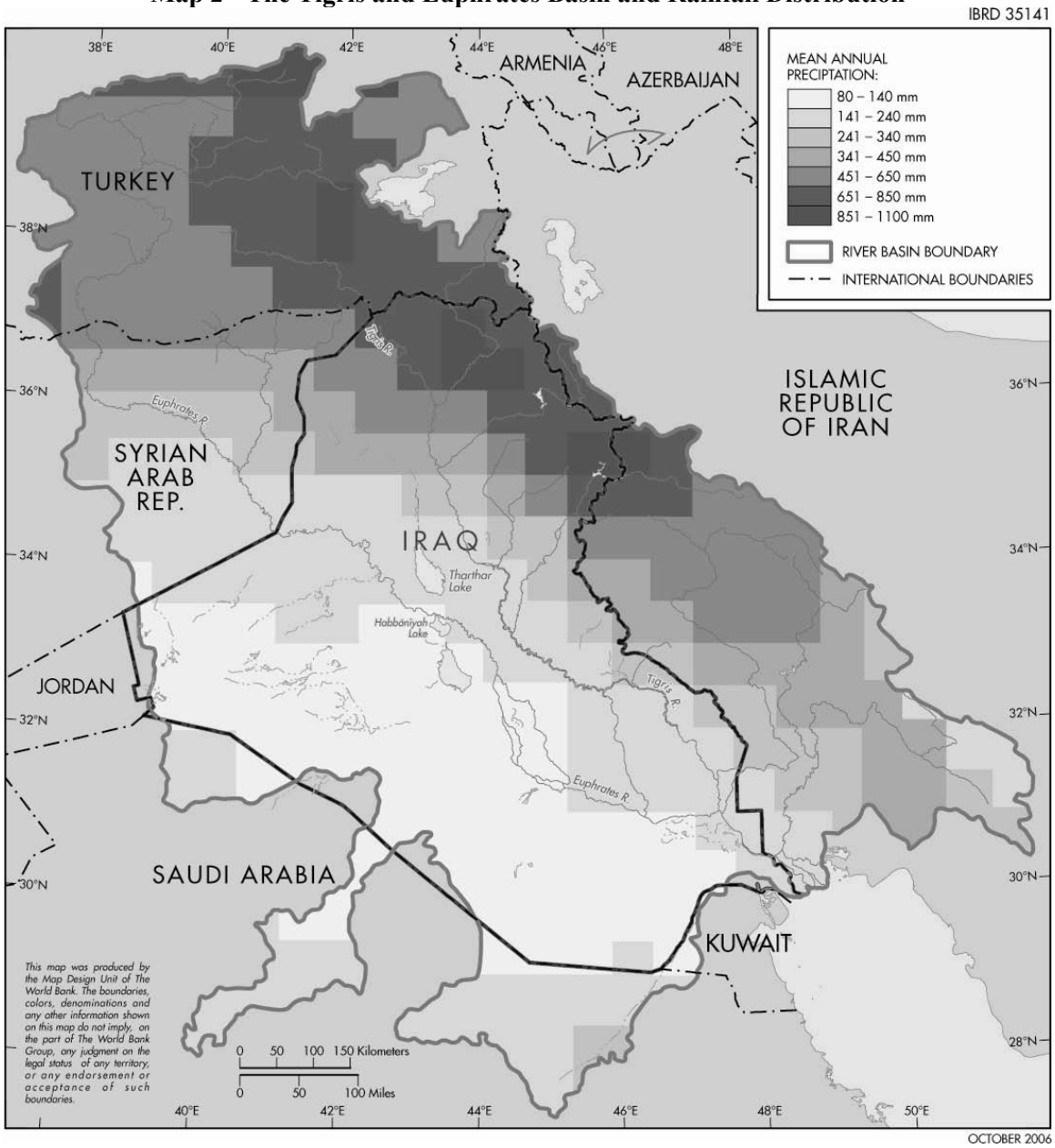
Annex 7: World Bank and Donor Engagement in Iraq

Annex 1

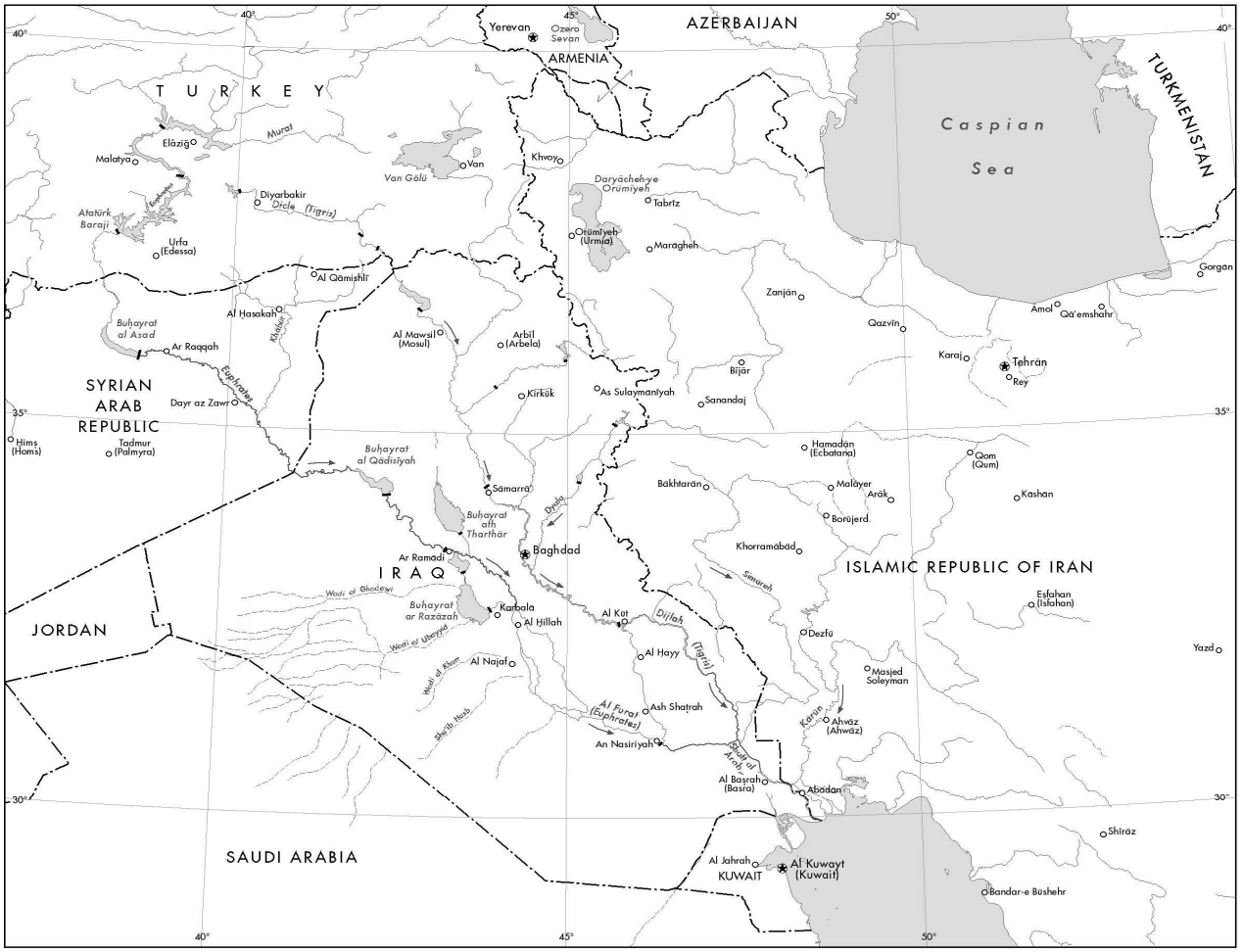
Map 1 - Political Geography

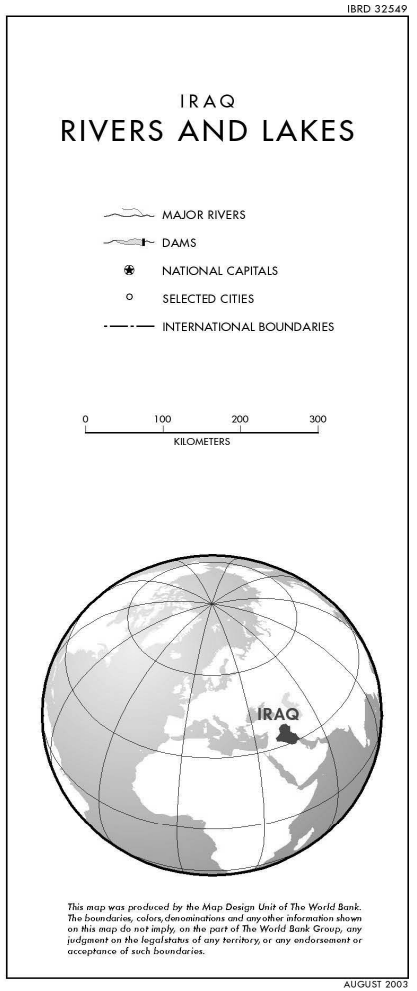


Map 2 - The Tigris and Euphrates Basin and Rainfall Distribution



Map 3 - Rivers and Lakes





Annex 2

Supporting Sectoral Information and Data

Table A2.1: Mean annual water potential of Tigris River in Iraq 1930-2004 (BCM)

River or tributary	Country of origin	percent of basin in Iraq	Flow from outside Iraq	Average flow into Tigris in Iraq
Tigris entering Iraq	Turkey, then Syria	0 percent	20.9	20.9
Greater Zab	Turkey	62 percent	5.7	13.6
Lesser Zab	Iran	74 percent	2.4	6.7
Al Adhaim	Iraq	100 percent	-	0.7
Diyala	Iran	75 percent	3.6	6.1
Nahr al Tib, Dewarege, Shehabi	Iran			(1.0)
Al Karkha	Iran			(6.3)
Total Tigris in Iraq				**48.0**
Originating from	*Turkey*		*26.0*	*48.0*
	Iran		*6.0*	

Source: Hydrological data of Tigris tributaries (FAO Annex 1 table A1-6).
Flows of Nahr al Tib etc. and Karhheh not included in total as they cannot be harnessed economically.

Figure A2.1: Depletion of water from Euphrates

Source: Frederick Michael Lorenz, Jackson School of International Studies, University of Washington (Adopted from Kolars and Mitchell, 1991)

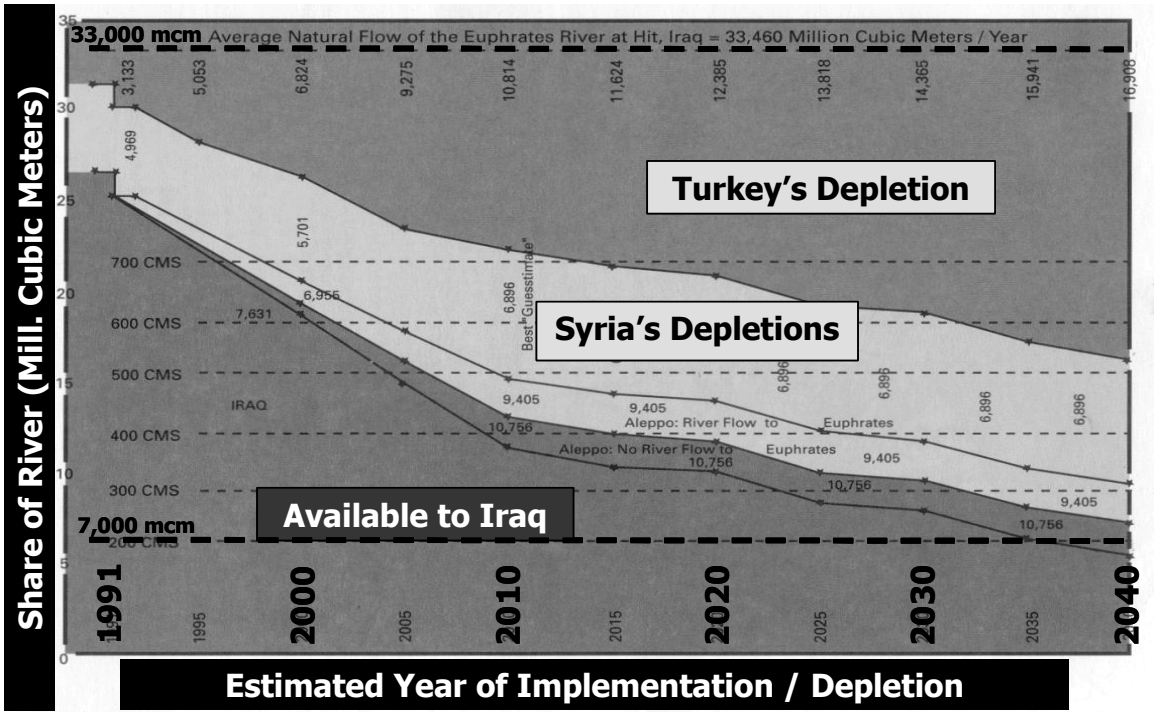
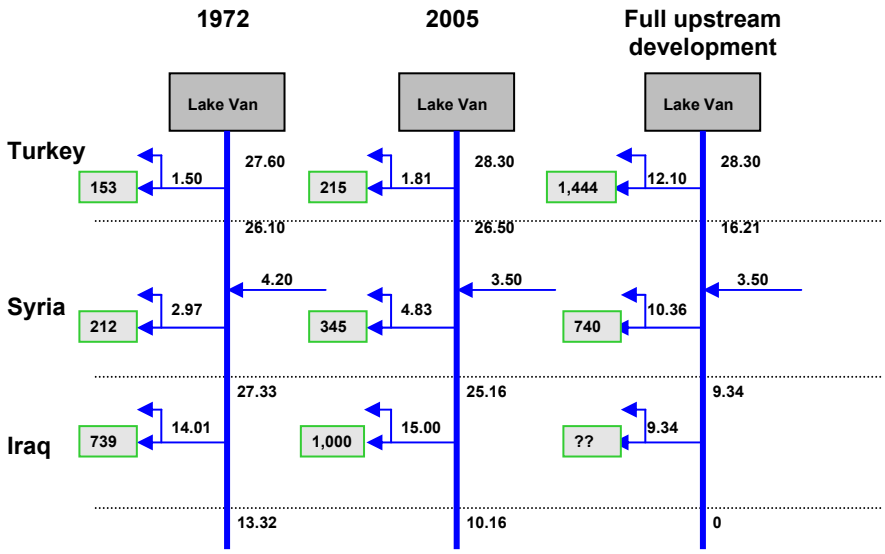


Figure A2.2: Schematic of diminishing transboundary flows in the Euphrates



Legend

Lakes

Euphrates River

27.60 Flow (BCM)

Natural inflows and net outflows

739 Irrigated Area (000 ha)

Table A2.2: Euphrates flows 2005 (BCM)

	Turkey	Syria	Iraq
Irrigated area (' 000 has)	215.0	345.0	1,000.0
Inflow	0.0	26.50	25.16
Natural flow arising	28.30	3.50	0.0
Net diversions	1.81	4.83	15.00
Passed downstream	26.50	25.16	10.16

Table A2.3: Euphrates flows at full upstream development (BCM)

	Turkey	Syria	Iraq
Irrigated area ('000 ha's)	1,444.0	740.0	-
Inflow	0.0	16.21	9.34
Natural flow arising	28.30	3.50	0.0
Net diversions	12.10	10.36	9.34
Passed downstream	16.21	9.34	0.0

Annex 3

Agriculture and the Economy

Overview of agriculture production

Iraqi agriculture is dominated by cereals production, which accounts for about two thirds of the agricultural area each year. Other crops and livestock take up about 12 percent of the agricultural area, and the balance 24 percent, is left fallow (Table A3.1 and associated Figure A3.1). Typically, in the center and the south, two thirds of the agricultural area is cultivated for winter crops and about 13 percent for summer crops. In the northern governorates, land utilization is typically somewhat higher – 72 percent land use in winter and 30 percent in summer.

Table A3.1: Land use by crop

Cereals	64 %
Vegetables	5 %
Dates	1 %
Orchards	2 %
Pasture	3 %
Livestock	1 %
Total land use as % of agricultural land	76 %

Source: FAO Rural Household Survey, 2004.

Figure A3.1: Use of Household Land for Different Purposes

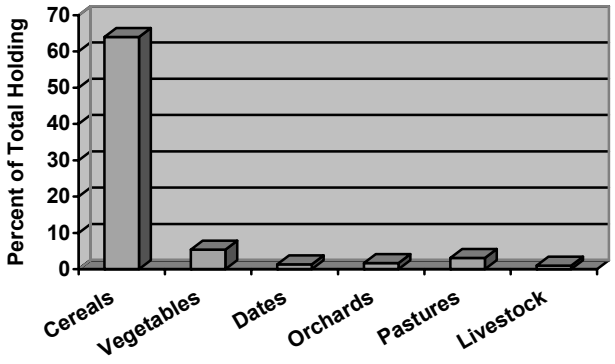
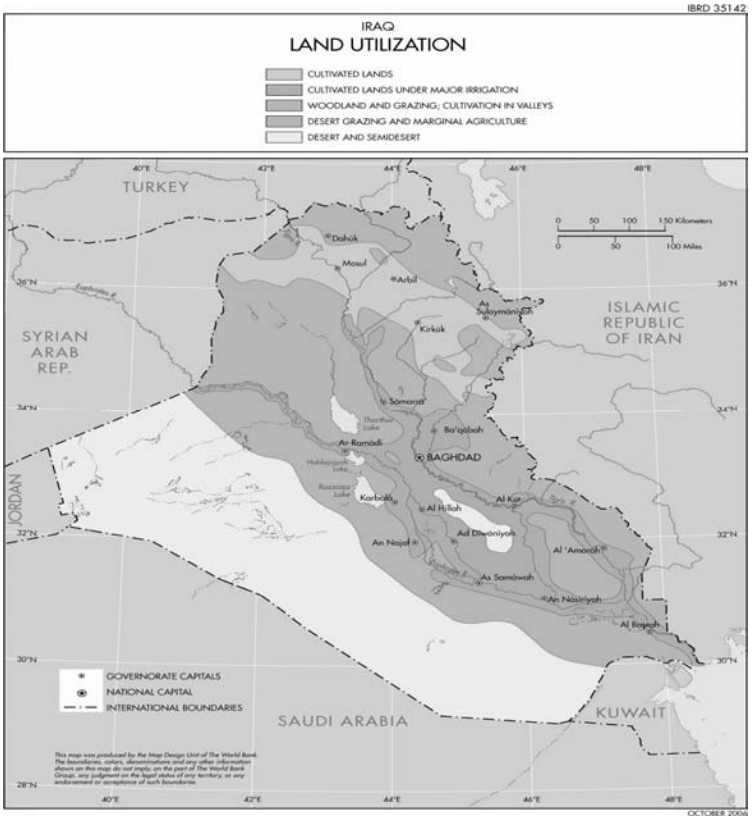


Figure A3.2: Agricultural-land utilization map

Land utilization, as illustrated in the adjacent map (Figure A3.2), generally parallels Iraq's climatic patterns. The three northern governorates – Dohuk, Erbil and Suleimaniya – and the governorates of Nineveh, Tameem and Salah al Din in the north-central region are the principal rainfed areas. There is one winter growing season extending from September/ October to April/May. The average precipitation in the region varies from 350 mm to 1100 mm, increasing from south to north, but with marked variability both within and between years. Consequently, rainfed crop production also varies from year to year. In the north, around 50 percent of the production is wheat and about 30 percent barley.



Nineveh governorate is noted for producing more than 1 million tons of wheat and barley in a good year. The rainfed farming systems throughout all zones are essentially similar with continuous wheat juxtaposed with a barley/fallow rotation. In an "average" year, rainfed wheat is cultivated on about 750,000 ha and rainfed barley on 600,000 ha; rainfed agriculture will produce 400,000 tons of wheat, 300,000 tons of barley, and 86,000 tons of chickpeas.

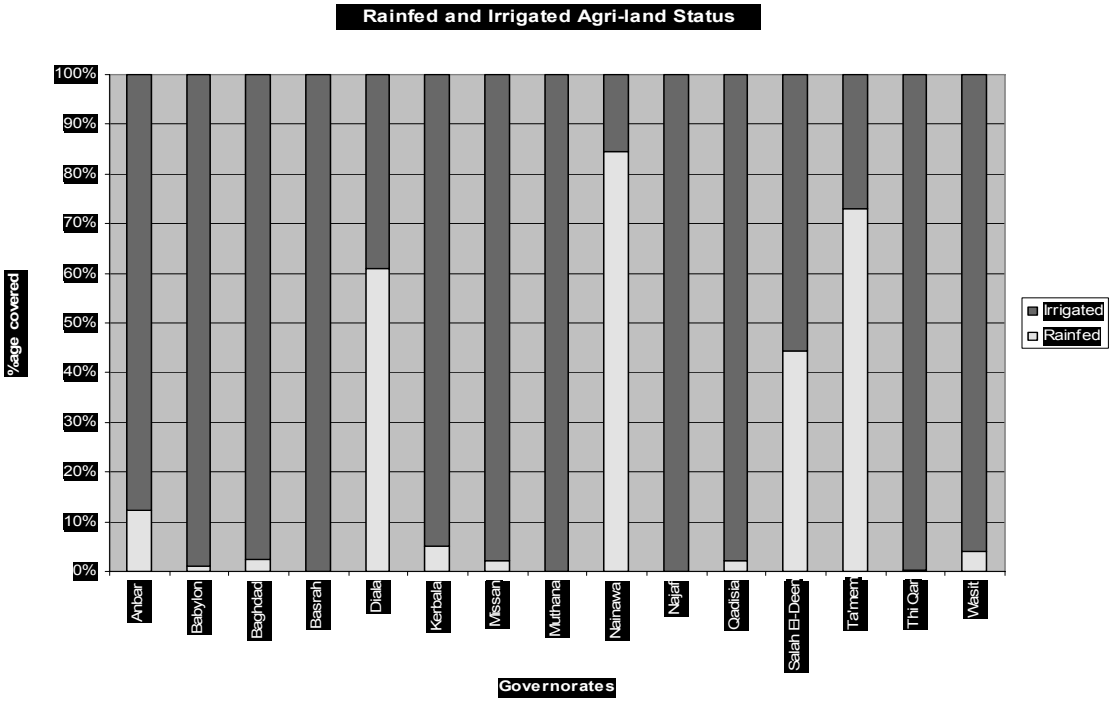
In contrast to the large hydraulic systems of the Mesopotamian plains, in northern Iraq the irrigated lands are scattered over small farms in the mountain areas or intermediate valleys and use water diverted from streams or springs. About 91,000 ha are cultivated with irrigated summer crops. The traditional irrigated crops such as rice, sunflower, and tobacco have given way to easily marketable summer vegetables and fruits such as tomatoes, onions, melon, etc. Another 15,000 ha are under permanent cultivation of grapes and fruit trees in small partly irrigated orchards.

Despite official encouragement of agriculture over the last fifty years, the terms of trade are generally unfavourable to agriculture, with the high exchange rate typical of an oil exporting country favouring agricultural imports and pricing agricultural exports out of the market.[17] Early casualties were Iraq's traditional export trade in barley and dates. Successive governments have tried to create incentives for agriculture through a complex set of capital and recurrent subsidies, and by border protection and administered prices. The resulting web of countervailing distortions

[17] These phenomena are aspects of what is often called the "Dutch disease".

persist to this day and presents a net disincentive to agricultural production that is proving hard for policy makers to unravel. Figure A3.3 illustrates the status, in terms of percentage, of rainfed and irrigated agricultural land coverage in selected governorates.

Figure A3.3: Percentage of rainfed and irrigated agricultural land coverage in selected governorates



Irrigated crops. Irrigated lands represent nearly 40 percent of the arable land in the country. Irrigated crops account for about 70 percent of domestic agricultural production, including about two thirds of wheat production. Most irrigated crops are produced in the area between the Tigris and the Euphrates rivers, primarily in central and southern Iraq, but stretching as far north as Mosul.

As in rain-fed agriculture, the main irrigated winter crops are wheat and barley, sown in October/November and harvested in May/June. When the irrigated area was fully farmed, these two crops were typically planted on about three quarters of the area equipped for irrigation (2.3-2.5 million ha out of the 3.4 million ha, Table A3.2). Irrigated summer crops include rice, corn, dates, cotton, vegetables, and fruits. Rice is sown in May and harvested in September and October. Other field crops include sunflower, cotton, sesame, lentils, chickpeas, and broad beans. Perennial crops, notably dates, alfalfa, citrus, fruits and nuts account for about 20 percent of the cropped irrigated area.

Table A3.2: Cropped area in a typical year
(million ha)

Crop	Cultivated area	Of which irrigated
Wheat	1.90	1.14
Barley	1.80	1.20
Rice	0.11	0.11
Vegetables	n.a.	0.46
Fruit trees	n.a.	0.19
Total		**3.10**

Cropping intensities are relatively low for irrigated agriculture: 50-80 percent for winter cropping, and 10-40 percent for summer crops. There is some multiple cropping, and some intercropping of vegetables and fruit trees. Cropping intensities suffer from limitations: the cropping calendar (Table A3.3) scarcely permits a second crop on the same parcel when winter cereals are grown, as these are in the ground for up to nine months; also water is scarcer in summer, and evaporation rates are higher. In addition, summer crops such as rice have high water requirements.

These intensities are in fact built into irrigation system design: on most schemes the canals have been designed to take enough water to irrigate up to 100 percent of the command area in winter. Because of the much higher evaporation rates and crop water requirements in summer, the water delivered by the canals is typically enough to irrigate only 40 percent of the command area at the most. For example, on the Lower Khalis project developed on the Diyala in the 1970s, design cropping intensity was 140 percent (100 percent winter, 40 percent summer). Actual cropping intensities in recent years have generally been in the range 50-80 percent in winter and 10-40 percent in summer. Thus overall intensity can be as low as 60 percent.

Table A3.3 Iraq Cropping Calendar

Commodity	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Wheat					Har^{S}	Har^{N}				PPL^{S}	PPL^{N}	
Barely					Har^{S}	Har^{N}				PPL^{S}	PPL^{N}	
Maize			PPL^{E}			Har	PPL^{L}					
Rice					PPL^{S}	PPL^{N}			Har^{N}	Har^{S}		
Chickpea			PPL^{N}				Har^{N}					
Beans					Har / PPL						PPL /Har	
Cotton			PPL	PPL					Har	Har		
SunFlower			PPL	PPL					Har	Har		

PLL = Ploughing;and Planting; Har = Havrvesting; N = North; S= South; E= Early,L= late

= Crops in the Field

Source: FAO-WFP Crop, Food Supply and Nutrition Assessment Mission (September 2003)

Centralized agriculture control and its consequences

Centralized production control set cropping patterns for irrigated areas, obliging farmers to produce cereals. Price controls included massive subsidies (averaging 85 percent) on inputs supplied through state monopoly outlets. For example, Diammonium Phosphate (DAP, a fertilizer), which costs $265/t delivered to Iraq is sold to farmers on a rationing system at $73/t. The MoA budget for input subsidies in 2004 was $200 million, five times the total operating and investment budget of the ministry ($35.4 million). A countervailing low procurement price was set for procurement of production. In 2003/4, the official procurement price for wheat was $117/t, against the landed cost of imported wheat of $175/t.

Marketing controls dictated that strategic crops had a mandatory to be sold to a state agency. Cereals, for example, had to be sold to the Grain Trade Board of the Ministry of Supply. Industrial crops like cotton had to be sold to para-statal agro-processing firms.

Where free markets for food crops existed, prices were depressed by the very low retail prices of strategic products under the Public Distribution System (PDS, during the sanctions period). Basic food commodities were sold through the PDS with a subsidy of up to 95 percent, "crowding out" Iraqi agriculture from competing in its natural market. In this sense, the $2 billion spent on the PDS each year represents lost value for Iraqi agriculture.

Decline in agricultural services. Agricultural services to irrigated farmers are provided almost entirely by the state, and have been affected by economic and political disruption, and by war. Physical facilities and equipment in services such as seed production, plant protection and mechanisation deteriorated throughout the 1990s due to lack of investment and very low budgets for operation and maintenance, and were further damaged by the war and post conflict looting. A parallel "brain drain" and deterioration in human resources has also sapped institutional capacity. An index of the decline in services is the growth of plant disease despite heavy pesticide use.

Decapitalization of the farming sector. With poor profitability, low cash flow and no institutional credit available, farmers have had neither the incentives nor the means to invest in farming. Most installations and equipments are worn out. Critically low personal resources allow no scope for capital accumulation to invest in repairs even if profitability were to thereby improve.

Irrigated agriculture at the crossroads. Irrigated agriculture in Iraq has failed to show the jump in productivity normally associated with high cost water control systems. The causes are many – physical and institutional – and some temporary and some structural. The conclusion is inescapable: that this low yielding sector needs profound adjustment if it is to contribute to farmers' income and national wealth.

Laws governing agricultural water

There are a number of laws governing agriculture and enforced by the MoA:

Law 12 for 1995, Maintenance of irrigation and drainage systems, provides for:

- MoWR to manage the headworks and irrigation and drainage system down to and including secondary canal level (> 400 letter per second, lps), and for farmers under the oversight of cooperatives to manage the system below that level (< 400 lps)
- Farmers to abide by the predetermined cropping intensities and calendars and by the water distribution agreed
- Farmers not to use their land for other than agriculture without permission;
- User fees to vary by category of irrigated land

Law 79 of 1985, Leasing and management of reclaimed agricultural lands, provides for where the state has equipped land, even where it is private, the state has specific rights:

- Farmers must follow agricultural plans determined by MoA
- Improved public land is leased to farmers for 5-20 years, with a lease fee
- Reclamation costs are recovered from farmers over 15 years, secured by a mortgage lien on the property
- Farms may not be subdivided into smaller lots than the minimum unit area

Annex 4

Details in the Challenges and Priorities in water resources management

This Annex provides an overview of the analysis of the challenges within the water sector and how the priority issues identified, providing the baseline for Chapters 7 and 8.

Challenges, priorities in water resources management

Challenges. The key challenges in water resources management in Iraq include:

- Within the institutional context, a dysfunctional water governance system, contributed by its centralized control, widespread inefficiency in water use and low returns on costly assets, with consequent high cost to the Iraqi people;
- The emerging need to coordinate the roles of (and balance the interests between) the national and sub-national (provincial) levels;
- The deteriorating water balance, characterized by declining water availability at the frontier, a high level of losses in supply, and inefficient use. These factors are inducing the onset of water stress, with growing costs to the society, the economy and the environment;
- Dilapidating infrastructure and the risk of dam failure and catastrophic flooding;
- declining water quality leading to increased salinization of agricultural lands, health hazards from water supply and sanitation systems, and pollution; and
- Degenerating water dependent ecosystems consequent to changes in water management.

Government plans and intentions. Government's official statement of its development program, the National Development Strategy (NDS detailed in Annex 6), does not directly discuss water resource issues. In July 2003, MoWR issued a one year strategic plan proposing: privatization of water facilities and reestablishment of water use fees, but no action has been taken on this agenda. In recent discussions, MoWR has emphasized the need for strategic projects involving dams and new irrigation, with the Behkhme dam as top priority. Emphasis has also been given to resolving transboundary water issues by reaching agreements not only with Syria and Turkey on riparian issues, but also with Iran in respect to the Tigris tributaries. Institutional development and capacity building is also emphasized by MoWR.

Priorities, options and comments

The immediate priority is to achieve rapid short-term improvements in water management, including targeted rehabilitation and modernization of key assets. The most cost effective investment in water supply is to improve the efficiency of diversion and supply down to the point of use, both in agriculture and in water supply. This requires an immediate prioritized program for rehabilitation of infrastructure. This rehabilitation should cover dams, barrages and weirs,

damaged pumping stations and conveyance structures. One of the most urgent needs is a comprehensive evaluation of dam safety for confirming the safety of these capital structures, and for correcting problems such as at the Mosul dam.

MoWR has estimated the total cost of reconstruction and rehabilitation needs at $3.6 billion, but this includes not only headworks, diversion and conveyance structures but also specific irrigation modernization investments. A first, three year, "emergency" phase of these works designed to rehabilitate the most vulnerable structures and remove bottlenecks is estimated to cost $750 million. The MoWR capital budget, assumed to be based on the 2004 allocation to be about $200 million a year, should in principle be adequate to cover these works. In the emergency phase, three issues need to be considered by the government:

- Prioritization should be based on cost-effectiveness consideration. For example, cost per m^3 of water saved, or cost per hectare of land irrigated or drained, etc.
- No investments should be made that clearly prejudices possible future decisions on supply or use. These should await the updated National Water Master Plan
- A start can be made in this first phase on defining and testing the institutional agenda, as for example, by employing labor-intensive approaches where possible, or by consulting users on the priorities for rehabilitation
- Lands need to be (re)classified on basis of the economic viability of reclamation, and on basis of the potential for switching to modern irrigation methods. In this regard, experience from other counties need to be utilized.

A medium-term integrated approach to balancing supply and demand is required. The *Strategic Vision* strategy, which is now beginning updated, will provide the elements for an integrated water plan balancing future supply and demand. The study needs full technical, political and financial support from the government, particularly from half a dozen ministries directly concerned with water resources, and from donors. Given the predominance of irrigation in water use, it will be imperative to integrate agricultural policy into the study proposals. This strategy should be conducted by adopting a consultative mechanism and by encouraging broad national discussion of its conclusions and recommendations.

Considerations on the water balance stemming from the study will highlight the options open to Iraq for living within its water budget. These will include a range of policy, institutional and investment options on both the supply and the demand side. Although it is possible to list most of the likely options now, credible consideration of them and the weight and sequencing to be assigned to each, and determination on an integrated approach to water will need to await study results. What is essential is that the study – and the discussion based on it – reflects not only the classic analysis of the supply side but also the reality of the demand side, particularly from agriculture. Decisions need to be based on economics, not just hydraulics.

The implication is that the medium term investment program and decisions on major investments should be considered once the results of the first phase of the National Water Master Plan is available in 2007. The timing of this is in fact quite appropriate, as experience in post-conflict situations shows that investment – and international aid – is most effective in raising growth when it is timed during the middle four or five years of the first post-conflict decade.

Box A4.1: What is a water master plan and why does it matter? The MENA experience.

Water resources management comprises supply management, which covers the activities required to locate, develop and exploit water resources, and demand management, which concerns mechanisms to promote desirable levels and patterns of use. Planning integrates the two aspects and provides the analytical basis for choosing between alternatives.

As water scarcity grows, investment options diminish and contaminants are concentrated. The marginal costs of supply and the costs of diluting pollutants rise markedly. Not only are the best sites exploited first but opportunity costs rise due to mounting externalities and foregone development in other uses. As market mechanisms are hard to apply to water, governments must assume responsibility for water allocation and preservation of environmental standards. Mechanisms include investment and allocation policy (supply management) and measures to influence user behaviour through regulation, technical innovation, incentives, or appeal for voluntary restraint (demand management). As shortages grow, the balance must shift – often quite rapidly – from development of new supplies towards modifications in allocation policy and demand management.

Water goals are set by governments, and there should be a process to involve all stakeholders. Evidence worldwide shows that participatory processes involving stakeholders in decision making result in more efficient and resilient solutions. However, decisions resulting from consultation with stakeholders must still reflect sound planning.

The planner's role is to evaluate the effects of alternative options on a consistent basis and to suggest policies and actions that can best achieve desired objectives. The planner provides the analytical basis for policy formulation and for linking water resources issues to policies at the macroeconomic regional and sectoral levels. Planners must value outcomes according to some consistent system, including economic, social and environmental outcomes. Subsidies need to be made explicit.

Experience with water resources planning in the Middle East and North Africa has been mixed. In some countries basin plans have been prepared and progressively consolidated into national plans (e.g., in Iran and Morocco). In Egypt, the basin plan is the national plan, as the Nile is the entire resource. In Tunisia, integrated planning has been made easier by a distribution system that integrates water management across much of the country. In general, weaknesses have been ambiguous goals and objectives, poorly executed studies, lack of data, and above all a lack of participation and of political commitment to the results.

Source: A strategy for managing water in the Middle East and North Africa (World Bank 1994)

The governance and demand management agenda. The organization of the water sector in Iraq is currently far from the model based on the principles adopted at the Dublin Conference in 1992 (A4.2). Understandably, Iraq is preoccupied with immediate reconstruction needs and with political process and security. However, experience in post-conflict situations suggests that even in the earliest phases of reconstruction there are advantages to working on improving policy, institutions, and governance.

The role of policy and institutions in managing supply and demand will become clearer when the results of the National Water Master Plan are available. In fact, consideration of policy and

institutional structure will be an important element in deciding, which supply and demand management options best fit Iraq's development objectives, social and institutional adaptive capacity, and implementation capability. However, even though the ultimate decisions on changes in the governance structure should await 2007, there is a case – given the long-term nature of many of the changes involved – for beginning to prepare some of the building blocks for a medium term overhaul of the water governance structure. For example, in a country entering water stress, global best practice suggests that Iraq should be considering new governance principles based on:

- Decentralization and accountability of service providers;
- Empowerment through rights and responsibilities of water users and their organizations;
- Introduction of a range of incentives for water users targeted at policy objectives, including financial viability of water service providers, equity, poverty reduction, and demand management.

While the National Water Master Plan is being prepared and discussed, there is scope for testing out decentralized and more participatory approaches in both irrigation and drainage, discussed in Chapter 5; and in water supply and sanitation, discussed in Chapter 6. Certainly as demand picks up and the risk of dwindling supply grows, government will have to begin the process of strengthening demand management measures. Since 90 percent of water use is in agriculture, which is the lowest yielding and least efficient user of water where most savings can be readily made, the first imperative is to manage the use side in agriculture in a way that improve efficiency and returns to water while also reducing aggregate demand. Classic approaches are, for example, by encouraging the use of efficient on-farm irrigation and agronomic practices, or by pricing water services higher.

Box A4.2 The Dublin Principles and best practice in water resources management

The Dublin Conference of 1992 adopted three basic principles that have guided thinking and practice in water resources management:

- ◊ The *institutional principle* established participation of all stakeholders (from governments to women and the poor) and decentralization as the best practice for water resources governance.
- ◊ The *instrument principle* highlighted the policy implication of growing water scarcity—the need for demand management through an incentive structure that reflects the true value of water to society.
- ◊ The *ecological principle* established the goal of integrated, inter-sectoral management of the resource - with the basin as the unit of management - and the need to factor environmental considerations into water resources management.

Integrated water resources management (IWRM) is further described in Annex 5 of this report

As part of the reconstruction process, it would be appropriate to open the debate within government and with the Iraqi people – all of whom are concerned water users – on these principles, in order to prepare for change in the medium term. A structured process of study and discussion should be carried out in parallel with the National Water Master Plan, with a view to developing policy and proposals for changes in the governance system within two years. Box A4.3 provides suggestions on what new arrangements in the water sector could ultimately look like.

Box A4.3: What might Iraq's water institutions look like in the future?

Although water resource management in a hydraulic economy such as Iraq's is inevitably centralized, there is ample scope to adapt "Dublin best practice" to the Iraqi situation. For example, the future institutional structure of the sector could reflect:

- An integrated approach to water, with inter-ministerial coordination
- A new approach to water as an enterprise, with a more important role for the private sector in public private partnerships etc.
- A more decentralized approach, for example in decentralizing more budget and responsibility to lower levels and setting up decentralized and financially autonomous water service providers in both irrigation and water supply and sanitation
- A new service orientation at point of delivery, again bringing in users – this will be important in water supply and sanitation
- Empowerment, ownership and participation in irrigation and drainage, and the development of autonomous water-user associations/organizations etc.

One key place to start is with better inter-agency coordination, particularly between MoWR and MoA.

Marshlands restoration will have to be sustained within the overall water balance. Although there are considerable pressing human needs, the restoration of wetlands cannot be ignored. The marshes are the home to a significant population, plays a unique part in the cultural and scientific life of the country, and there is considerable external interest in conservation and restoration.

The feasibility and sustainability of marshland conservation and restoration has to be assessed within the integrated framework of water resource management. USAID is financing preparation of a comprehensive system model of water supply to the marshes, and this will be integrated into the National Water Master Plan. The costs and risk are likely to be high, and all efforts should be coordinated with the other donor activities currently underway. A suitable decision will have to be taken based on the quantity and quality of water available.

Participatory approaches in planning and execution will be helpful. Marshland desiccation has affected the *madan*, its traditional inhabitants, the most and they should be included in the restoration process as full partners. Their traditional knowledge could be very helpful in designing the restoration strategy.

There is also an emerging need to coordinate the roles of (and balance the interests between) the national and sub-national levels. The best way to coordinate the national and sub national roles is to manage water on the basis of river-basin hydrological (as opposed to sub-national) boundaries. This helps to maximize the cross-sectoral, cross-administrative benefits from water. Thereafter, reaped benefits can be redistributed across sub-national boundaries, possibly including compensation to harmed water users. The Bank's extensive experience from comparable situations in many countries is available upon request. See Box A4.3 for a few examples.

Box A4.3: Coordinating the national and sub-national interests in water

In Morocco, managing competition for water starts at a commission of local authorities whose decisions are based on plans made by the concerned River Basin Agency. If the commission fails to resolve a conflict on water, it is raised to the interdepartmental commissions within the Ministry of Land Planning, Water and Environment. The next level is to consult the inter-ministerial commission, which is chaired by the Prime Minister and includes representatives of all water-related ministries including ministries of Health, Energy, and Finance. Finally, the High Council of Water and Climate is the highest authority regulating conflicts, which deals with the national water policy and the master plans of integrated water resources management.

In Oman, the Ministry of Water Resources was established to improve the management of scarce and polluted water resources, yet the Ministry is separate from functional and sectoral water activities.

In China, there are comprehensive plans for the major river basins and specialty plans for sectors. The Ministry of Water Resources at different levels of Government prepares comprehensive plans. Specialty plans are sectoral, to be prepared by the concerned departments/Ministries. Remedial measures and compensation are required in cases of interference with existing developments. The water law provides for the settlement of disputes among districts through amicable consultations. If consultation fails, disputes are referred to the next level of government.

In Australia, the Federal Government and the states of Australia have an "Intergovernmental Agreement on the Environment". The agreement distinguishes the responsibilities and interests common to all levels of government and those, which are the concern of specific levels of government (federal, state and local governments). The agreement states procedures for the accommodation of interests in water.

In the United States, the National Water Commission ensures that policy planning is separated from functional planning, design and construction, and operation by action agencies. In California, this neutrality of overseeing water institutions/users has been deemed one of the catalysts of forming water markets.

Challenges, priorities in irrigation and agricultural sector

Challenges in the irrigation and agricultural sector. The issues in irrigated agriculture are usually quite complex in any country, as the sector straddles several key areas of public policy – water resources management, agriculture, food policy, and environment. In the case of Iraq, issues of irrigation water supply are inextricably linked to questions of agricultural policy and particularly to agricultural profitability.

On irrigation, the challenges are:

- A widely dysfunctional water service, characterized by deteriorated physical infrastructure and unaccountable bureaucratic institutions that has failed to mobilize financial resources for operating the system.
- A chronic problems of waterlogging and salinization that requires a response, which is expensive in terms of both investment and management

On the irrigated agriculture aspect, the immediate challenges are:

- A distorted incentive framework that favours imports and urban consumers.
- An array of state-managed agricultural services, which have largely broken down
- A governance structure related to a failed economic model, and characterized by a deteriorated administrative apparatus and lack of social capital at the producer level.

Government plans and intentions. On irrigation, currently the government plans are to progressively rehabilitate the irrigation network. MoWR has prepared a list of essential investments in all governorates totaling $3.6 billon. This list is intended for implementation over a five-year period (2004-8), comprises investments in rehabilitation of headworks, pumping stations, canals and drainage networks, and in salinity control. The list also includes investments in new water storage and diversion.

On agriculture, the NDS expects a growing role for agricultural sector in the Iraqi economy to diversify the economy beyond oil. The long-term vision is that the sector would contribute significantly more to growth, employment, poverty reduction and food security. The NDS emphasizes progressive transition towards market based economy, increasing agricultural productivity through market oriented, private sector led growth. The proposed agenda for administrative decentralization and private sector involvement raises the prospect of future decentralization of irrigation management, and possibly of some private sector participation.

In government's view, essential steps to revive agriculture include improvements in supply of input and support services and improved water management, backed up by rehabilitation of agro-industries, critical rural infrastructures, irrigation and drainage networks and storage capacity. The Ministry of Agriculture has prepared an investment plan for rehabilitation of its own installations, including seed farms, plant protection facilities, extension centers, etc. The Ministry of Supply is also planning rehabilitation of its stores and silos.

Beyond these proposed investments, the government has taken some initial steps towards freeing prices of fertilizer, insecticides and cereals but has not yet developed a strategy to implement the vision of a market-oriented agricultural sector. The World Bank is working with government on a *Framework for Agricultural and Rural Policy and Institutional Development* (IFARPID, Section 7.2), which is designed to highlight the kind of changes to institutions and incentives that are needed to revive profitability in Iraq's irrigated agriculture.

Options and comments

Immediate improvements in the irrigation and drainage network. In terms of irrigated agriculture, the key challenge includes modernizing the agricultural sector. During the emergency phase, priority should go to modernize, by removing bottlenecks in the irrigation and drainage system, to saving valuable assets that are at immediate risk, and to drainage investments. Modernization is essential, and new irrigation development is not a priority (Box A4.4). Based on the design of ECIRP, the following guidelines would help government to prioritize its investments in irrigation and drainage during the emergency phase. As the government moves towards a market-oriented economy, the World Bank's Agriculture Sector Capacity Building Project will address institutional strengthening while priority investments are needed to modernize the agricultural sector. The rehabilitation of existing systems is systematically underway by the Iraqi government however, targeted investments for efficient water saving

agricultural practices are necessary. Investments piloted at targeted sub-national levels, will later extend to priority regions conducive to a growing market economy.

Box A4.5: "Modernizing" large-scale irrigation

In large-scale irrigation, the objective is to improve farming profitability sustainably through improved service at the least cost. The inflexible water delivery systems and bureaucratic institutional design that characterize much large scale irrigation makes the response to changing markets and profit opportunities difficult. Further improvements in profitability have to be made through integrated system modernization, that is, by turning both the irrigation delivery system and the institutional structure around to focus on delivering a sustainable, efficient, and demand-responsive water delivery service. Large scale irrigation modernization thus requires an integrated package of physical improvements and institutional change in addition to agronomic improvements.

Physical improvements will include a broad range of "hardware" investments and related management practices to assure an efficient, least-cost water service delivery that meets farmer needs. Optimization tools have been developed that allow the most cost-effective investments to be selected.

The parallel *institutional changes* to create a demand-responsive water service delivery typically include a reduction of the role of governments in management and financing, and promotion of decentralization, agency accountability, and scheme financial autonomy as an interim milestone toward full scheme management transfer. Efficiency improvements should be introduced to reduce costs and expand the revenue base: in the irrigation reform in Victoria, Australia, 80 percent of the improvement in financial performance came from system efficiency gains and an expanded revenue base, and only 20 percent from increased water charges. Water user associations have proved effective in modernization programs, and user participation should be included at each step of the decision process. Scaling up to water boards or user federations should be encouraged.

A vital component of institutional change—scheme financial autonomy—depends on cost recovery. Low cost recovery leads inexorably to poor service: if systems are to deliver quality service, somebody has to pay for it. Within a scheme, it has to be clear what investment, operations and maintenance, and other costs should be recovered from whom, and how—for example, the costs of upstream works could be financed by government, downstream works at the tertiary and quaternary level by the irrigators, with cost sharing for the secondary canal level.

Overall, irrigation "modernization" is a process implemented over an often lengthy period, with changes sequenced and integrated as needed. Priorities are a focus on the objective of farmer profitability through improved service delivery; a market-driven demand orientation; integration of physical investment, agronomic improvements, and institutional change including a reduced role for government; involvement of users throughout; efficiency improvements to reduce costs; and scheme financial and managerial autonomy.

- A quick economic test is needed: this should be applied at the level of a scheme rather than at the micro level, to establish the possibility of modernizing profitable irrigated farming for the scheme as a whole, identify what are the least cost means of improving water service and farmer incomes, and modernize with cost-effective water saving technologies. Emergency Community Infrastructure Rehabilitation Project (ECIRP) has adopted this "quick test" approach (Box A4.5), while Box A4.6 illustrates option for irrigation modernization, rationalization and rehabilitation.

Box A4.5: "Quick test" criteria for screening sub-project investments under ECIRP

Input based criteria:

- Investment cost/ha maximum 10 time the value of incremental production induced by the investment
- Cost ceiling $500/ha for rehabilitation of off farm irrigation and drainage infrastructure
- Cost ceiling of $1000/ha for "modernization"
- Local labor content of civil works at least 30 percent

Output based criteria:

- Off-farm water conveyance efficiency with the project to reach 75-85 percent
- On-farm irrigation efficiency with the project to reach 70 percent for flooding and 90-95 percent for modernization
- Incremental crop yield (or incremental cropping area) to increase by at least 100 percent.

Source: Background Report:" Improving targeting of ECIRP subprojects"

- Wherever possible, modernization should be undertaken through labor-intensive works suitable for community contracting. Support should be provided to the Government's rehabilitation efforts, including de-weeding and de-silting of canals and drains, can incorporate labor-intensive techniques employing local people. Communities can be involved in contracting for these works, which should be split, wherever possible, into small contracts to encourage small and medium enterprises, as well as direct community contracting. Community contracting could establish ownership and cost sharing principles for the first time.
- This first phase can be used to identify and pilot new institutional arrangements. Although institutional change will demand much analysis and preparation, and some changes will by their nature be long term, there is a window of opportunity during the first phase of investment to identify possible institutional changes and to try them out, in preparation for a large-scale application in the medium term. This approach corresponds generally to the experience of post-conflict reconstruction that *policy and institutional changes can best be brought about if a start is made early in the reconstruction period*. For example, the labor-intensive works program can be the first seed of community collaboration with a more service oriented irrigation administration, and this could form the basis for encouraging farmers to develop a water user association.
- A poverty targeting approach could be adopted by giving more emphasis to districts and sub-districts with a high proportion of vulnerable households.
- It will be important in this first phase to plan the irrigation investment in tandem with agricultural policy and services. To this end, Ministry of Agriculture should be actively engaged with MoWR during the design and execution of the program for ensuring that linkages to on farm water management and husbandry are achieved, and the program objective – increased and more profitable production – is accomplished. Over time, this initial phase can help develop a framework for more structured coordination and cooperation between the MoWR and Ministry of Agriculture.

Box A4.6: Options for infrastructure modernization, rationalization and rehabilitation

Modernization and rehabilitation of irrigation infrastructure in post-conflict Lebanon

The Lebanon Irrigation Rehabilitation and Modernization Project, appraised shortly after the end of the civil war, was designed to restore productive capacity in the country's irrigation system, which had been neglected and partially destroyed during the fifteen years of hostilities. The project was conceived on a program basis, with technical, economic, and institutional criteria applied, and priority given to schemes within the program that had the highest benefit cost ratio.

Technical solutions were a combination of infrastructure modernization, rehabilitation, and rationalization. For example, the Yamouneh Project, in the upper Beqaa, was improved by a mix of technical modernization and simple rehabilitation. The scheme was fed from accumulations of spring water on Mount Lebanon, which cascaded down through a series of natural earthen and rock chutes and fissures in the mountainside, dropping a distance of 800 meters to the Yamouneh plains where the water was distributed among the irrigation network. There were considerable losses from this primitive conveyance chute, and the most cost effective solution was to replace it by a baffled-type USBR chute. This improved water control and was complemented by simple rehabilitation of the concrete canalets downstream.

Modernization on the Lower Khalis in Iraq lacks complementary institutional development

In Iraq, the Lower Khalis Project, partly financed by a 1973 World Bank loan, was perhaps the most modern in Iraq. On an area of about 55,000 ha, the project included comprehensive land reclamation (laser controlled land leveling, piped field drainage, comprehensive system of open collector drains, main and outfall drains) together with concrete lining for all canals, and use of Nyrpic type Amil upstream float regulated gates and hydro modules. Its area (from memory) was about 55,000 ha. A cooperative system provided for a measure of farmer involvement, but this was not formalized into a partnership between scheme management and water associations and user groups, and cost recovery was not provided for, with implications for subsequent operation and maintenance of the secondary and tertiary irrigation and drainage infrastructure.

Rationalization of infrastructure: a case from Iraq

In the early 1970s, lands on the left bank of the Diyala were fed by a series of small, leaky canals - the Ruz, Muqdadiya, Mahrut, Khorasan,Tel Asmar and other smaller canals (Arda and Sinsil) - all of which used to flow very inefficiently for 10 to 15 km in separate and parallel meandering channels creating considerable conveyance loses. The separate off-takes were originally constructed to safeguard the unique water allocations and duties for each canal.

Under the Diyala Combined Head Reach Project, a new 15 km Combined Head Reach Canal was constructed. The head regulator for each off-take was positioned to provide optimum gravity command and equipped with movable weir gates to measure flow to ensure water duties were maintained. This rationalization of infrastructure saved considerable water and improved water service to farmers.

The medium- to long-term governance and institutional agenda. In line with the principles for institutional reform – decentralization and accountability, empowerment of users, and incentives targeted at policy objectives - future investment in irrigation and drainage would need to be accompanied by an institutional and incentive framework that will ensure efficient management and sustainability of the networks. Although every country is different, a model that has been broadly successful elsewhere is decentralization to local, financially autonomous institutions to manage the irrigation and drainage system – for example, regional water boards or a local irrigation corporation. Users can be engaged through user associations in both management and financing, benefiting farmers from greater accountability of the service agency

while also benefiting the service agency in terms of a more professional management, increased financial flows, and prospects of financial autonomy.

Medium term policy agenda. Government has stated its intention to move towards a more market-oriented economy. For irrigated agriculture this will create a challenge not only of institutional adjustment, but of determining the economic base of the sector. For example, it will be necessary to contemplate whether Iraq's irrigated cereals can compete with imports unless some level of protection is assured. Although recent performance in cereal production has been constrained by poor water service, salinization, and distorted incentives, cereal production in Iraq was *never* high[18], and major investment programs of the 1970s and 1980s made no apparent difference. It will be hard for Iraq's irrigated farmers, particularly in the centre and south of the country, to compete with imported wheat at $175 a ton when their yields per hectare have generally averaged less than 1 t/ha. On another dimension of the same problem, if average farm size in the centre and south is really just 1-2 hectares, gross farm income from cereals would not exceed $350 per household, and net income would be a fraction of that. Irrigated agriculture under those circumstances would not provide farmers with an exit route from poverty.

Cereals are of particular importance because they are the dominant crop. Evidently, higher value crops like fresh fruit and vegetables will be more profitable, and the demand in the domestic market for these is not fully met. If borders are open, Iraq may also have advantage in exporting some of the products in the regional market, although fierce competition from other regional producers and the disincentive of a high exchange rate may reduce performance. Costs will rise, too; as the urban economy recovers, relative wage rates will become an inducement to labour mobility.

If Government were to treat agriculture as principally a source of *food production*, inability to compete with imports could mean the need for a complicated structure to insulate domestic production from world markets whilst keeping food prices down. The experience in other countries is that such arrangements are leaky, and benefits the better off. Morocco, for example, is dismantling such a system in favour of a free market approach. If irrigated agriculture is treated as a *source of growth*, the sector will need to be oriented progressively towards higher value crops where Iraq has a comparative advantage, such as fresh fruit and vegetables, or possibly some industrial crops like cotton, and solutions to poor productivity of cereals production will become essential.

Criteria for investment in the medium and long term. Beyond the emergency investment phase, Iraq needs to develop a medium term investment program to restore efficient productive capacity and revive irrigated agriculture. The water resources planning and agricultural policy aspects of this are discussed above; the investment program will be driven by the key considerations of water resources availability and farming profitability. Within those parameters, investment choices need to be determined by both infrastructural efficiency and social and institutional feasibility.

[18] Irrigated cereals yields in Northern Iraq where water quality is better are reported to be much higher (2.5-3t/ha) than in the center and south.

Challenges, priorities and options in water supply and sanitation

Challenges. The key challenge in water and sanitation in Iraq is to tackle the dramatic drop in coverage and service standards and the consequent decline in living standards and health status. This requires reversing the recent pattern of underinvestment and poor management in the water supply and sanitation sector and planning for a decentralized, demand responsive and financially self-sustaining approach for the utilities.

Government program and intentions. The NDS places water supply and sanitation at the top of the government's priorities, arguing that water is a crucial limiting factor in both the human and economic development of the country. Government's objective for the sector is, thus, to restore water supply and sanitation services to pre-war levels as fast as possible with assistance of the donor community. The approach is to give priority in the first instance to rehabilitation or reconstruction of water supply and sanitation facilities. The financing plan is essentially to rely on the national budget and consumer payments to cover operation and maintenance costs, and to rely on donor funding for the construction of new facilities and networks.

The MMPW is currently preparing the basic data needed for the development of a ten-year Potable Water and Wastewater Strategy. The main elements of this strategy are:

- *Water supply services*: to increase coverage, reduce rural/urban disparities and regional imbalances, and improve water quality. The strategy also provides for capacity building.

- *Sanitation services*: to rehabilitate existing pumping stations and sewerage networks and improve their efficiency, improve effluent quality to meet environmental specifications for processed water, increase coverage, and upgrade the networks.

- *Sector financing*: to move towards financial viability, through gradual increase in the price of services.

- *Water as a business* (in the longer term): to initiate planning for decentralization of sector management, public-private partnership initiatives, demand management and tariff increases. MMPW is incorporating these approaches into an Organizational Restructuring Plan.

Government investment program. In line with the above strategic approaches, MMPW has also drawn up an emergency Drinking Water and Wastewater Investment Program for the coming ten years based on the NDS approaches and on two needs assessments carried out in the sector: the UN/WB Iraq Joint Needs Assessment (October 2003), and a US project identification exercise (2004). The process has identified 83 water supply projects and 12 sanitation projects for urgent intervention. These projects were developed and prioritized in conjunction with MMPW officials and local government representatives, taking into account equitable distribution of aid to the 18 governorates.

Options and comments. The need to restore service levels in water and sanitation is an essential component of post-war reconstruction in Iraq. With total needs for the sector estimated by the UN/World Bank Joint Needs Assessment at US$7-8 billion for the coming five years, the MMPW is facing a large financing gap and relies heavily on donor funding for its capital investments.

In government's approach, the "water as a business" agenda is relegated to the longer term. However, in water supply and sanitation, as in other sub-sectors, there are advantages in initiating policy and institutional changes early in the reconstruction period, so that infrastructure investments are matched with institutional changes. People generally expect changes to occur after conflicts, and are more willing to accept them; changes indicate that it is *not* business as usual.

The period of crisis management could thus be utilized to lay the foundation for a progressive transformation of water and sanitation services. The process can start by decentralizing water supply and sanitation operations and moving towards operating on a commercial basis. The local authorities could be to provide greater responsibilities as the immediate reconstruction phase is completed. This could become the first step towards financial autonomy and corporatization. In addition, benchmarking of key efficiency indicators could help the authorities to program investment and management improvements to achieve progress on key indicators, and help MMPW to track performance. For the longer term, private sector participation is likely to be feasible, and government should begin now to reflect on how to adjust the legal framework to allow for private sector participation in water supply and sanitation.

Experience worldwide has shown that water supply and sewerage services are best provided by decentralized autonomous utilities delivering defined services for a fee. By isolating the service function from other influences, the utility promotes operational efficiency, service accountability, and sound financial management. The basis for effective public accountability and oversight can be established.

The supply systems need cost recovery to become sustainable. Currently, water tariffs are extremely low and cover only a portion of the costs of operation and maintenance. Government needs to plan for rationalization of tariff for ensuring sustainability of water services beyond the urgent phase of reconstruction, with step-wise movements towards cost recovery. There is need for a consolidated and efficient regulation system. Several agencies are responsible for regulation, with the result that no effective regulation is carried out. Regulation of services is being done by the Ministry of Planning and Development Cooperation (MoPDC), the Ministry of Health and the Ministry of Environment.

Next steps. A comprehensive study of how to restructure Iraq's water and sanitation services is needed. To back up its commitment to institutional reform, government should begin studying and testing different institutional reforms right away, taking advantage of the "window of opportunity" provided by the early days of reconstruction.

MMPW and its branches have to work with MoWR and other agencies on the projection of bulk water needs for water supply and sanitation in coming years. This work should be done in conjunction with the *water master plan* exercise being undertaken by MoWR and in collaboration with the Planning and Development Ministry and the Environment Ministry. It should take account of the latest census and current per capita water consumption and demographic projections and likely future needs. It should also assess the existing and projected industrial water demand.

Annex 5

Integrated Water Resources Management & Lessons in Transboundary Cooperation

Integrated water resources management. The principles of integrated water resources management (IWRM) were adopted at the Dublin Conference of 1992. These principles guided thinking and practice in water resources management:

- The *institutional principle* established participation of all stakeholders (from governments to women and the poor) and decentralization as the best practice for water resources governance.
- The *instrument principle* highlighted the policy implication of growing water scarcity—the need for demand management through an incentive structure that reflects the true value of water to society.
- The *ecological principle* established the goal of integrated, inter-sectoral management of the resource - with the basin as the unit of management - and the need to factor environmental considerations into water resources management.

These principles do, in fact, underlie many important changes happening globally in water management, including:

- The adoption of decentralized and inclusive governance models in the irrigation business such as the creation of financially and managerially autonomous scheme management boards or corporations and the development of water user associations as responsible partners;
- Awareness of the role of water as an economic good and of the need to move toward cost recovery and to use economic mechanisms to transfer water to the uses that society most values;
- The integration of irrigation in basin-wide approaches;
- The decentralization of water supply and sanitation services to financially self-sustaining and locally accountable utilities;
- Recognition of the need in planning for water to consider environment as a water-using sector.

The threat to Iraq's water resource and hence to its people and its economy is real and cannot be ignored. The Iraqi government is well aware of the problems of its dependence on upstream riparians and has initiated contacts with them. Certainly international best practice on integrated water resources management would support a cooperative and joint approach to development and management of the Euphrates basin (Box A5.1). International law would seem also to support cooperation between riparians. The guiding principles of international law most likely to be applicable are that 1) riparians should *not cause significant harm*; and 2) riparians must use an international watercourse in a manner that is *equitable and reasonable* vis-à-vis other states sharing the watercourse with a view to attaining optimal and sustainable utilization. Both principles can positively support a cooperative approach. The 'no significant harm' principle can prevent the upper riparians from excessive exploitation of the resource to the detriment of Iraq. The 'equitable and reasonable utilization' principle supports a joint approach based on optimizing and sharing benefits.

Box A5.1: International best practice on IWRM supports a joint approach to basin development

The Dublin Principles reinforce the case for a cooperative and joint approach to the development and management of the Tigris and Euphrates Basins.

The institutional principle suggests that water resource management in the basin would best be done with the participation of all stakeholders.

The instrument principle suggests that as scarcity grows in the basin, water needs to be seen increasingly as an economic good. Thus, more use of incentives and economic principles should be made to improve allocation and enhance quality, and that opportunity costs and externalities need to be considered in allocation and investment decisions.

The ecological principle would suggest that development can only be optimal if all riparians cooperate in a basin wide and integrated approach to basin investment and management planning, and factor consideration of the environment into planning.

Iraq needs to work out the basis for approaches to the riparians and to work with facilitating partners. In deciding on approaches to the problem, Iraq will need to consider options under a number of issues: the political economy of transboundary negotiations; the institutional mechanisms that are best suited; the role of technical cooperation; the economic role of the water resource and the role of demand management; and finally the environmental risk and options.

Institutional mechanisms. Of institutional mechanisms available to the riparians, the most immediate solution could be to reconvene the Joint Technical Committee as a starting point. This would have the merit of not requiring a new mandate at the political level, and there is a procedural and practical track record. This Committee could ultimately develop into a permanent commission, and example would be the Permanent Indus Commission, between India and Pakistan (Box A5.2).

Box A5.2: The Permanent Indus Commission

The Permanent Indus Commission consists of two Commissioners, one appointed by Pakistan and the other by India. The Commission was constituted to establish and maintain cooperative arrangement for the implementation of the Indus treaty. Apart from promoting cooperation between parties in the development of waters of the rivers, the Commission undertook the study of matters referred to it, to help resolve questions concerning interpretation or application of treaty, and to make tours of inspection. The Commissioner is the direct representative of the government for all matters arising from the treaty and serves as the regular channel of communication on all matters relating to implementation of the treaty. There is no voting involved in the decision process - the Commissioners have to agree or disagree with regard to an issue after discussion. The decision in a matter can only be taken by joint agreement and differences and disputes are referred to experts for advice or to a Court of Arbitration.

Technical cooperation. Even if there is no agreement to set up a formal process, lower key alternatives can be pursued, such as simply sharing data on stream flow, precipitation, groundwater level, water quality measurements, or setting up a joint research institution for scientific study of the Euphrates and Tigris river basins. These low key alternatives can act

politically as confidence building measures and can be of collective benefit, helping improve water management and shaping future policy debates on water allocation. If the cooperation proves beneficial, it could represent a first step towards integrated basin planning. Technical cooperation could be institutionalized and this will improve the quality of studies and research. There is also a need for a mechanism to share the technical findings with the political authority. It is perhaps by this means that technical cooperation could grow into political cooperation, for example, through high-level conferences attended by ministers from all three countries. This itinerary from a technical start is illustrated by the case of the Nile Basin Initiative (Box A5.3)

Box A5.3: The Nile Basin: getting to yes with ten riparians

In the Nile Basin, there are ten riparians: Burundi, DRC, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda. The population of the basin is over 300 million people, and growing fast, is likely to double in thirty years.

Only the two downstream riparians have an agreement: by a 1959 treaty, Egypt has 55.5 BCM, and Sudan 18.5 BCM. The two countries have committed all these resources, mostly to large-scale irrigation. Egypt is expanding its irrigated area by 1 million hectares over the next twenty years, which could require a further 8 BCM. Ethiopia, where 86 percent of flow originates, has developed only one twentieth of the potentially irrigable land, and now has ambitious plans for investment in irrigation. In addition, hydropower potential on the Blue Nile is enormous.

Current technical and political processes are aimed at finding a mutually beneficial solution. The Nile Basin Imitative began as a low-key technical partnership, sharing data and conducting research. Now it has developed into a framework of economic cooperation and joint investment, offering considerable potential for major cooperative development of the Nile River, including large-scale irrigation and hydropower development. In addition, opportunities for regional cooperation and integration in a range of activities beyond the river have arisen as a consequence of strengthened relations built up from the Nile Basin Initiative.

Source: World Bank 2005.

Economic strategy. Besides treating water as a social and environmental good, riparians should promote water as an economic good (in line with the Dublin instrument principle) and seek application of economic principles as well as distributional principles for integrated water resource management in the Euphrates basin as a whole.

The economic strategy for managing the Euphrates should probably concentrate more on sharing benefits than sharing water. The opportunity cost will vary between locations, so a cubic meter does not have the same economic value, yet it is value the parties are seeking. In addition, benefits are less sensitive to negotiate than headline water quantities. Agreeing on an investment program that brings benefits to all partners is politically easier than negotiating quotas of water. The benefits should be considerable, as reaching agreement over water will reduce risk and encourage economically optimal investment for all riparians.

As cooperation leads to joint planning at the basin scale, investment and management can be progressively optimized – for example to take account of basin-wide externalities. Reaching agreement over water will reduce risk and encourage economically optimal investment for all riparians. Ultimately, basin level planning can maximize the aggregate value that a unit of water can generate as it moves through the river system before it is consumed or lost (Box A5.4).

Box A5.4: Negotiating development for the greatest benefits to the basin as a whole

Euphrates water is used in Turkey, Syria and Iraq for different purposes such as irrigation, hydroelectric power, domestic consumption, etc. Each of these purposes has its own value to the country planning the use. However, there could be different combinations of uses. As for example, combination 1 could be dam in Turkey, irrigation in Syria and irrigation in Iraq. Combination 2 could be dam in Turkey, dam in Syria and irrigation in Iraq. These, of course, are simplistic examples. The system value for the two combinations discussed above will be different and the one with higher value is preferable. If cooperation is to be won from the riparian, which must make a sacrifice to achieve a higher overall system value, that riparian must be compensated for the loss it faces.

Benefits agreed need not all be water related benefits. For example, under a 1996 agreement around the Aral Sea, Kyrgyzstan stores Syr Darya winter flow for release in the spring when Uzbekistan and Kazakhstan need irrigation water. The deal reduces Kyrgyzstan's winter hydroelectric output, so Uzbekistan gives natural gas in return, and Kazakhstan gives coal. The international agreement was brokered by USAID.

Internal demand and supply management solutions. One contribution that Iraq can bring to discussion of Euphrates water is its potential for reducing water use through demand management. For example, the water to irrigate the equipped area is not a fixed quantum but a function of conveyance efficiency, cropping pattern, plant variety, and on-farm water management. Iraq can contribute water saving through efficiency improvements to the discussions. In addition, when planning can be done at the basin level, there may be scope to phase water demand in each part of the basin optimally through the year. There may also be scope for transfer between the Tigris and the Euphrates on a systematic basis, to take advantage of greater water availability in Tigris and the availability of good quality irrigable lands on the Euphrates side.

Environmental considerations. The consumption of water in projects undertaken by Turkey and Syria is likely to leave very little for the marshes in future, and this and the shrinking of environmental flows in the river have major social and environmental costs for Iraq. Iraq should highlight these long-term consequences of neglecting ecology in its negotiations with the upper riparians. The UN Convention on International Watercourses as well as other international protocols on environment place obligation on the governments of a country to preserve ecology within its territory and to cause no damage to the environment of its neighbors.

International experience offers some guidance to getting started. Many countries depend on trans-boundary water flows from the world's 260 major international rivers for large parts of their irrigation water. Among countries where irrigation is important, Egypt, Iraq, Syria, Turkmenistan and Uzbekistan depend on rivers flowing through neighboring countries for two thirds or more of their total surface water.

While a basic premise of water resources management is that river basins are best managed and developed as an integrated whole, this always complex task is more difficult in the case of international waters, as there is no "apex authority" through, which differences can be resolved and, although criteria for allocating water and benefits can be drawn from a growing body of customary international law, there is no consensus on the criteria for equitable allocation. Nations often seek to develop river segments within their own territories, settling for what are – from an unconstrained basin-wide perspective – second best investments.

In extreme cases, tensions over international rivers have halted development, as with the al Wehda dam in the Jordan Valley, or undermined the viability of infrastructure, as with the Khodaferin Dam, which is under construction by Iran into territory disputed between Azerbaijan and Armenia.

Agreement on international water sharing can help future development of irrigation in a number of countries. The absence of agreement could compromise these developments. There is a history of equitable settlement of riparian issues through negotiation and joint beneficial development, often with support from "honest brokers" such as the World Bank. Some best practice lessons are emerging on enhancing water resources management through international cooperation on riparian issues:

- It is essential to act early before the situation becomes critical and to take advantage of windows of opportunity.

- In the process, mediation can be key. Bilateral partners can bring political endorsement of the process. Technical partners can advance cooperation through investment and knowledge. In many basins, for example, programs financed by the Global Environment Facility (GEF) support integrated management of river basins – including major basins in Africa, Central Asia and the Middle East. A program for cooperative management of the Mekong River basin has started.

- Solutions need to focus on the benefits of cooperative management rather than rights, and to create benefits for all (Box A5.5).

- Joint projects, usually multi-purpose operations, are a key component of agreements, bringing evident economic benefit. In the Nile Basin, for example, the three major riparians – Ethiopia, Sudan and Egypt – have agreed lately on a series of multi-purpose operations both within and between their countries for hydropower, irrigation, and watershed management including the proposed Tana Lake integrated water development program in Ethiopia.

- Finally, in negotiating assignment of rights, it is important to factor in environmental flows.

Box A5.5: The sub-Saharan Africa experience on transboundary water issues

In sub-Saharan Africa, shared basins cover 63 percent of the land area, and 11 countries depend on external resources for more than half their total water resources. With this large proportion of shared water resources, regional planning and coordination for transboundary resource allocation, irrigation and watershed management are particularly important.

Current processes are emphasizing cooperative and mutually beneficial development. A number of states have begun cooperation under various programs. Mauritania, Senegal and Mali have established the Organization de Mise en Valeur de la Fleuve Senegal (OMVS), and have constructed dams at Daima in Senegal and Manantali in Mali for irrigation, hydropower and navigation

Experience shows that an initial focus on the benefits of cooperative management – say for water flow and quality– and of agreed or cooperative development for irrigation and hydropower can lead in due course to more formal relationships and viable transboundary institutions. This creates opportunities for optimizing investment strategies at the basin scale, and partnerships for joint management and development of a number of sub-Saharan African shared basins have been created.

Regional organizations and donors have helped to forge these partnerships and have provided investment support. With support from donors, the Zambezi riparians agreed a Protocol on Shared Watercourses in 1995 as a basis for regional integration in water resources management and investment. This led to the 1998 Regional Strategic Action Plan for IWRM in SADC countries and has now triggered the Zambezi Process amongst the eight riparian states and the establishment of a permanent Zambezi Watercourse Commission. These partnerships give priority to investment in irrigation and hydropower.
Source: World Bank 2005

Annex 6

Iraq's National Development Strategy

Iraq's National Development Strategy. The discussion of the water sector in this report highlights the role of the National Development Strategy (NDS) as an important statement of government policy. This policy document, the first produced by a democratically elected government of Iraq and published in July 2005, stresses themes that are of importance for the future of the water sector: good governance, market based and private sector-led growth, and diversification away from dependency on oil. The market oriented approaches outlined in the NDS prioritize a) reviving irrigated agriculture, in particular the emphasis on diversifying the economy, on revitalizing the private sector as the engine of growth and job creation, b) laying the groundwork for eventually privatizing state owned enterprises, c) rehabilitating urban water services, and d) restructuring state-owned banks to encourage consolidation and privatization should all improve the prospects for agricultural investment and production. The NDS commitment to reforming and monetizing the PDS food basket should delink the agricultural incentive structure from the social safety net. The proposals for administrative decentralization could support the idea of regional water boards or local irrigation corporations.

The NDS also emphasizes the need to improve access to clean water and sanitation, and here too the agenda for administrative decentralization and for private sector involvement is consistent with future moves in the water and sanitation sector towards financially autonomous utilities.

The NDS is thus a useful indicator of overall policy and provides a framework for policy dialogue in the water sector. The discussion of policy options in this report is intended to help Iraq move forward from the level of the NDS principles to a more specific policy, institutional and investment program in the water sector.

Iraq's current resource allocation priorities. Subsequent to the NDS the Iraqi government gave clarity, through its 2006 budget, to both the immediate- and medium-term intentions. The budget gives priority in 2006 to investment of national fiscal resources in rehabilitation of oil installations in order to generate future higher revenue streams. Investments across all sectors would then be expected to increase rapidly 2007-2010. This approach underlines that Iraq will have, at least in the medium term, considerable resources to invest in its own development. Preparation of policies and programs for this future investment phase is currently top priority, alongside emergency reconstruction, for both government and its backers. The budget also makes commitments to phase out PDS and other subsidies by 2010, with a 25 percent reduction in 2006. Budget decentralization and bank restructuring are also on the agenda.

Annex 7

World Bank and Donor Engagement in Iraq

1. International assistance: coordination, partnerships and donor activity in water

The international community was quick to recognize the need for a multilateral approach to the reconstruction and development of Iraq. At the request of the international community, the World Bank and the United Nations Development Group worked together to produce an assessment of Iraq's reconstruction needs. The resulting *Joint UN-Bank Iraq Needs Assessment* estimated reconstruction needs for the period 2004-2007 at US$35.8 billion for the fourteen sectors covered.[19] The total need, including security and oil, was estimated at $55 billion. The Assessment served as a basis for an international donors' conference held in Madrid in October 2003, where donors pledged US$32 billion for the period 2004-2007. Eleven donors and the World Bank and IMF accounted for 99 percent of the pledges, and the United States alone for 43 percent. Excluding assistance from the United States, pledges comprise about US$9 billion in loans and US$4 billion in grants. About US$1 billion was pledged for 2004/5 for Trust Funds to be administered by the UN and the World Bank. In June 2005, the Iraq International Conference in Brussels reconfirmed support for Iraq's economic recovery and reconstruction and pledged to expedite aid transfers.

Water resources management: donor coordination and partnerships. In water resources management, donor activity is limited. USAID, FAO and the Bank have coordinated their activities in preparation for the present report, and the CWRAS process is being cofinanced by the BNWPP. Sharing of knowledge with FAO and USAID has been particularly important for this study.

The principal donor investments in water resources management have been in support to MoWR. Introduced earlier, USACE helped with the rapid assessment of dams and is collaborating with MoWR in capacity building, including conducting a training needs assessment for the ministry. USACE also helped MoWR in the preparations for the *water master plan*, which is being financed by USAID. UNESCO is implementing an institutional development project Capacity Building of Water Institutions ($3.3 million, UNESCO with UNDG-ITF funding).

Irrigation and drainage and irrigated agriculture; donor coordination and partnerships. In irrigated agriculture, FAO, WFP and the World Bank worked together on Joint Needs Assessment in 2003 and published a 2003 paper *Reconstructing Iraq's agriculture, water resources and food security system*. All subsequent Bank sector work in irrigation and agriculture is being undertaken in partnership, particularly with the UN, notably FAO and WFP, and with the USA and Australia amongst bilaterals. FAO has provided support to the design and implementation of the ITF-financed Emergency Community Infrastructure Rehabilitation Project.

[19] The fourteen sectors include education; health; employment creation; water and sanitation; transport and telecommunications; electricity; housing and land management; urban management; agriculture, water resources, and food security; finance; state-owned industries; investment climate; mine action; and government institutions. The crosscutting themes include gender, environment, and human rights.

The Bank is working with a donor group on building capacity of the new Ministry of Environment, through support to an environmental strategy and, possibly, through an environment project. Several donor investments in the sector are underway (Box A7.1). The only World Bank investment to date in irrigation and drainage is in the Emergency Community Infrastructure Rehabilitation Project (ECIRP), through an ITF grant to MoWR for $20 million approved in December 2004. The project implementation period is January 2005-December 2006. This is an emergency operation to meet immediate rehabilitation needs in irrigation and drainage (and in water supply) in rural areas whilst creating employment opportunities. The focus is on the southern governorates. The project follows a programmatic approach. In all, the project will finance an estimated twenty to twenty four subprojects and create more than 20,000 short-term jobs. After a slow start, there has been a rapid increase in activity since May 2005. By May 2006, the Project Management Team in MoWR has contracted eight labor-intensive civil works subprojects valued at $4.5 millions, which will create an estimated 6-8,000 jobs. In addition, three goods contracts have been processed. Total commitments in December 2005 stood at $6.5 million.

Box A7.1: Donor activities in irrigation and drainage and in irrigated agriculture

- Improvement of Drainage Conditions in Major Agricultural Areas ($5.4 million, FAO with UNDG-ITF funding, Ongoing).
- Rehabilitation of Pumping Stations ($13.4 million, FAO with UNDG-ITF funding, Ongoing).
- Agricultural Reconstruction and Development for Iraq (ARDI, financed by USAID, Ongoing).
- Community Action Program (CAP, financed by USAID) $131 million to Sept 2005, Ongoing).
- Rehabilitation and Development of National Seed Industry ($5.1 million, FAO with UNDG-ITF funding, Pipeline).
- Emergency Community Infrastructure Rehabilitation Project ($20 million. World Bank with ITF funding, Ongoing).

Discussions have been held with the Iraqi authorities on several other possible investments in the sector. There have been discussions with MoWR on a possible Irrigation and Drainage Basic Infrastructure Rehabilitation Project (IDBIRP). In agriculture, government has expressed interest in Bank financing for agricultural sector development (MoA $40 million) and for rehabilitation of grain silos (Ministry of Trade, $20 million). Although some identification work has been done on these project ideas, there has been no agreement to proceed.

Water supply and sanitation, donor coordination and partnerships. A number of donors have been supporting the Iraq WSS sector since May 2003 including the US, Japan, UN and the World Bank. Coordination between the Bank team and other donors has been active; representatives from Japan, USAID, DFID, EC, the UN and the Bank have met several times all together with the Iraqi government. With support from the Bank, MMPW and MOB hosted a sector donors meeting in the fall of 2005 to present the Government's interim (five to ten year) investment program in water supply and sanitation for possible financing.

Japan and the Bank are considering co-financing several large projects in and outside Baghdad. Moreover, Japan is working closely with the Bank and Iraqi counterparts to align implementation mechanisms on those adopted for World Bank projects. The USAID and the Bank are considering complementary project financing, linking the construction of large water and

wastewater treatment plants in Baghdad with the construction of transmission and/or distribution networks.

Water supply and sanitation, donor coordination and partnerships. The USA is the single largest donor for the sector but has scaled down its originally intended level of support. Total financing currently programmed is approximately $1 billion, down from the $4.3 billion planned in 2003. The US has implemented several projects across the country, through its own institutions, the Iraq Reconstruction Management Office (IRMO) and Iraq Projects and Contracting Office (PCO), United States Agency for International Development (USAID) and the US military. The US support has been largely focused on urgent rehabilitation and reconstruction activities.

Japan, the second largest donor (with allocations of US$1.5 billion grant and US$2 billion soft loan) has focused its assistance on the governorates of Ninawa and Al-Muthana. Part of the grant has financed the rehabilitation of sewage treatment plants and the supply of water treatment units and heavy machinery.

UN support of about US$100 million, channeled largely through UNICEF and financed from its ITF, has focused on supply of equipment and materials for operational activities, technical assistance, training, and on completion of rehabilitation projects started under the Oil for Food Program.

Through the ITF, the World Bank is financing two water supply and sanitation projects for a total amount of US$155 million: the Emergency Water, Sanitation and Urban Reconstruction Project (US$90 million), implemented by MMPW; and the Emergency Baghdad Water Supply and Sanitation (US$65 million), implemented by the Mayoralty of Baghdad. These projects assist in the restoration of basic water supply and sanitation services in the poorest areas of Baghdad and nine governorates throughout Iraq through: (1) reconstruction, rehabilitation and expansion and upgrading of existing facilities; and (2) capacity building support through training and technical assistance.

2. World Bank Engagement

Historic context for World Bank engagement in Iraq

The World Bank renewed its involvement with Iraq in 2003, after a twenty-year break.[20] Based on the Needs Assessment and the Madrid Conference, the Bank prepared a First Interim Strategy Note for 2003-5. In its activities in Iraq, the Bank is following five guiding principles:

- *National ownership*: in delivering assistance to Iraq, the Bank emphasizes Iraqi ownership and seeks to strengthen national institutions, essentially implementing all its activities either through or in close partnership with national institutions.

- *Preparation for future reforms*: the Bank combines its financing of emergency needs with analytical and advisory services to ensure that emergency investments are sustainable and that the groundwork is laid for future reforms.

[20] This section draws extensively on the World Bank's August 2005 Second Interim Strategy Note for Iraq.

- *Sector wide approaches*: the Bank also seeks to build its financing into a coherent sectoral program and to support Iraq in building a comprehensive framework for sector-wide approaches and close partnerships

- *Selectivity*: through the development of sector wide approaches and partnerships with other agencies, the Bank is seeking to develop an increasingly selective work program for the future, specializing in a few key areas where it can work best.

- *Alignment with international best practice*: through its global reach, the Bank aims to provide the Iraqi authorities with access to international best practice.

World Bank experience with post-conflict reconstruction. Continued lack of security has complicated and slowed disbursements of this donor assistance and has lessened its impact on the ground. Although the circumstances of Iraq are highly specific, its experience of aid in reconstruction is generally like that found in other conflict-affected environments. Even in true post-conflict settings, it typically takes several years for international assistance to reach its maximum effectiveness due to limited aid absorption capacity during the early post-conflict years. Experience has suggested that in the early years aid should focus on improving policy, institutions, and governance, and special attention should be given to building credible institutions of social inclusion. It is subsequently, during the middle four or five years of the first post-conflict decade, that international aid is more effective in raising growth. Even then, aid effectiveness is highly dependent on the quality of policy, institutions, and governance.[21]

The Bank in Iraq's water sector. The World Bank's initial assistance to Iraq's water sector was conceived in line with the five guiding principles the Bank has adopted. In 2004, the Bank approved three projects financed from the Iraq Trust Fund for the water sector. Two projects finance immediate reconstruction needs for water supply and sanitation – the Emergency Baghdad Water Supply and Sanitation Project (US$65 million); and the Emergency Water Supply, Sanitation, and Urban Reconstruction Project (US$90 million). A third project – the Emergency Community Infrastructure Rehabilitation Project ($20 million) – finances labor-intensive rehabilitation of water supply, sanitation and irrigation in rural areas.

All three projects are being implemented by Iraqi ministries, a considerable achievement considering that Iraq lacks recent experience with international donor procedures. Implementing arrangements are designed to ensure Iraqi ownership and strengthen institutional capacity. Project management teams (PMTs) in recipient ministries comprise dedicated ministry staff paid at regular salary levels. PMTs are thus designed to provide the skills needed for effective project implementation, yet be flexible and easily reintegrated into the ministry's institutional structure. The projects have been designed and are implemented within an overall sector program managed by government, in coordination with other donors in the sector. The water supply and sanitation projects have been accompanied by policy dialogue on institutional reform in the sector. Under the Emergency Water, Sanitation and Urban Reconstruction Project, the ministry has launched a nationwide water and wastewater survey to prepare a water sector strategy; and it is preparing a comprehensive water sector investment program to present to the donor community for future financing.

[21] This paragraph draws on *Breaking the Conflict Trap: Civil War and Development Policy* (World Bank Policy Research Report. 2003) and reported in the *Iraq: Second Interim Strategy Note*, August 2005.

World Bank Assistance Strategy 2005-7

Objectives and Results. In 2005, the Bank Board approved a Second Interim Strategy for Iraq[22], to cover a period up to two years. The strategy is based on the NDS, emphasizes Iraqi ownership and reflects the experience and lessons learned to date. The Bank's objective is to help Iraq build efficient, inclusive, transparent, and accountable institutions as needed for stability, good governance, and sustainable economic prosperity. The Strategy emphasizes that the Bank's most important contribution would be to help Iraq develop institutional frameworks, policies, and systems that allow for more effective use of Iraq's own financial resources and of those of other donors. A particular priority will be to help build credible institutions of social inclusion. Under the umbrella of institution building, the Bank Group's work program is organized into four pillars to support government efforts to:

- Restore basic service delivery;
- Enable private sector development;
- Strengthen social safety nets; and
- Improve public sector governance, with particular focus on public resource management.

Using analytical and advisory activities and together with investment resources from the ITF, IDA, and IFC, the Bank aims to move along a *continuum of support*: policy advice; institutional capacity building; and, the security situation permitting, financing for investment operations to address emergency reconstruction. The outcome at which the Bank is aiming over the next two years is to have strengthened institutional capacity in all four pillars.

Second Interim Work Program

Under the Second Interim Work Program, the Bank will provide the proposed "continuum of support" from three sources:

- *Analytical and advisory activities (AAA)* will help Iraq strengthen its policies, institutions, and governance, and so improve the effectiveness of national expenditures and international aid in the medium term. In addition to sector-specific policy notes and diagnostic studies, AAA will continue to be clustered into three themes: (1) economic reform and transition; (2) poverty, safety nets, and social development; and (3) public sector management. Advisory activities will aim to lay out options available to Iraqi policymakers and discuss trade-offs under each option.
- *ITF resources* will be used for investment activities that lend themselves to grants rather than loans, such as projects to build institutional capacity, alleviate poverty, protect vulnerable groups, or pilot operations. ITF resources can also be used to cofinance IDA operations.
- The Bank will lend up to US$500 million of *IDA funds*. Iraqi authorities have asked the Bank to initiate IDA lending in four key sectors: education; electricity; roads; and water supply and sanitation. The Bank is already providing support in two of these sectors through the ITF and will build on its experience to deepen its support. Given the difficulty of implementation in Iraq, investment projects will focus mainly on straightforward rehabilitation and expand only cautiously into new sectors or themes.

[22] World Bank. August 23, 2005. Second Interim Strategy Note for Iraq. Report # 32115-IQ. Washington D.C.

Relation of the work program to water sector development. The complete program of Bank support is attached in Annex. Table A7.1 below highlights several proposed AAA and investment operations relevant to the water sector.

Table A7.1: Proposed operations and AAA relevant to the water sector FY06/07

	Restore basic services	Facilitate private sector development	Improve social safety nets	Strengthen public sector governance
AAA		SOE reform TA Financial sector ESW/TA Incentive framework TA Agriculture strategy ESW/TA	Poverty assessment Social protection strategy	Public sector management TA Water assistance strategy Environment strategy Gender TA
ITF			Capacity building for safety nets	Environment
IDA	Water supply and sanitation			

Under the pillar restore basic services; the Bank will finance a follow on project to improve water supply and sanitation and to continue the process of policy reform.

Under the pillar Facilitate private sector development, four components of studies and technical assistance will address subjects important to the future of irrigated agriculture. Support to *SOE reform* and eventual privatization may include industries making and supplying agricultural inputs and processing and marketing irrigated agricultural produce. AAA support to develop and strengthen the *financial sector* will improve the prospects for investment and working capital finance for irrigated agriculture. Technical assistance to review of *the incentive framework* will help to highlight options for unraveling the distortions in incentives in irrigated farming. Studies and technical assistance will help government develop the *agriculture strategy*, which will be essential to reviving the fortunes of the irrigation sector (Chapter 5).

Bank assistance under the pillar Improve social safety nets will support a comprehensive household survey and related capacity building to help the government collect data on poverty, understand the characteristics and causes of poverty, predict the impact of economic policies on poverty, and design a poverty-reduction and safety-net strategy. This process should give essential information about the nature of the rural poverty problem and highlight how irrigated agriculture can play a role in poverty reduction. The household survey will also provide information on the status of water supply and sanitation services and their relation to poverty and health status, allowing prioritization of the WSS program, design of pro-poor tariff programs etc. This support will also identify short-term interventions to help the vulnerable in rural areas: this can be of use in the design of labor-intensive programs for irrigation and drainage rehabilitation. In addition, design of medium-term social-protection policies will help delink social protection from the agricultural incentive framework.

Under the pillar Strengthen governance and public management, in addition to the water assistance strategy – subject of the present report – the proposed technical assistance on public sector management can provide support to determining the role of public services in agriculture and the appropriate division of responsibilities between ministries, different levels of government, and the private sector and civil society, as well as identifying options for decentralizing irrigation management and for putting essentially public agricultural and irrigation services on a cost effective basis. Support to the decentralization and financial autonomy of WSS services on a utility basis can also be provided.

Also under this pillar falls Bank support to Iraq's efforts to improve management of the environment, including support for an environmental strategy. An ITF-financed environment project may assist Iraq in developing a Shatt El Arab Rehabilitation and Environment Management Project, a regional operation that could be cofinanced by the Global Environmental Facility. Finally, Bank work to help mainstream gender issues should help highlight the role and needs of women and girls in both irrigated agriculture and in water supply and sanitation.

Lessons Learnt of the Bank's ITF portfolio

An independent review of the Bank's ITF portfolio (Box A7.2) concluded that in Iraq's challenging implementation environment, the Bank should continue to focus on simple projects that fall within its core competencies, and that projects should shift from an exclusive focus on immediate reconstruction needs to supporting strategic thinking and planning at the sector level.

Experience with the three water projects confirms that initial investment assistance may be slow in getting started: nine months after the financing was approved, only $180,000 has been disbursed from the total financing for the three projects of $175 million. Government, meanwhile, has worked actively on the policy, institutional and governance agenda.

Box A7.2: Findings from an Assessment of the World Bank Project Portfolio in Iraq

The Bank's Middle East and North Africa Region commissioned a rapid independent review of the current portfolio of eight ongoing projects funded by the Iraq Trust Fund (ITF).

Strengths:

- The program has been appropriately sequenced: an initial needs assessment was followed by a capacity building project (especially on dealing with the Bank), which prepared the ground for initial operations.
- The initial operations are generally very straightforward—basic investments in infrastructure rehabilitation and provision of essential goods such as textbooks and pharmaceuticals.
- Embedding implementation capacity within ministries is appropriate, even if complicated in the short term, and is consistent with the Bank's emphasis on country execution, which is unique among most donors.

Shortcomings:

- The original timeframes for project completion lack realism, given the typical experience even in countries familiar with the Bank and routinely visited.
- The Bank should have better managed the expectations of donors and counterparts, since Iraq is effectively a "new" borrower for the Bank, there is no fast-disbursing adjustment lending, and projects take four to seven years to disburse on average in other countries.
- Projects should give more attention to developing and measuring performance indicators to assess impact, especially in the Iraqi environment where learning by doing is important.
- Projects should be designed to include support for strategic thinking at the sector level. Six of the eight current projects focus exclusively on immediate reconstruction needs.
- The Bank should work toward more explicit cooperation and harmonization among donors, especially since the Bank is a small player in financial terms but a major player in the development agenda.

Recommendations for managing the current portfolio :

- Focus on implementation, since absorbing additional financing would be a challenge for any country, much less a new borrower in a fragile and unpredictable environment.
- Be more realistic on timing and focus on monitoring and evaluation.

Recommendations for future assistance:

- Stay focused to avoid spreading the Bank's effort too thinly across too many sectors at a time when the Bank does not have a physical presence in the country. An alternative would be a sequenced approach, initially deepening involvement in sectors where the Bank is already engaged or has particular strengths.
- Concentrate on implementation, which will be crucial given the upcoming rapid expansion of the program to almost US$1 billion in less than two years in a country that has not dealt with the Bank for more than 25 years.