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PROJECT PERFORMANCE ASSESSMENT REPORT

MOROCCO

**WATER RESOURCES MANAGEMENT PROJECT
(SCL-42890 SCL-42891)**

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*Sector Evaluation Division
Independent Evaluation Group (World Bank)*

IEGWB Mission: Enhancing development effectiveness through excellence and independence in evaluation.

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To prepare a Project Performance Assessment Report (PPAR), IEGWB staff examine project files and other documents, interview operational staff, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, and interview Bank staff and other donor agency staff both at headquarters and in local offices as appropriate.

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Risk to Development Outcome: The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). *Possible ratings for Risk to Development Outcome:* High Significant, Moderate, Negligible to Low, Not Evaluable.

Bank Performance: The extent to which services provided by the Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan/credit closing, toward the achievement of development outcomes. The rating has two dimensions: quality at entry and quality of supervision. *Possible ratings for Bank Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Borrower Performance: The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. *Possible ratings for Borrower Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

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<p>This report was prepared by Silke Heuser, who assessed the project together with Antoine Boussard in September 2008 under the supervision of Ronald S. Parker. Marie Charles provided administrative support.</p>
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Principal Ratings

	<i>ICR*</i>	<i>ICR Review*</i>	<i>PPAR</i>
Outcome	Satisfactory	Moderately Satisfactory	Moderately Satisfactory
Institutional Development Impact**	Modest	Modest	———
Risk to Development Outcome	———	———	Moderate
Sustainability***	Likely	Likely	———
Bank Performance	Satisfactory	Satisfactory	Satisfactory
Borrower Performance	Satisfactory	Satisfactory	Satisfactory

* The Implementation Completion Report (ICR) is a self-evaluation by the responsible Bank department. The ICR Review is an intermediate IEGWB product that seeks to independently verify the findings of the ICR.

**As of July 1, 2006, Institutional Development Impact is assessed as part of the Outcome rating.

***As of July 1, 2006, Sustainability has been replaced by Risk to Development Outcome. As the scales are different, the ratings are not directly comparable.

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Preface

This is the Project Performance Assessment Report (PPAR) prepared by the Independent Evaluation Group (IEG) for the Water Resources Management Project (WRMP).

The WRMP was approved in FY98 for a loan of US\$20.24 million. At mid-term review (May 2001) the project implementation was extended to 6 years. Actual project costs amounted to US\$ 14.46 million. The reduction in total project costs was due to savings on consultancy services and currency appreciations.

This report is based on the Project Appraisal Document (PAD), sector and economic reports, special studies, Country Assistance Strategies (CASs), Policy Framework Papers, credit documents, review of the project files, and discussions with Bank staff. An Implementation Completion Report (ICR, Report No. 31531, dated May 11, 2005) was prepared by the Middle East and North Africa Region. An IEG mission visited Morocco in September 2008 and discussed the effectiveness of the Bank's assistance with government officials, other development organizations, beneficiaries, and stakeholders (see Annex F). Their cooperation and assistance in facilitating meetings and site visits are gratefully acknowledged. Special thanks go to Ms. Sabah Bencheqroun, Mr. Mohamed Oubelkace, Ms. Françoise Clottes, Mr. Hassan Lamrani, and Ms. Laila Moudén.

The IEG PPAR mission visited the Oum-er-R'bia River Basin Agency that was funded under the project, and one of the six other RBAs that followed suit. It also visited four of five agencies involved in project implementation and examined laboratories, drip irrigation infrastructure, and groundwater recharge weirs in Rabat, Agadir, Beni Melall, and Fkih ben Salah (see Annex E). Based on these field visits and interviews with officials and beneficiaries, this PPAR supports ICR findings in all important particulars and finds it to be an accurate portrayal of the achievements encountered during implementation. Furthermore, this report reviews changes in the country's approach to watershed protection in order to inform an upcoming Evaluation of Bank Group Support for Water—a major IEG evaluation that will examine the development impact of increased attention to water resources management and water services. In addition, this PPAR will inform a case study on Morocco's water sector.

Copies of the draft PPAR have been sent to the relevant government officials and agencies for their review and comments. No comments were received from the borrower.

Summary

Morocco is a dry country, its water resources are unevenly distributed and its rainfall patterns are erratic. To offset these disadvantages, since its independence in 1956, the country has invested heavily in the construction of reservoirs. The number of dams has increased from 12 in 1960 to 114 by 2006, and led to a nine-fold increase in water storage capacity. Serious water problems remain, however, and successive years of drought have resulted in a nearly continuous drop in reservoir water levels. As a consequence, many people have been forced to rely on groundwater to satisfy at least a part of their water needs. Unfortunately, the drilling of a massive number of wells has overtaxed subterranean supplies, and groundwater is being rapidly depleted.

In the early 1990s, the Government of Morocco (GoM) decided to reform its water sector and in 1995 it passed a comprehensive water law that laid the groundwork. The 1998 Water Resources Management Project (WRMP), the subject of this Project Performance Assessment Report, was designed to support the goals and principles of the water reform legislation by financing activities that took an integrated water resources management (IWRM) approach, and *inter alia* decentralized water management to the basin level and set up river basin agencies, while promoting further legislation to change the institutional structure and help the 1995 law become more functional.

The objectives for the WRMP were to assist the GoM in promoting comprehensive water management in a manner that is economically efficient, equitable, and environmentally sustainable. Specifically, the project aimed: (a) to support the establishment of an institutional framework for integrated water resources management and the creation of one River Basin Agency (RBA); (b) to improve capacity in water resources planning and management; (c) to improve water use efficiency; (d) to increase the effectiveness of existing hydraulic infrastructure; and (e) to introduce water pollution control measures.

Decrees and public orders (21 and 32, respectively) to support the institutional framework for integrated water resources management were processed through the national administrative, political and legislative systems, and published. The Oum-er-R'bia River Basin Agency was created under the project. As of 2009, seven major and two smaller river basins are managed by basin agencies. RBAs collect user fees, manage watershed planning, protect the environment, and mitigate natural hazards. Under the project, RBAs constructed flood-prevention infrastructure by stabilizing degraded hillsides through check dams in a wide area, and by constructing a flood evacuation channel to reduce annual flooding of a city center near the foot of a mountain range.

The national capacity for water resources planning and management was increased through the preparation of 21 studies including: a National Water Plan, a National Flood Protection Plan, a National Plan for Water Quality Improvements, and a Bulk Water Pricing Study. The analytical work undertaken under the loan and through the various studies supported a database on water resources that is still guiding policy decisions and investments in the water sector.

Large-scale irrigation schemes in Morocco regularly experience water losses in excess of 50 percent. Under the project, 11,000 hectares, or 10 percent of the Tadla irrigation perimeter has been equipped with drip irrigation technology, equipment for irrigation efficiency demonstration plots was acquired, and six pieces of heavy equipment were procured for land leveling activities. Trials covering more than 580 hectares were carried out to determine crop water requirements, demonstrate the use of sprinklers, and to identify and promote improved surface irrigation

techniques. Water savings due to drip irrigation technology ranged from 16 percent to 38 percent, while production increased by between 50 percent and 76 percent depending on the type of vegetable planted. According to a 2008 assessment, the decreasing presence of nitrates in the aquifer demonstrate the effectiveness of drip irrigation and the associated more limited use of fertilizers, which together led to dramatically improved groundwater quality in the Tadla region.

The overall outcome for the WRMP is rated as moderately satisfactory. Shortcomings occurred with respect to the project's efficiency, and with a program to control waterborne diseases. The project's risk to development is rated moderate, while Bank and Borrower performance is rated satisfactory. Lessons derived from the WRMP experience were as follows:

- *Providing subsidies to promote the use of water-saving equipment is a necessary but not sufficient condition, even when the technologies increase production and lower production costs.* For drip irrigation to spread, government subsidies that lower the cost of equipment are not enough because of their high transaction costs (farmers have to clean and service the drip irrigation nozzles continually, and they need to learn new fertilizer application techniques). Additional measures and/or incentives may be required. It proved necessary to support the creation of new agricultural extension services to work with drip irrigators, for example. Furthermore, land tenure issues needed to be resolved in order to allow farmers to take their own decisions with respect to installing the new technology and making further investments in its support. In addition, extension agents need to watch new adopters very carefully to ensure that the misuse of the new technology does not lead to major crop losses—which would make further diffusion of the innovation far more challenging.
- *Providing unlimited access to credible environmental data can be an effective way to promote change, institutionally and on the ground.* Under the WRMP, a study on flood prevention created vulnerability maps to identify hotspot areas, and these were put in the public domain. In retrospect, having these spots clearly identified led to flood prevention actions. Similarly, data on falling levels of agricultural chemicals in the aquifer is helping to promote drip irrigation.
- *The use of geographic information system (GIS), software during environmental monitoring can help to assess levels of aquifer pollution.* Water quality monitoring efforts clearly identified the geographic areas where reductions in agricultural chemical might be expected to reach subterranean aquifers. When the responsible parties knew where to look for water quality improvements, they were able to document major improvements.

Vinod Thomas
Director-General
Evaluation

1. Background and Context

1.1 Morocco is a water scarce country, and securing an uninterrupted supply of water for human consumption, agriculture, industry, and tourism has been a constant concern. Since its independence in 1956, the government has invested heavily in reservoirs: The number of dams has increased from 12 in 1960 to 114 in 2006.¹ This increase has resulted in a nine-fold increase in water storage capacity (and an 80 percent mobilization rate for surface water) which has helped Morocco to compensate for its uneven geographical distribution of water resources and erratic rainfall patterns.

1.2 Currently, 100 percent of the urban population and 58 percent of the rural population have access to an improved water supply.² The country is expected to achieve the Millennium Development Goal of access to safe drinking water, something that would not have been possible without the huge capacity increase. The reservoirs also sustain large irrigation systems. In 1967 the government committed itself to the provision of irrigation to one million hectares of land by the year 2000.³ Thanks to considerable investment over the period, this goal was achieved by 1998,⁴ and as of 2006, the country possesses a total irrigated area of 1.4 million hectares.⁵

1.3 Serious water problems remain, however. Since the 1980s, successive years of drought have resulted in a nearly continuous drop in reservoir water levels. As a consequence, many people have been forced to rely on groundwater to satisfy at least a part of their water needs. Recurrent drought has led to the drilling of thousands of wells to guarantee a parallel supply of water for the most urgent needs, not to mention the massive amounts required for tourist amenities such as swimming pools and golf courses. Subterranean supplies are overtaxed, and groundwater is being rapidly depleted. In southern Morocco, farmers in Agadir report that the water table is falling by 1.5 to 3 meters per year, requiring them to deepen wells every year or two.⁶ Faced with spreading shortages, the government together with the private sector, is currently investing in transfer schemes to channel water from the north, where it is relatively plentiful, to water-scarce areas further south.

¹ According to documents in the files of the 2007 Morocco – Water Sector Development Policy Loan (P095840), an important dam construction program that increased the number of dams from 12 in 1960 to 114 in 2006 resulted in an 80% mobilization rate for surface water and a nine-fold increase in water storage capacity, i.e., from 1.8 billion m³ to 16 billion m³.

² WHO/UNICEF (2008). *Progress on Drinking Water*. Retrieved on 09/27/08 from: http://www.who.int/water_sanitation_health/monitoring/jmp2008.pdf

³ According to Ait Kadi (1998), government policy in the agricultural sector has always favored investments in the irrigation subsector. The goal was to put under perennial irrigation one million hectares by the year 2000. This was referred to as the "million-hectares" policy.

⁴ "The objective of irrigating one million hectares was achieved. The agricultural development policy with respect to irrigation was started in 1967. Under the policy, one million ha were to be irrigated by 2000. At the end to 1998, one million ha of surfaces are effectively irrigated." See: «L'objectif du million d'hectares irrigués est atteint.» Retrieved on 02/02/09 from : <http://hal.archives-ouvertes.fr/docs/00/17/98/40/PDF/Debbah.pdf>.

⁵ 2007 Morocco – Water Sector Development Policy Loan (P095840).

⁶ The IEG mission was altered to falling water levels by staff from the Souss Massa Basin Agency in Agadir.

ROLE OF THE BANK

1.4 The World Bank has helped Morocco to finance investments in the water sector since 1963. Over the past 45 years, nearly 40 percent of Bank lending to the country has been water related.

1.5 Faced with a severe drought during the 1990s and with reservoirs that were disturbingly shallow, it was apparent to decision-makers at the highest political levels that finding new solutions to the challenges of water resources management were pressing: efforts to reduce demand needed to supplement the search of increased water supplies. While many donors were active in the search, the Bank supported Morocco's development of a water sector strategy and sector staff provided important technical inputs leading to the Water Law of 1995.

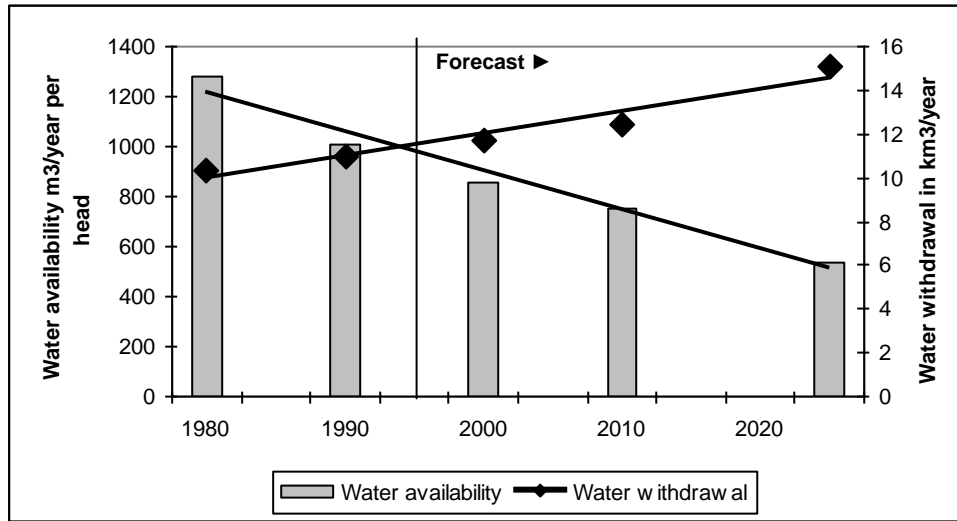
1.6 With Board approval of the (1998) Water Resources Management Project (hereafter WRMP) Bank financing began to support Morocco in applying the Water Law of 1995. The law advocated more integrated management of water resources and encouraged conservation to supplement the investment in dams. Demand-management, reuse of treated wastewater, water transfers, and desalinization were promoted. In addition, the law provided for increased cooperation between the various water subsectors and highlighted the importance of reducing water losses from the source and at all intermediate points up to the receiving body of water. The project also provided funding for the first basin management agency, the Oum-er-R'bia River Basin Agency (RBA).

1.7 In 2007, the Bank approved a Water Sector DPL for Morocco with the objective of securing institutional reforms not yet fully achieved under the 1998 WRMP. However, the timing was unfortunate. While the Water Sector DPL was prepared under a government favorable to the reform of the water sector, a change in government in 2007 resulted in a regime that preferred the *status quo ante*.

1.8 While it is hard to know what stance Morocco's water sector will elect if shortages become more dire, Bank water staff foresee ever worsening water resource conditions that under current climate change scenarios are expected to affect the Maghreb region particularly early and hard. Cause for further concern is the 30 percent drop in average precipitation since 1970, which, along with more frequent droughts and floods, is hard to be seen as anything other than a sign of climate change. By 2025, 35 percent of Moroccans could be living in "absolute scarcity," which is defined as having less than 500m³/capita/yr (see Figure 2).⁷

⁷ The World Bank (2007). Water Sector Development Policy Loan (PO95840), p. 6.

Figure 1. Gap Between Water Availability and Water Withdrawal Is Likely Widening



Source: Figure from IEG, data from Shiklomanov and Rodda, 2003

1.9 Despite a succession of investments in very costly dams and the resultant dramatic increase in surface water storage capacity, existing surface water supply continuously falls short of actual demand, and this has led to stringent water use restrictions in irrigated areas. A new CAS, which is currently under preparation, is expected to strongly emphasize the adaptation to the water-related impacts of climate change.

2. Objectives and Components

PROJECT OBJECTIVES

2.1 The Water Law of 1995 provides the necessary regulatory, legal and institutional framework to support sustainable water management. The 1998 Water Resources Management Project (WRMP) was focused on putting the Water Law into practice, and reforming Morocco's water sector.⁸ Policy reforms supported include the development of a framework for long-term planning, the establishment of a regulatory framework to limit groundwater mining and to control water pollution, the promotion of economic incentives to control demand, and improvements in cost recovery for water-related services.

2.2 The objectives for the WRMP as indicated in the Staff Appraisal Report (SAR) were to assist the Government of Morocco (GoM) in promoting comprehensive water management in a manner that is economically efficient, equitable, and environmentally sustainable. Specifically, the project's objectives were: (a) to support the establishment of an institutional framework for integrated water resources management and the creation of one River Basin Agency (RBA); (b) to improve capacity in water resources planning and management; (c) to improve water use efficiency; (d) to increase the effectiveness of existing hydraulic infrastructure; and (e) to introduce water pollution control measures.

PROJECT COMPONENTS

2.3 The original components of the WRMP included the following:

(a) *Policy Reforms and Institutional Development*, to promote integrated water resources management, establish a rational tariff policy, increase cost recovery, and promote decentralized water management through the establishment of Morocco's first river basin agency; (b) *Capacity Building* in water resource planning, information systems and technology to improve national and river basin planning, monitoring, and management capability and foster water conservation technology through applied research; and (c) *Investments* in water mobilization and quality to improve the productivity and sustainability of physical infrastructure through the rehabilitation and maintenance of dams, safety monitoring, and groundwater development for reliable water supply. Lastly, water quality would be improved through the construction of sewerage systems in small urban centers, which would be complemented by improved public education campaigns to combat waterborne diseases.

⁸ According to the PID, the passage of the Water Law of 1995 was a major step in the implementation of an integrated water resources management program. It was the result of a continuous policy dialogue conducted with the government by the Bank in the context of the preparation of the 1995 Water Sector Review. The Law provides the necessary regulatory, legal and institutional framework to support sustainable water management and institutes a number of fundamental policy reforms such as : (a) the creation of river basin agencies for decentralized water management and increased stakeholder participation; (b) the establishment of long-term national and river basin water master plans; (c) the introduction of water charges on bulk water resources and pollution taxes; and (d) the establishment of the monitoring and control of water quality.

2.4 To better distinguish between the respective implementing agencies' tasks (Ministry of Public Works [including the Department of National Meteorology], the Ministry of Agriculture, and Ministry of Public Health), the implementing agencies and the Bank informally reorganized the project's main components, increasing them from three at appraisal to five during the supervision mission of April 2000. The revised components, which took into account all the original project sub-components, included: (a) water resources planning, (b) establishment of the Oum-er-R'bia RBA, (c) optimization of irrigation efficiency, (d) control of waterborne diseases, and (e) investments in water mobilization.

2.5 Table 3 below lists the WRMP's objectives, revised components, component cost, and total project cost (at appraisal and actual).

Table 1. MOROCCO – Water Resources Management Project (Loan 4289)

Objective	Components	Costs	
		Appraisal	Actual
To support an institutional framework for IWRM and to create one RBA	Establishment of an RBA	1.05	4.25
To improve capacity in water resources planning and management	Water resources planning	14.70	6.78
To improve water use efficiency	Optimization of irrigation efficiency	3.15	2.55
To increase the effectiveness of existing hydraulic infrastructure	Investments in water mobilization		
	• Rehabilitation of Nakla dam	1.80	0.43
	• Recharge of Souss aquifer	2.16	1.54
	• Study of Triffa aquifer	1.67	1.95
To introduce water pollution control measures	Control of waterborne diseases	1.06	0.50
Total		25.59	18.00

Source: WB Database

3. Design and Implementation

PROJECT DESIGN

3.1 The WRMP was originally conceptualized as a US\$200 million loan. It was dimensioned to support a comprehensive water reform program. In early discussions with the borrower, the project was expected to finance the Dachr El Oued Dam, at a cost of about US\$80 million, in addition to several other activities. However, after the engineering designs had been completed with Trust Fund resources (World Bank/Japanese PHRD), and following further discussions with the appraisal team, the GoM decided to construct the dam without Bank financing, and, by the end of the appraisal, the WRMP was ultimately reduced to US\$25.6 million.

IMPLEMENTATION EXPERIENCE

3.2 Implementing the WRMP proved challenging. Not only had the financing for the project been dramatically reduced, but promoting institutional change in ministries that had their own traditions and approaches to coordination proved difficult. In practice, the various agencies that had historically discharged responsibilities for water resources management had done so in an uncoordinated manner. Therefore, the consolidation of responsibilities into one resource management structure often conflicted with traditional spheres of influence and strongly vested interests.

3.3 Although the country had many experienced water engineers, they were not necessarily institutional specialists—previous water sector investment projects in Morocco built infrastructure, not a new sectoral bureaucracy. International consultants were hired for the conceptual institution-building work, but their output pleased almost no one. Few public officials were to be left with their domains intact. An important consulting contract had to be cancelled after two years because, according to local informants, “the results did not meet the government’s needs.”

3.4 During the mid-term review mission of May 2001 a number of changes were suggested: project implementation was extended to six years. Additions were made to technical assistance components that included more training and equipment for the project-supported RBA; strengthening of the Directorate General of Hydraulics (DGH, later the State Secretariat for Water, SEEau), more equipment and materials for the Department of Rural Works (MoPW) for carrying out applied research and demonstrations with their Experimentation, Trials and Standards Unit (SEEN) and the three Regional Agricultural Development Authorities (ORMVAs). Adjustments were made to unit costs as well as physical and price contingencies. Even with these additions, the project’s total cost was reduced from US\$25.6 million to US\$20.24 million, mainly due to savings in consultancy services and favorable exchange rates.

PROJECT COSTS

3.5 The loan for the WRMP was composed as a basket of currencies consisting of US\$10 million and FF 59 million. In 2002 when the Franc went out of circulation, this amount was converted into Euro at the prevailing rate (it was equivalent to € 8.99 million at that point). The loan was declared effective in January 1999. There were three cancellations totaling € 4.98 million: FF 13 million in 2001 (equivalent to € 1.98 million) after the mid-term review; € 1.5 million in 2002; and € 1.5 million late in 2004. At appraisal, implementation was estimated to take four years. The project was extended twice by a total of two and a half years and closed in December 2004. Project extensions provided additional time so that implementing agencies conducting time-consuming activities could complete the ones that were behind schedule. Cancellations were due to cost savings—delays with studies, equipment purchases, and civil works led to payments being made at more favorable exchange rates.

3.6 As of May 1, 2005, US\$10 million was disbursed plus € 3.40 million, thus making the total disbursement from the Bank loan US\$14.46 million (equivalent), which represented 72 percent of the original loan. The final estimate of total project costs is equivalent to US\$18 million or 70 percent of the appraisal estimate. The Government's contribution, estimated at a total of US\$3.65 million, represents 68 percent of the initial appraisal estimate, in line with the Bank's contribution.

4. Outputs and Outcomes by Objectives

OUTCOME OF THE WRMP

4.1 The outcome of the WRMP is rated **moderately satisfactory** (see Table 4). The tripartite basis for the moderately satisfactory outcome rating is discussed in the three following sections using the traditional IEG criteria.

Table 2. Development Objective and Outcome for the WRMP

Development Objective	Relevance	Efficacy	Efficiency
(a) supporting the establishment of an institutional framework for integrated water resources management and the creation of one River Basin Agency (RBA); (b) improving capacity in water resources planning and management; (c) improving water use efficiency; (d) increasing the effectiveness of existing hydraulic infrastructure; and (e) introducing water pollution control measures.	High	Substantial	Modest
Overall Project Outcome	Moderately Satisfactory		

RELEVANCE

4.2 The relevance of project objectives is rated **high**: The project's objectives are highly relevant given that Morocco is a water scarce country, which is expected to become water stressed⁹ in the near future.

4.3 While the World Bank had provided assistance to Morocco's water sector for thirty years, this loan represented a change in strategic approach. While in the past, the Bank had provided assistance to different water sub-sectors, in this case it began to address water issues in a comprehensive and integrated manner—a shift that reflected the international consensus on water expressed in the Dublin Principles.¹⁰

4.4 In support of this new orientation, a Bank policy paper was prepared and approved by the Board in 1993. Country and region-specific strategy papers followed, such as the 1995 Morocco Water Sector Review and the 1995 MENA Strategy for Managing Water.¹¹ Both strategies describe institutional changes needed for implementing an integrated approach to water resources management.

4.5 Reflecting the Bank's policies and strategies on water, the 1997 CAS specifies strengthening integrated water management as an objective. This objective is still relevant as the most recent 2005 CAS stipulates the importance of improving Morocco's legal, financial, and institutional framework in the water sector. In particular, the overarching objective was to improve intra-sectoral coordination, in part by matching sector financing mechanisms to sector priorities (including integrated water resources management through river basin agencies), and to strengthen operator regulation.

4.6 A 2007 CAS review described the reform process in Morocco as fragile. According to the progress report, the reform of the sector has yet to be consolidated and to lead to sustainable changes in behavior.¹² The latest thinking within the Bank—to use the climate change agenda to facilitate difficult political decisions—can be seen as a

⁹ The 2006 UNDP Human Development Report, *Beyond Scarcity*, defines countries or regions under water stress as having less than 1,700 cubic metres of water available per person.

¹⁰ The 1992 Dublin Conference established four guiding principles for managing freshwater resources: Principle No. 1 - Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.

Principle No. 2 - Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

Principle No. 3 - Women play a central part in the provision, management and safeguarding of water.

Principle No. 4 - Water has an economic value in all its competing uses and should be recognized as an economic good. *Source: International Water and Sanitation Centre (IRC).*

¹¹ The World Bank-funded Water Sector Review (1995) provided the framework for a national water resource management strategy and recommended Bank investment lending to the proposed first water resource management project. The Water Sector Study (1997) provided the basis required for formulating a strategy for water resource management.

¹² The 2007 CAS Progress Report No. 41254 - MA states that backed by the Multi-Year Support Program (Water-MYSP) studies and wide-ranging advice through the Development Policy Loan (Water-DPL), long-term reforms (governance, integrated management of resources, irrigation, drinking water supply and sanitation) are starting to produce significant results. This progress, and the dynamism of the underlying inter-ministerial dialogue, is not irreversible. It has yet to be consolidated and to lead to sustainable changes in behavior.

necessary condition if the water sector is to secure a sustainable supply of water for the future.

4.7 Relevance of project design is rated **substantial**:

4.8 Project design was relevant to achieve the specific objectives of establishing an institutional framework for integrated water resources management, the creation of a River Basin Agency, capacity building, improving water quality and efficiency, and increasing the effectiveness of existing hydraulic infrastructure.

4.9 With respect to the project's results framework, one of the specific objectives and outcome indicators was not tied to inputs, and remained very broad compared to expected outputs of the project. The disconnect can be found in Objective 1 ("to support the establishment of an institutional framework for integrated water resources management", see Annex C). The output indicator for this objective was to publish a number of decrees and public orders. While these decrees were to create the legal basis for important reforms in the water sector, only a limited number of key institutions received funding to improve their capacity for implementing and subsequently enforcing the decrees. Stated in another way, either the objective was formulated too broad or sufficient capacity was not developed country-wide to link outputs (published decrees) to outcomes (e.g., institutions capable of controlling water quality and ensuring that polluters pay for pollution). Reflecting this weakness, the project's results framework did not sufficiently align outcome indicators with the first project development objective.

EFFICACY

4.10 The achievements by objectives for the WRMP include the following:

4.11 **Objective 1:** *Supporting the establishment of an institutional framework for integrated water resources management and the creation of one River Basin Agency (RBA)*; this objective is rated **substantial**.

This objective consisted of two parts: 1) the establishment of an institutional framework, and 2) the creation of a River Basin Agency (RBA). Overall, this objective is rated substantial, because decrees and public orders to support the institutional framework for integrated water resources management were published, and the Oum-er-R'bia River Basin Agency was created. As of 2009, seven major and two smaller river basins are managed by basin agencies. RBAs collect user fees, manage watershed planning, protect the environment, and mitigate natural hazards. Under the project, RBAs constructed flood-prevention infrastructure by stabilizing degraded hillsides through check dams in a wide area, and by constructing a flood evacuation channel to reduce annual flooding of a city center near the foot of a mountain range. Despite these considerable achievements, problems remain, which will be discussed in the following paragraphs.

4.12 Decrees and public orders were prepared, processed through the national administrative, political and legislative systems, and published. These measures were designed to support the institutional framework for integrated water resources management (and they were clearly necessary to put the Water Law of 1995 into practice). By project closing in December 2004, 21 of a total of 37 decrees had been

published as well as 32 public orders (see Table 5). Arguably, the two most important published decrees related to water extraction (irrigation, electricity, potable water, and industry) and water pollution. However, both the public orders related to the collection of fees for industrial water use and the public orders complementing the decree for water pollution were still under preparation.

Table 3. Published Decrees as of June 2004

Text	Decrees	Public Orders	Bulletins
Published texts	21	32	10
Texts under preparation	16	19	2
Totals	37	51	12

4.13 In the intervening years since project closing, a total of 11 more decrees have been approved and published. According to local sources, nine of these decrees have regulations that are approved or they have been put into effect to some degree. A total of five decrees have been prepared but are still in the process of being approved. Despite this considerable progress on the legal front, the reform process is far from complete. While publishing decrees is an important step, a far more important challenge is the creation of an institutional framework and a change in behavior among the ministries and the population.

4.14 A public awareness effort known locally as the “National Debate on Water”, began in 2002 to forge a broad consensus on some of the reform issues in the water sector. A publication documenting the National Debate four years later¹³ specifies the following issues as priorities in future reforms: securing water resources, safeguarding water quality, promoting efficient water use, limiting groundwater extraction, and fighting erosion. Not much progress has been made. The World Bank-funded 2007 Water Sector Development Policy Loan reiterates (four of) the same reform objectives¹⁴ as the 1998 WRMP. While it is not surprising that reforming and integrating Morocco’s water sector has not happened overnight, given that it is now 10 years since the approval of the WRMP it is beginning to look as if it will take a generation to see results. Some informants felt that the WRMP would have accelerated this process a bit more if it had paid more attention to the political processes involved, and especially to who was gaining and losing power and influence, while it was supporting increased attention to integrated water resources management.

¹³ National Debate on Water / Débat National sur L’Eau 2006.

¹⁴ The 2007 Morocco – Water Sector Development Policy Loan (P095840) aims to achieve the following objectives:

1. Improved governance, financing arrangements, and policy coordination in the water sector.
2. Enactment of integrated water resource management towards sustainable water uses.
3. Enhanced service, asset management and usage productivity in irrigation.
4. Better access to water and sanitation service, and increased wastewater treatment capacity.

4.15 **Creation of the Oum-er-R'bia River Basin Agency:** Since the project WRMP closed, there has been considerable progress in the development of the basin agency for the Oum-er-R'bia Basin in Beni Mellal (see Map Annex G for the Oum-er-R'bia basin). The Oum-er-R'bia RBA was signed into law by Decree 2-96-536 in November 1996 as the first basin agency in Morocco. Under the WRMP the agency received funding for legal and technical assistance as well as the procurement of equipment. Since then, Morocco's seven major basins are managed by basin agencies (three of them functioning with the support of other donors). As of September 2008, two agencies began to manage two smaller basins. The principal functions of all of these RBAs include the allocation of water to the various users in each catchment, the control of water quality, the assurance of cost recovery via charges for extraction of water and discharge of wastewaters, the maintenance of hydraulic infrastructure including dams, the enforcement of extraction, and effluent discharge licenses, and flood control procedures.¹⁵

4.16 According to the Water Law of 1995 and following the example of basin agencies in France, Spain, and elsewhere, RBAs are supposed to be financially autonomous. In this respect they are accountable to their stakeholders as well as to the state bureaucracy. The issuance of decrees discussed earlier in this report was important as a legal and regulatory basis for the agency to collect dues. The IEG PPAR mission found that as of September 2008, the Oum-er-R'bia RBA was approaching financial self-sufficiency. The agency was able to finance ongoing work with beneficiary contributions (80 percent of the total budget), while staff salaries (20 percent) were still covered by the government budget. Beneficiary contributions were transparently managed in the MIS, based on the Oracle software system, which had been procured with project funds. The most important clients listed (in terms of billing) were the National Potable Water Office (ONEP), responsible for drinking water distribution in Morocco, and the National Electricity Office (ONE).

4.17 The mission attempted to assess the various functions of the RBA, such as water quality monitoring, flood protection, and recording of hydrological and meteorological data. All the necessary information was available using the MIS system. The same system also manages accounts receivable and payable, and otherwise handles the accounting. Staff responded to information requests with alacrity and competence, although they would have appreciated project-funded training in the use of the software program with which they worked.¹⁶ The mission found that training had not been given as was intended because the MIS system had been installed on the computers too close to project closing for this to be arranged.

¹⁵ Initially, most of the personnel for the new Oum-er-R'bia Basin Agency came from the Directorate General of Hydraulics. Regional offices of the Directorate General of Hydraulics had been set up during the 1980s in every basin. Given its function in hydraulic research, monitoring, and water resources planning, it was a precursor of the various RBAs that are now functioning.

¹⁶ According to the ICR, in 1999, the provision of technical assistance and training, as well as equipment and materials to the DGH, was been contracted to the FAO. All of the technical assistance (more than 30 operations) and training (more than 10 programs, mainly in water resources planning and management) have been completed. Moreover a large number of computer and field equipment, as well as 29 vehicles, were delivered to the DGH and the six other newly established river basin agencies using loan proceeds.

4.18 The mission visited one of the project-financed meteorological station (12 of which had been refurbished). It was equipped as intended, with all instruments functioning. Meteorological data gathering and analysis is one of the many functions of the RBA. Yet another function of the RBA is the control and enforcement of groundwater extraction via permits. En route to the meteorological station the mission was (coincidentally) able to observe Oum-er-R'bia RBA staff engaged in enforcement work. Traveling in a vehicle with IEG, basin management agency staff noticed a mobile rig drilling for groundwater. These rigs are easy to move around and therefore usually hard to catch in the act if they are not discovered during the hours they are engaged in drilling (see Figure 3). They approached the rig and demanded that the driller show his permit. Since none of the men working the rig could produce a permit their drilling was illegal, and it was halted. They were not allowed to resume until agency staff could be shown a permit from the Oum-er-R'bia Basin Agency.

Figure 2. Mobile Drilling Rig



Picture: IEG

4.19 Another responsibility of the RBAs is the maintenance of all the dams in the basin. However, according to the SAR, the inclusion of dam maintenance staff in the RBAs had not been envisioned prior to the appraisal mission.¹⁷ According to officials working in the RBAs, dam maintenance puts significant pressure on the budget as well as on staff time. Staff interviewed noted that the few people working in basin agencies are overloaded with a multitude of responsibilities. If this is true for other RBAs, it would indicate that the balance of resources and responsibilities needs to be revisited.

¹⁷ According to the SAR, the appraisal mission was informed on the last day of the mission, ie: after the "wrap-up" meeting that an internal decision had been taken to include maintenance staff within the RBA structure beginning January 1, 1997. The impact on the budget was not clear at that time and was subject to further consideration.

4.20 **Objective 2: *Improving capacity in water resources planning and management***; this objective is rated **substantial**.

4.21 The national capacity for water resources planning and management was increased under this loan primarily through the preparation of studies. The following section will demonstrate how the research conducted with project funds translated into capacity building of government officials and led to fundamental changes in water resources management, flood prevention and mitigation, water quality monitoring, and bulk water pricing. A total of 21 studies have been completed. Several studies consist of multiple volumes and represent considerable work. More detail on these studies is presented in Annex D. Four studies (as follows) are discussed below¹⁸:

1. National Water Plan
2. National Flood Protection Plan
3. National Plan for Water Quality Improvements
4. Bulk Water Pricing Study

4.22 **National Water Plan (US\$2.1 million)**. The original objective was to help Morocco restructure its water sector according to IWRM principles, involving stakeholder consultation, but developing the National Water Plan proved challenging. The GoM hired an international consultant to work on the plan within the ex-DGH (later SEEau). The consultant spent nearly three years on the task, but still left it incomplete. The TOR for the study called for five deliverables: (1) preparation of a detailed inventory of the information available on water resources, (2) setting up a database, (3) carrying out detailed studies related to water resources planning, (4) making recommendations for improving the institutional context, and (5) presenting a national master plan.

4.23 The analytical work that was undertaken led to the updating and strengthening of the database on water resources and the information it provides is still guiding policy decisions and investments in the water sector. However, other aspects of the National Water Plan, such as options for future investments and financial analysis were not furnished at the level anticipated. While the international consultant summarized information involving different stakeholders, informants noted that the DGH / SEEau expected a more traditional study describing Morocco's water resources and future infrastructure needs, including feasibility studies and cost-benefit analyses. It therefore terminated the contract early. However, the ongoing 2007 DPL on water represents a renewed effort to develop a National Water Plan by consolidating individual river basin plans with the already existing information from the National Water Plan.

4.24 **National Flood Protection Plan (US\$1.1 million)**. The preparation of the national flood protection plan included: 1) the formulation of a typology of floods, 2) the identification of vulnerable sites as well as the prevention measures that should be adopted to protect each site, and 3) a review of the institutional context and the preparation of a detailed action plan.

¹⁸ The four studies were selected because they represent the bulk of the allocation for studies in addition to being the most important in terms of influencing water policy and related government actions.

4.25 For phase 1 of the study, the DGH / SEEau surveyed local offices and identified 390 specific sites vulnerable to flooding. Subsequently, six international consultants together with Moroccan experts visited the sites and determined/assessed vulnerability levels. Vulnerability maps were produced with the help of GIS software, and a total of 20 sites were classed as highly vulnerable to flooding.¹⁹ Four sites were selected (Fes, Sattat, Berrechid, and Mohammedia) out of the 20 vulnerable sites for more detailed design and urgent flood protection measures. Sites were marked on a vulnerability map and transferred to local basin offices for further action.

4.26 According to one government official, the most important lesson learned from the international experts was that flood prevention cannot be tackled by departments going it alone or by treating the flooding problem with inadequately designed and dimensioned protective infrastructure. Small infrastructure which was put in place in the past did not solve the flooding problem; rather, it simply transferred it further downstream or upstream. The solution was to treat flooding in a comprehensive and integrated way with the relevant departments working together. This has now been accomplished in Mohamedia, a city that was devastated by floods in 2002.

4.27 The IEG PPAR mission visited flood protection structures in one of the hotspot areas identified by the flood protection study in the city of Beni Mellal. Flood protection structures were financed by the Oum-er-R'bia RBA with beneficiary contributions. Flash floods used to be caused by runoff from steep hillsides nearby every summer. The RBA financed gabion structures and terraces in the hills above the city, as well as a drainage channel, which was designed to conduct flood water through the city (see Figure 4). Flooding was thus managed in a comprehensive way. The mission was informed that during the RBAs's last board of directors' meeting, representatives of different stakeholder groups attended in order to express their gratitude for the work completed and the protection that was accomplished.

¹⁹ Source: Etude du plan directeur de protection contre les inondations et impacts des ouvrages de protection contre l'environnement. Mission 1: Caractérisation des problèmes posés par les inondations et dispositions réglementaires du contrôle des usages du sol dans les zones inondables. Sous Mission 1.3 : Mesures de prévention et définition d'un ordre de priorité en ce qui concerne les aménagements de protection à mettre en œuvre. 2001. p. 21.

Figure 3. Flood Protection Structures Financed by the Oum-er-R'bia RBA



Pictures: Oum-er-R'bia RBA and IEG

4.28 National Plan for Water Quality Improvements (US\$0.7 million). The national water quality protection plan comprised: 1) a diagnosis of the quality of water resources, 2) an analysis of sources of pollution and their impact on water quality, 3) the preparation of a water quality protection plan for the Oum-er-R'bia Basin and the country in general. All those steps were completed, and the computer model developed for the Oum-er-R'bia Basin has been extremely useful in formulating remedial measures against pollution. The next section (objective 3, paragraph 4.37) will provide evidence for achievements with respect to water quality monitoring and pollution control in the Tadla region.

4.29 In addition, a financial model was developed to determine the tariff level for pollution from households, the tourist industry and other industries (mainly sugar, oil, leather, milk, and phosphate production), as well as fertilizer and pesticides used in large irrigation schemes. While most of the tariff issues have been resolved with the help of this study and by the related decree and public orders, the identification of the agency entitled to receive payments for reused water is still pending. Both the water supply agency ONEP, responsible for water treatment, and the RBAs, responsible for water allocation, are in dispute over who would benefit from the revenues. As a result, large golf courses and agro-businesses are not able to save water by making use of treated wastewater.

4.30 Bulk Water Pricing Study (US\$0.3 million). The completed study on bulk water pricing included: 1) an analysis of the tariff system, 2) an evaluation of the fees paid for bulk water, and 3) the formulation of a methodology for determining the cost of bulk water. According to the people interviewed, this study on bulk water pricing was perceived as a major milestone in reforming Morocco's water sector. Before the study, water was seen as "a gift from God," and no analysis existed as a basis for why and how much water users should pay for water. With the establishment of RBAs, a main part of their budget was to come from water users, and this study together with decrees and public orders laid the foundation for that to happen. This study also found, however, that

the government needed to contribute to the operating costs of the RBAs because beneficiary contributions from bulk water were not going to be enough to cover the multiple activities with which the RBAs were charged.

4.31 **Objective 3: *Improving water use efficiency***; this objective is rated **substantial**.

4.32 Large-scale irrigation schemes in Morocco regularly experience water losses in excess of 50 percent. Given Morocco's water shortages, it was important to increase water use efficiency in irrigation. Under the project, equipment for demonstrations (including 2,500 tubular siphons) was procured, and six pieces of heavy equipment were procured for land leveling activities. Some 144 trials (covering more than 580 ha) were carried out in stations and fields on the following topics: crop water requirements, localized irrigation, improved surface irrigation techniques, and sprinkler irrigation. Land leveling was supposed to reduce water losses by 35 percent. However, the high costs of land leveling (US\$190 per hectare) and the absence of state subsidies led to this technique being dropped. Since 2002, the government has provided a 60 percent subsidy for investments in drip irrigation, which made this type of technology more affordable. Drip irrigation also proved efficient in that tests conducted in the Ouled Gnaou trial station showed positive results for saved water and increased productivity (Table 6).

Table 4. Field Trial by Ouled Gnaou Station — Comparing Water Use With and Without Drip Irrigation Technology

	Production t/ha		Water volumes applied m ³		Gain	
	Surface irrigation	Drip irrigation	Surface irrigation	Drip irrigation	Production	Water volume
Sugar beet	60	97	7650	4732	62 %	38 %
Potatoes	25	44	5800	4890	76 %	16 %
Beans	7	10.5	4900	3500	50 %	29 %
Onion	46	74.5	6880	5300	62 %	23 %

Source: AGR/DDGI/DE/SEEN/ORMVA du Tadla : Economie et Valorisation de l'Eau d'Irrigation dans le Périmètre du Tadla, March 2004.

4.33 According to this field trial, water savings due to drip irrigation technology ranged from 16 percent to 38 percent, while production increased by between 50 percent and 76 percent depending on the type of vegetable planted. However, these tests were not replicated, neither in the Ouled Gnaou trial station nor in other stations, which moderates the credibility of the results.

4.34 The IEG PPAR mission spoke with one farmer who watered five hectares of land with drip irrigation technology. One hectare had been provided to him with project financing on the condition that he would equip the rest of his fields with his own funds. The IEG PPAR mission saw five hectares equipped with drip irrigation. Results were impressive, as the farmer doubled production while also reducing water consumption. Asked why his neighbors and friends were not following his example (as originally intended by the project), he explained that there were several reasons: family land use

rights (which provide decision-making power to the older generation); use of the system increased farmers' workload (regular cleaning of the tubes is required), as is specialized knowledge (about how to apply fertilizers). In this regard, drip irrigation also requires special fertilizer application techniques. If it is done wrong, the whole crop can be lost, which would, of course, result in the approach losing acceptance among farmers. Yet extension services were not provided under the project, and there is no place where farmers are routinely imparted this specialized knowledge. This finding is reflected in a 2007 Country Assistance Review undertaken by the IEG (formerly OED). The Review highlighted the imbalance between the Government's strong support for irrigation relative to the low priority which it gave to complementary extension and research. The review also stressed that a lack of training and basic equipment was having an impact on the motivation and the effectiveness of agricultural extension agents. Notwithstanding the absence of a mechanism to support the technology transfer, according to officials in the Tadla ORMVA, 11,000 hectares, or 10 percent of the irrigation perimeter has been equipped with drip irrigation technology under the project, increasing yields and reducing production costs. Meanwhile, the government has conducted feasibility studies to equip the rest of the perimeter with drip irrigation technology by financing 10,000 hectares with the hope that the use of this technology would spread.

4.35 For farmers to receive government subsidies for drip irrigation technology, their equipment has to be tested and certified by SEEN. Under the WRMP, a lab just for system testing was set up in the Moroccan capital, Rabat, to certify tubes and hoses (Figure 5).

Figure 4. SEEN Tests and Certifies Material for Morocco's Irrigation Systems



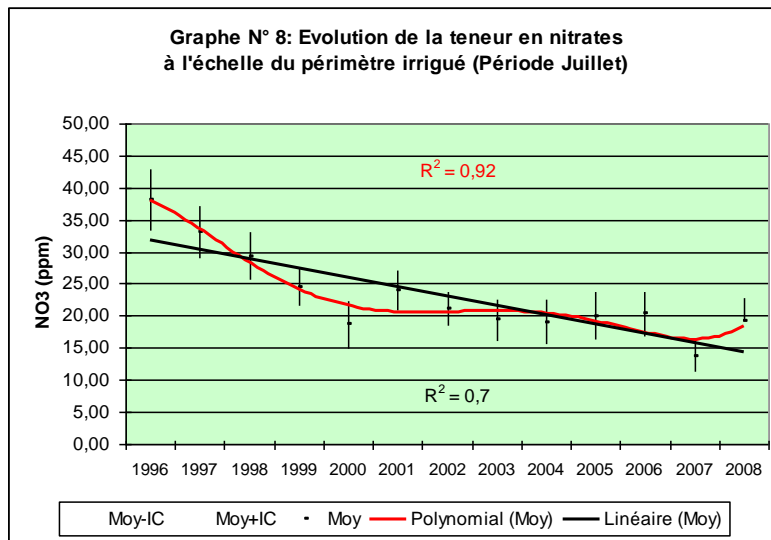
Picture: IEG

4.36 Under project-financed testing, more than 400 irrigation equipment approval certificates have been delivered by the SEEN. However, as of September 2008, agency staff levels were to be cut and the office with all the test equipment was to be relocated. Clearly, in this case, the sustainability of the materials testing lab is uncertain.

4.37 With respect to the environmental monitoring sub-component, a system was implemented in the Doukkala and Tadla regions for assessing water and soil quality. This has helped to identify the locations and causes of pollution as well as the remedial measures to be taken. In order to improve environmental monitoring, the project has provided technical equipment and consumables to the ORMVAs as well as staff training. Almost 45,000 soil and water analysis tests have been conducted for private individuals, mainly farmers.

4.38 The IEG PPAR mission visited a lab for water and soil quality testing. In appearance it was clean, and equipment appeared to be functioning and well-maintained. Staff demonstrated that all the equipment purchased under the project was present and verified that it was in general use. This could be observed at the time of the visit, as a room full of soil samples was awaiting analysis. GIS software had been installed, and levels of salinity as well as points of pollution had been mapped. A 2008 assessment, tracing 100 water points since 1996 demonstrates that nitrate levels have actually decreased in the aquifer of the Tadla irrigation perimeter (Figure 6).

Figure 5. Sinking Levels of Nitrate in the Aquifer Due to an Improved Use of Fertilizers (1996-2008)



Source: ORMVA/DGRID/SER/Bureau Environnement: *Situation de la qualité des eaux de la nappe phréatique dans le périmètre irrigué du Tadla, Juillet 2008*, p. 6.

4.39 According to the 2008 assessment, decreasing nitrate levels in the aquifer demonstrate the effectiveness of drip irrigation and the associated more localized use of fertilizers, which leads to lower levels of nitrate reaching the aquifer. These results are important, and they should be used to inform farmers and policy makers about the potential impact of further investments in drip irrigation on water quality in the aquifer. The evidence on the environmental benefits of using this technology is quite convincing.

4.40 **Objective 4:** *Increasing the effectiveness of existing hydraulic infrastructure;* this objective is rated **modest**.

4.41 **Nakhla Dam.** The targets for increasing the safety, reliability, and efficiency of water resource mobilization were only partially met for the following reasons:

4.42 Studies conducted after appraisal revealed that water losses were due to leakages in the foundations, not in the upstream surface of the dam. Proposed remedial measures were therefore not feasible, and instead, cement was injected into the foundations in order to reduce water losses. An evaluation undertaken by the FAO in 2003 demonstrated that the cement injection failed to reduce water losses. Therefore, ONEP built small catchment basins on each side of the dam to stem water losses and use the “lost” water to supply water to the city of Tetuan. The original goal of obviating the need for additional new dam construction, in this case of the Amsa Dam in the Martil River (just below the Nakhla Dam site) was not achieved, and plans are already well underway to construct the newer and larger Amsa Dam. Once the new structure is complete, which is estimated to happen in four to five years, the Nakhla Dam will be abandoned. While everything that could have been done about dam safety was undertaken, and engineers’ understanding of the situation has been somewhat improved through studies and evaluations, a 20 year extension of the life of the dam as estimated at appraisal could not be achieved.

4.43 **Artificial recharge of the Souss aquifer.** The objective of mobilizing additional groundwater by artificially recharging the Souss aquifer was met in the limited area where it was attempted.

4.44 The water table is falling dramatically in the southern area of Agadir. The area is known for citrus production, mostly for export to Europe and the U.S. In recent decades, farmers had to deepen wells every two years, since water tables were falling by 1.5 to 3 meters per year. A study was financed to assess the condition of the aquifer under the WRMP. In addition, financing was provided to rehabilitate five weirs that had been constructed in 1991, and to construct an additional weir, Talekjount weir. The purpose of the weirs, which have been constructed downstream of dams, is to prevent the water that overtops the dam or that is released for irrigation purposes from being lost to the sea. Weirs are made out of gabions or concrete structures. The ones visited were from three to four meters high, and the theory is that they will retain water and that this will artificially recharge the aquifer.

4.45 The Aoulouz Dam releases water according to a schedule determined by farmers’ needs. Since the establishment of the Souss Massa RBA in Agadir, farmer associations have been actively involved in the decision-making process concerning water releases. On average, four releases per year take place with wide variance according to the annual rainfall pattern. Since 1991, a total of 1,532 million m³ of water has been released.

4.46 Under the WRMP, the Souss Massa RBA undertook an evaluation of the effectiveness of aquifer infiltration (Figure 7). It found that, contrary to what was expected, water does not infiltrate the entire aquifer, though it is detectable quite far from the insertion point—in this case it could still be measured more than 80 km from the dam. This does not help communities that have to tap into its ground water from further away.

One community, about a 100 km from the weir had to build a pipeline (it was constructed in 2008) to transfer water from the dam. This project is being financed by the private sector together with government subsidies.

4.47 As the weirs accumulate topsoil, gabions need to be built to raise their level for them to continue the water-trapping function. No such actions were observed or reported.

Figure 6. Artificial Recharge of the Aquifer Effective Within a Radius of 50 Miles



Picture: IEG

4.48 **Objective 5: Introducing water pollution control measures;** the achievement of this objective is rated **modest**.

4.49 **Pollution control.** While water pollution control legislation has been passed (see Objective 1), the enabling regulations have yet to be approved. Flood control structures in Beni Melall and Mohammedia do, in fact, reduce the risk from waterborne diseases during flooding. In addition, the project financed the construction of a laboratory for water quality testing in addition to equipping seven already existing laboratories. Equipment receives periodic maintenance and is used to control water pollution (see also Objective 3).

4.50 **Control of waterborne diseases.** According to the ICR, the project-supported control of waterborne diseases in the Oum-er-R'bia Basin has strengthened the capacity of the Department of Epidemiology and Diseases Control (DELM) in six provinces covering the basin (Khouribga, Azilal, Beni Mellal, Khénifra, El Kelaa and Settat). Equipment and vehicles were purchased under the project. Since the MoPH did not request a specific budget from the Ministry of Finance and Privatization (MFP) for activities in the first years of implementation—developing hotspot maps for infectious disease areas, hygiene education, and staff training for ONEP—this had to be financed by the agency's own funds. The IEG PPAR mission was not able to arrange meetings with staff involved in the DELM and it therefore cannot verify the status or impacts of the above-mentioned actions.

EFFICIENCY

4.51 Efficiency is rated as **modest** because the six land planners retained for land levelling activities ultimately proved ineffective. The lack of extension advices led to limited uptake of new technology; and the results of the US\$2 million invested in the National Water Plan did not meet government expectations.

4.52 An ERR was calculated for three project activities at appraisal and again at completion. The combined ERR for the three infrastructure activities (Nakhla dam, weirs, and the installation of 12 meteorological stations) was estimated in the ICR at 79 percent over 20 years. These activities represent 24 percent of total project cost. Thus, the relative efficiency of the bulk of the investment has not been quantified. The ICR estimates the ERR for the benefits of the repairs to the Nakhla dam over 20 years. However, it will be recalled that it was ultimately not possible to repair the Nakhla Dam, and it may only have a very short additional period of use.

4.53 In the example of the weirs, no baseline data exists. It is not clear how much of the trapped water reaches the aquifer, or even what the infiltration rate would be without the weirs. Therefore, it cannot be determined if investments in the weirs are economically justifiable, although for communities that would have insufficient access to water without them, their use can be considered a survival issue. Furthermore, the water levels in the dam that releases water to the weirs is at a historic low, which makes future water releases uncertain. Most other investments face similar problems, either because their benefits are unknowable, or the cost of the externalities prevented cannot be calculated.

RISK TO DEVELOPMENT OUTCOME

The risk to development outcome is rated as **moderate**. The new regulatory and institutional framework and policy reforms have laid the foundation for sustainable water resources management by providing the basis for efficient water resources allocation by protecting against water pollution and floods and by ensuring stakeholder participation. Decrees and public orders in support of an IWRM approach to water management have been published. Others are still in the process of being approved by parliament. RBAs have been established in seven major river basins, and they are covering 80 percent of their operating costs from fees. The principle of having a fully integrated management of water resources in Morocco is widely accepted by relevant ministries, even though individually they are unwilling to give up any authority.

4.54 The World Bank has re-engaged with the Water Sector DPL in 2007. Other donors, in particular the EU and the AfDB have decided to lend their support to the reform process in the water sector. However, recent changes in government have slowed down reforms, and there is a risk that the GoM will further delay tough decisions, which would impact the release of the next DPL tranche.

4.55 With respect to risks, around the Nakhla Dam the investments in capturing leaking water will have a limited lifespan, since it will be abandoned in four to five years, and needed improvements to the weirs constructed in the Souss aquifer are not taking place, which limits the stream of future benefits that can be expected.

BANK PERFORMANCE

4.56 Overall Bank performance is rated as **satisfactory**. The Bank took a bold approach to water resources management and addressed the tough issues despite the difficulty involved.

4.57 Quality at entry is rated as **satisfactory**: The WRMP was preceded by substantial ESW carried out during preparation. This sector work provided a framework for a sector-wide strategy and policy formulation and enabled a broad-based policy dialogue with the Government.²⁰ The project was further prepared through a PHRD grant and the engagement of FAO/CP. A Quality at Entry Assessment by QAG was conducted in FY 1999. The assessment rated quality at entry as satisfactory, but pointed out weaknesses in the M&E framework, as well as with financial management. The PPAR concludes that quality at entry overall was satisfactory. However, some of the project objectives should have been formulated more carefully to better reflect the limited financial resources available for the intervention. It also draws attention to the failure to systematically identify the relative power of the winners and losers of the proposed institutional reform process.

4.58 Quality of supervision is rated as **satisfactory**: QAG also carried out a Quality of Supervision Assessment in FY 2000. It rated overall quality of supervision as satisfactory, but pointed out that an effective M&E system was not in place. Supervision missions focused on the progress of the legal framework, as well as with the establishment of the Oum-er-R'bia RBA. As will be further explained in the M&E section of this report, this PPAR argues that the lack of M&E within the PIU was compensated through M&E activities by World Bank consultants and supervision missions and by the establishment of in-country measurement systems in several line agencies. These are likely to be more sustainable than a project-focused M&E system within a PIU. An adequate number of supervision missions per year were conducted. The skill mix of staff was diverse and appropriate for the diverse components of the project, except for the fact that not enough attention was given to the project's health education and control of waterborne disease activities. Staff continuity contributed to the achievements of the project, especially given its complexity and the challenging political context. In addition, performance reporting was exceptional and compensated for the lack of a monitoring and evaluation framework.

²⁰ The Water Sector Review (1995) provided the framework for a national water resources management strategy, and the Water Sector Study (1997) provided the basis required for formulating a strategy for water resource management.

BORROWER PERFORMANCE

4.59 Overall, Borrower performance is rated as **satisfactory**.

4.60 The Government's performance is rated as **moderately satisfactory**: Support for the WRMP came from the highest levels of government in favor of reforming Morocco's water sector and taking an IWRM approach to water resources management. The Borrower involved the Bank in a series of ESW, which led to the Water Law of 1995, followed by a water strategy. However, given the complexity of the project, support varied according to the sub-sectors involved. QAG, for example, pointed out that the PHRD completion memorandum highlighted a lack of Government ownership at the time of project preparation.

4.61 According to the SAR, the legal status of the High Council for Water and Climate (CSEC) was to be strengthened under the WRMP. However, while the Council met eight times before the project, it met only once thereafter. Difficulties with interagency cooperation could have been more easily overcome had the Council assumed its role. Moreover, delays in the provision of counterpart funding, particularly during the early years of the project, caused implementation delays.

4.62 The implementing agencies' performance is rated as **satisfactory**: The following five implementing agencies were involved in project implementation: 1) the MoPW, which in 2003 was transformed into the Ministry of Territorial Activities, Water and Environment (MATEE), 2) the DGH, which later became SEEau, 3) the Oum-er-R'bia RBA, 4) the Department of National Meteorology (DMN), and the 5) Department of Epidemiology and Diseases Control (DELM). According to the SAR, a technical coordination committee was to be created as well as a PIU. Although such a committee was established, it was under-staffed and did not assume its coordination responsibilities. Therefore, coordination between agencies proved challenging, although reporting took place on a regular basis. However, after 2003 the SEEau took over monitoring all project activities and closely collaborated with supervision missions.

5. Monitoring and Evaluation

5.1 Overall monitoring and evaluation is rated as **substantial**.

5.2 *M&E Design*: According to the SAR, indicators related to each project component reflecting the input, output, and impacts related to that component were to be applied to measure overall progress in meeting project objectives. Indeed, Annex 11 of the SAR provides a results measurement framework linking objectives to inputs and outputs, assessing risks and assumptions and describing the expected impact of project activities (also see Annex B and C in this report). However, performance indicators were not clearly defined in the SAR and had to be improved upon by Bank supervision missions in collaboration with the implementing agencies.

5.3 ***M&E Implementation:*** Supervision missions developed a set of performance indicators, which were meticulously tracked in PSRs. Overall performance monitoring by the Bank was exceptional in that progress on each individual activity was described in 40 to 100 page-long supervision reports. Tables listing progress with decrees, public orders, and bulletins were prepared. In addition, tables for progress with studies, as well as training activities implemented by the FAO were updated on a regular basis. Furthermore, the project's financial and economic aspects were also tracked in supervision reports. Despite the excellent reporting from the Bank's side, an M&E system maintained by the Borrower has never been established, making the sustainability of M&E progress reporting in ongoing sector reforms unlikely.

5.4 ***M&E Utilization:*** The Bank's supervision missions used information tracked in supervision reports in their discussions with government officials. Thus the M&E system was an important element in advancing reforms in the water sector. At the country level, the ability to monitor and evaluate water resources development, allocation, and quality control was improved in the DGH / SEEau as well as in RBAs through TA and training. The capacity to monitor and mitigate flooding and to evaluate water and soil quality was also strengthened.

SAFEGUARDS, FIDUCIARY COMPLIANCE, AND UNINTENDED OUTCOMES FOR THE LWMPP AND THE WRMP

5.5 The project triggered two safeguard policies: 1) OP/BP 4.01 on Environmental Assessment and 2) OP/BP 4.37 on the Safety of Dams. For the WRMP, the SAR appropriately classified the WRMP as Category B. Annex 8 of the SAR describes the potential environmental impacts of project activities, and plausibly discounts potential significantly negative impacts of project activities.

5.6 With respect to dam safety, assurances were obtained that DGH / SEEau would seek the expertise of the Public Laboratory for Trials and Studies (LPEE) to review specific safety aspects of the Nakhla Dam. In the event, the dam had problems that were not repairable and it is scheduled for replacement.

5.7 The IEG PPAR mission visited Aoulouz Dam near Agadir. This dam had a group of 11 employees managing the dam. A seismograph was installed on the dam monitoring risks of earthquakes. Spillways for different volumes of water release were part of the dam structure. In addition, two engineers were responsible in the Souss Massa RBA for dam maintenance. It is evident that for dams that are safe to operate, there are systems in place in Morocco for monitoring that they stay that way. These systems also help to manage flood control, seismic monitoring, and maintenance.

6. Conclusions and Lessons

6.1 The successive droughts of the 1990s, coupled with the steadily falling water levels in its reservoirs moved the management of water resources, already high on the national development agenda, even further up. With the approval of the WRMP and the work which was performed under its auspices, Morocco opted to face up to the thorny problems that were constraining the benefits stemming from its expensive and prolonged efforts to build dams wherever feasible to secure its water supply. The country changed its laws and drafted many regulations which, taken together, generally recognize that conservation needed to supplement investments in increased supply.

6.2 In the Moroccan context, setting up river basin agencies proved to be an effective way to introduce IWRM principles into the water sector. They proved able to cover the bulk of their own operating expenses (except for salaries which remained under the public payroll). And they improved public safety, reducing the risk of flash flooding. Agriculture, the biggest consumer of water, was the focus of pilot efforts with drip irrigation. The results were positive, leading to dramatic reductions in chemical pollution and improvements in water quality. Weirs have raised ground water levels for a radius of 50 miles, albeit they need additional investment to maintain performance at the current level. Yet the question remains as to how to sustain the efforts of this groundbreaking first step.

6.3 It is cause for worry that the sector is only part way to achieving the benefits of soil and water conservation and push-back is already well underway. The legal framework has a way to go before it will be fully capable of supporting a broader reform of the water sector. The current government may well find that it has few affordable alternatives as it strives to achieve the right balance between continuing to investing in expensive water storage capacity, and taking a demand-management approach. Yet at this interim point, it is clear that this project points out one viable approach to which Morocco may chose to return if water stress in the Region as predicted becomes more severe.

6.4 The Bank is to be commended for recognizing when more than infrastructure was going to be required to overcome the chronic water shortage. As an early water resources management project, the results are encouraging regarding what can potentially be achieved with an IWRM approach. What the Bank needs to learn from this experience is that there is more to institutional reform than technical correctness. Reform is a political process as well as a technical one, and careful identification of winners and losers from any proposed reform, and the relative strengths and weaknesses they have within the governing structure, need to be considered at the outset.

6.5 Lessons from the **WRMP** were the following:

- *Providing subsidies to promote the use of water-saving equipment is a necessary but not sufficient condition, even when the technologies increase production and lower production costs.* For drip irrigation to spread, government subsidies that lower the cost of equipment are not enough because of their high transaction costs (farmers have to clean and service the drip irrigation nozzles continually, and they need to learn new

fertilizer application techniques). Additional measures and/or incentives may be required. It proved necessary to support the creation of new agricultural extension services to work with drip irrigators, for example. Furthermore, land tenure issues needed to be resolved in order to allow farmers to take their own decisions with respect to installing the new technology and making further investments in its support. In addition, extension agents need to watch new adopters very carefully to ensure that the misuse of the new technology does not lead to major crop losses—which would make further diffusion of the innovation far more challenging.

- *Providing unlimited access to credible environmental data can be an effective way to promote change, institutionally and on the ground.* Under the WRMP, a study on flood prevention created vulnerability maps to identify hotspot areas, and these were put in the public domain. In retrospect, having these spots clearly identified led to flood prevention actions. Similarly, data on falling levels of agricultural chemicals in the aquifer is helping to promote drip irrigation.
- *The use of GIS software during environmental monitoring can help to assess levels of aquifer pollution.* Water quality monitoring efforts clearly identified the geographic areas where reductions in agricultural chemical might be expected to reach subterranean aquifers. When the responsible parties knew where to look for water quality improvements, they were able to document major improvements.

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Annex A. Basic Data Sheet

Key Project Data (amounts in US\$ million)

	<i>Appraisal estimate</i>	<i>Actual or current estimate</i>	<i>Actual as % of appraisal estimate</i>
Total project costs	25.59	18.00	70
Loan amount	20.24	14.46	72
Cofinancing	NA	NA	NA
Cancellation	---	5.78	---

Project Dates

	<i>Original</i>	<i>Actual</i>
Initiating memorandum		09/14/1994
Negotiations		04/04/1996
Board approval		02/26/1998
Signing		10/05/1998
Effectiveness		01/05/1999
Closing date	06/30/2002	12/31/2004

Staff Inputs (staff weeks)

<i>Stage of Project Cycle</i>	<i>Actual/Latest Estimate</i>	
	<i>No. Staff weeks</i>	<i>US\$ ('000)</i>
Identification/Preparation	25	100,000
Appraisal/Negotiation	65	250,000
Supervision	110	450,000
Other	12	50,000
Total	212	850,000

Mission Data

	<i>Date (month/year)</i>	<i>No. of persons</i>	<i>Specializations represented</i>	<i>Performance rating Implementation Progress</i>	<i>Performance rating Development Objective</i>
Identification/Preparation	07/01/1994	7	ECONOMIST (2);		

	<i>Date (month/year)</i>	<i>No. of persons</i>	<i>Specializations represented</i>	<i>Performance rating Implementation Progress</i>	<i>Performance rating Development Objective</i>
			AGRONOMIST (1); POLLUTION SPEC. (1); HYDRO-GEOLOGIST (1); DAM SPEC. (1); IRRIGATION ENG. (1)		
	11/01/1995	1	ECONOMIST (1)		
Appraisal	03/01/1995	7	ECONOMIST (2); SANITATION SPEC. (1); RIVER BASIN SPEC. (1); REMOTE SENSING SPEC. (1); AGRONOMIST (1); IRRIGATION ENG. (1)		
	05/01/1996	7	ECONOMIST (1); COUNSEL (1); ENVIRONMENTAL SPEC. (1); HYDRAULIC WORKS SPEC. (1); PROJECT ANALYST (1); RIVER BASIN SPEC. (1); IRRIGATION ENG. (1)		
Post- Appraisal	10/01/1996	1	IRRIGATION ENG. (1)		
	05/01/1997	1	IRRIGATION ENG. (1)		
Negotiations	11/01/1997	3	IRRIGATION ENG. (2); COUNSEL (1)		
Supervision	05/08/98	3	TEAM LEADER (1); CIVIL ENG. (1); PROCUREMENT SPEC. (1)	S	S
	11/04/1998	5	TEAM LEADER (1); CIVIL ENG. (1); FINANCIAL MANAG. SPEC. (2); RIVER BASIN SPEC. (1)	S	S
	10/13/1999	3	TEAM LEADER (1); FINANCIAL MANAG. SPEC. (1); RIVER BASIN SPEC. (1)	S	S
	12/04/2000	5	TEAM LEADER (1); FINANCIAL MANAG. SPEC. (1); CIVIL ENG. (1); RIVER BASIN SPEC. (1);	HS	S

<i>Date (month/year)</i>	<i>No. of persons</i>	<i>Specializations represented</i>	<i>Performance rating Implementation Progress</i>	<i>Performance rating Development Objective</i>
		PROCUREMENT SPEC. (1)		
12/04/2000	3	TEAM LEADER (1); FINANCIAL MANAG. SPEC. (1); SECTOR MANAGER (1)	S	S
05/04/2001 (MTR)	6	TEAM LEADER (1); FINANCIAL MANAG. SPEC. (1); OPERATIONAL OFFICER (1); IRRIGATION ENG. (1); RIVER BASIN SPEC. (2)	S	S
01/24/2002	7	TEAM LEADER (1); FINANCIAL MANAG. SPEC. (1); IRRIGATION/AGRICULTURE SPEC. (1); WATER RESOURCES SPEC. (1); RIVER BASIN MANAG. SPEC. (1); WATER TREATMENT SPEC. (1); COMMUNICATION SPEC. (1)	S	S
10/03/2002	5	TEAM LEADER (1); IRRIGATION ENG. (1); FINANCIAL MANAG. SPEC. (1); WATER RESOURCES SPEC. (1); RIVER BASIN SPEC. (1)	S	S
04/16/03	5	TEAM LEADER (1); FINANCIAL MANAG. SPEC. (1); RIVER BASIN SPEC. (1); IRRIGATION ENG. (2)	S	S
11/12/2003	3	TEAM LEADER (1); FINANCIAL MANAG. SPEC. (1); RIVER BASIN SPEC. (1)	S	S
06/08/2004	5	TEAM LEADER (1); FINANCIAL MANAG. SPEC. (1); RIVER BASIN SPEC. (1); IRRIGATION ENGINEER (1); AGRIC. ECONOMIST (1)	S	S

	<i>Date (month/year)</i>	<i>No. of persons</i>	<i>Specializations represented</i>	<i>Performance rating Implementation Progress</i>	<i>Performance rating Development Objective</i>
Completion ICR	12/15/2004	5	TEAM LEADER (1); FINANCIAL MANAG. SPEC. (1); RIVER BASIN SPEC. (1); WATER RESOURCES SPEC. (1); AGRIC. ECONOMIST (1)	S	S

Other Project Data

Borrower/Executing Agency: The Ministry of Finance and Privatization

FOLLOW-ON OPERATION

<i>Operation</i>	<i>Project ID</i>	<i>Amount (US\$ million)</i>	<i>Board date</i>
Morocco - Water Sector Development Policy Loan	P095840	100	05/01/2007

Annex B. Key Performance Indicators from ICRs

Table 5. Morocco: Water Resources Management Project – Key Performance Indicators/Log Frame Matrix

Outcome / Impact Indicators	Projected in last PSR	Actual/Latest Estimate
Water Planning and Mobilization		
- Savings in pumping costs at the Nakhla dam (MAD '000)	NA	700 yearly
- Additional water available with recharge of Souss aquifer (Mm ³)	5 yearly	5 yearly
Irrigated Agriculture		
- Number of hectares covered	NA	4.500*
Health		
- Coverage of control stations (%)	100	94
- Coverage of problematic sites (%)	60	57
- Percentage of sites covered with biological control	50	75
- Bacteriological control level according to norms (%) in urban distribution networks	50	37
- Coverage of collective water points (%)	50	60

Source: Self-evaluation report (ICR)

* Does not take into account the final level of adoption by farmers due to lack of data.

Table 6. Morocco: Water Resources Management Project – Key Performance Indicators/Log Frame Matrix

Output Indicators	Projected in last PSR	Actual/Latest Estimate
Water Planning and Mobilization		
- Number of studies ongoing (completed)	13	1 (21)
- Number of CW contracts ongoing (completed)	4	6 (45)
- Number of decrees published	13	21
- Number of public orders published	30	32
- Number of training days	NA	4979
- Technical assistance (person /months)	50	62 (FAO)
- Number of infiltration sills constructed (rehabilitated)	1 (5)	1 (5)
- Number of meteorological stations.	12	12
Irrigated Agriculture		
- Number of station trials (and hectares)	NA	14 (24)
- Number of trials in farmers' fields (and hectares)	NA	130 (556)
- Number of training sessions (and study tours)	NA	47 (140)
- Number of studies ongoing (completed)	4	(5)
- Number of training days	NA	2873
- Number of analyses and trials carried out	NA	45.000 et 400
Health		
- Number of training sessions	NA	0
- Number of laboratories constructed	2	1
- Number of laboratories equipped.	2	7

Source: Self-evaluation report (ICR)

Annex C. Morocco – WRMP: Results Framework

Table 7. Retrofitted Results Framework (Based on Information from the SAR, the ICR, and the IEG PPAR Assessment)

Objective	Planned Outputs at Appraisal	Actual Outputs from ICR	Planned Outcome at Appraisal	Actual Outcome from ICR and IEG Assessment
(a) supporting the establishment of an institutional framework for integrated water resources management and the creation of the River Basin Agency (RBA);	<i>Decrees and public orders published.</i> Fully functional RBA at effectiveness.	21 decrees published. 32 public orders published. <i>OER basin agency functional.</i>	Implementation of long-term water management strategy. Improved water resources management at basin level. Implementation of the appropriate water charges by GoM for RBA.	Long-term water management strategy only partially implemented. WRM improved through setting up RBA. RBA financially only semi-autonomous.
(b) improving capacity in water resources planning and management;	National Water Plan. Determining of appropriate water and pollution charges increasing user contribution to water. Two master plans for flood control and measures against accidental water pollution, including flood areas and contamination-prone sites identification countrywide and proposals for priority projects. Comprehensive real-time water management system installed in the central OER river basin, including	<i>National Water plan partially completed.</i> 21 studies completed (see Annex X). <i>MIS system installed using the software program Oracle.</i> 12 <i>mechanic (not automatic)</i> meteorological stations installed. 4,979 training days completed. 62 person/months provided by FAO.	Policy decision based on application of sound economic principles and tariff levels increase. Government able to implement flood control investment projects in priority areas, mobilize appropriate resources, and take adequate measures to combat accidental water pollution. 2% increase of agricultural production resulting from better knowledge and forecasting of recurring drought. Additional capacity for planning, implementing and monitoring water resource	As of 2008, policy decisions in the water sector are still largely based on studies undertaken under the WRMP. OER RBA financed flood control measures in hotspot areas. The total annual benefits from improving water monitoring stations was estimated at MAD 52 million, and the ERR was estimated at 113% over 20 years with a NPV of MAD 243,690 (US\$ 27,381 of 2004). Capacity for WRM increased through MIS system.

	hydrological telemetry and decision-support system. An additional 12 automatic meteorological station installed in the OER basin and connected to the national climatological network operated by DMN. DGH / SEEau planning capacity reinforced.		management.	
(c) improving water use efficiency;	Parameters for water conservation in irrigation fully tested in the OER river basin. Status and options for the improvement of modern private irrigation fully assessed.	14 trial stations established on 24 hectares. 130 trials in farmers' fields conducted on 556 hectares. 47 training sessions conducted plus 140 study tours. 5 studies completed 2,873 training days completed. 45,000 analyses and 400 trials carried out.	Doukkala and Tadla ORMVAs able to implement large-scale water saving programs aimed at reducing on-farm water-losses by 20% over 10 years. AGR in the position to promote irrigation efficiency improvement in the modern irrigation sector with the objective of reducing water losses by 15% and increase yields by 5% over five years.	4,500 hectares covered by surface, sprinkling and trickle irrigation techniques by the end of the project.
(d) increasing the effectiveness of existing hydraulic infrastructure;	Nakhla dam concrete face rehabilitated. Three additional infiltration weirs constructed in the Souss riverbed to increase recharge of the Souss aquifer. Triffa aquifer fully surveyed and optimum exploitation parameters determined.	Nakhla dam partially rehabilitated. 1 infiltration weir constructed. 5 infiltration weirs rehabilitated. Triffa aquifer study completed.	Dam life period extended by 30 years, safety significantly improved and an estimated 6 Mm ³ would be saved and reused for Tetuan water supply. An estimated 20 Mm ³ currently infiltrated in the upper reach of the river or lost to the sea would be infiltrated in the central reach where the deficit of the	Savings in pumping costs at Nakhla dam ca. US\$88,000 (MAD 700,000) annually. 5 Mm ³ additional water available with recharge of Souss aquifer.

(e) introducing water pollution control measures;	Master plan for water quality improvement. A three-year health improvement program implemented by MOH to reduce the impact of waterborne diseases.	1 laboratory constructed. 7 laboratories equipped.	groundwater resources has reached a critical stage. Government able to implement and investment project meant to produce an additional 3-5 Mm ³ for drinking water supply. The government would be able to start investments for water quality improvement in the OER basin. 70% reduction of the mortality rate from typhoid, malaria, cholera, and bilharzia in the OER basin.	Water quality improvement achieved and documented. Infections documented on website.
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Source: Morocco – WRMP SAR, ICR, and IEG Assessment (Text in italic added by IEG)

Annex D. Morocco – WRMP: Studies

Table 8. Studies conducted with funding from the WRMP

Studies	Start date	Duration (months)	Phases
1. Plan National Eau	09/08/1999	34	M I M II A M II B M III 1 M III 2 M IV M V
2. Etude Tarification de L'Eau Brute	22/08/2000	12	M I M II M III M IIIA
3. Etude Système Information et Gestion ADB	05/04/1999	8	M I M II M III M IV
4. Module Gestion Comptable et Financière ADB	28/09/2000	8	M I M II M III
5. Module Gestion des Ressources Humaines	28/09/2001	8	M I M II M III
6. Module Gestion Domaine Hydraulique Public, ADB	03/10/2000	8	M I M II M III
7. Etude SIG ADB pour Gestion Marchés	15/02/2001	8	M I M II M III
8. Plan Communication ADB	03/09/1999	18	M I M II M III
9. Plan National Qualité Eau	03/09/1999	18	M IA M IB M IIA M IIB

			M III M IV
10. Plan National de lutte Contre les Inondations	05/06/2000	20	M I -1 M I -2 M I -3 M II M III
11. Système de Télésure	02/09/1999	36	M I1 M I2 M I3
12. Etude Recharge Nappe Souss	14 /02/2000	24	M IA M IB M II M III
13. Etude géophysique Nappe de Triffa	25/08/00	7	M I M II M III
14. Etude de modélisation Nappe des Triffa			
15. Etudes Barrage Nakhla	15/ 09/00	12	M I M II M III M IV
17. Etude Environnement Bas Doukkala (SEEN)	15/09/1999	13	M I M II M III M IV
18. Etude Impact Eaux/Sols Tadla (SEEN)	15/09/1999	18	M I M II M III M IV
19. Etude Impact Eaux/Sols Haut Doukkala (ORMVAD)	02/10 /1999	6	M I M II M III M IV
20. Etude Irrigation Privée	15/11/1999	18	M I M II M III M IV

21. Analyse des débits et qualité de l'eau
(ORMVAD)

MI

22. Etude des zones touchées par la salinité
(ORMVAD)

Source: World Bank Documents

Annex E. Sites Visited by the IEG PPAR Mission

Table 9. Site Visits to Rabat, Agadir, Beni Melall, Azial, and Fkih ben Salah

Site Visit	Assessment
Rabat	
1. Experimentation, Trials and Standards Unit / Service des Expérimentations, des Essais et de la Normalisation	The mission visited a laboratory equipped under the WRMP to test irrigation pipes and tubes imported to Morocco or produced in Morocco. Pipes are being put under pressure to test their resilience. Elaborate systems were constructed to test the effectiveness of the material for drip irrigation. Morocco has a new program for drip irrigation in which farmers receive a subsidy of 60 % if they invest in drip irrigation. All material being subsidized has to be tested in this Rabat agency.
Souss Massa Bassin - Agadir	
2. Souss Massa RBA	Meeting with five employees of the Agency. Presentation of research and report on measures to recharge the Souss aquifer artificially. Under the WRMP, a mathematical model was developed for the Souss aquifer. It helped document the alarming yearly decline of the water table by between 1.5 and 3 meters. In response to this decline, nine weirs were constructed or improved (five of them financed under the WRMP) to artificially recharge the aquifer. The mission visited two of the weirs (see below).
3. Aoulouz Dam	The dam built in 1991, has a storage capacity of 100 million m ³ . It was constructed to mitigate flooding and to store irrigation water for years of drought. Water from the reservoir irrigates citrus fruit and vegetable plantations further downstream. Water is released from the dam 3-4 times per year in order to artificially recharge the aquifer. The date for the release is negotiated with farmer associations. When the mission visited the dam, a release had been scheduled, but was postponed because it rained. The study of the WRMP found that artificially recharging the aquifer is effective only within 80 kilometers of the dam. This is why the private sector now financed a pipe transferring water directly to the citrus plantations of Sebt-Guerdane, more than 100 kilometers from the reservoir.
4. Talekjount Weir	Built in 2005 on an effluent of Oued Souss. Three layers of

concrete quarters block the river and force the water to infiltrate the aquifer. The weir was designed to modify the path of the river and improve the aquifer recharge in lower-lying areas. The mission noticed sediment accumulated upstream of the weir, reducing its effectiveness. Officials discussed the idea of involving farmers in silt removal because it contains a high level of nutrients. However, as of 2008, no maintenance action has taken place.

5. Freija Amont Weir Weir on the Oued Souss, renovated under the WRMP. The 4 m high dam has been completely filled with silt and bushes, which reduces the effectiveness of the weir. Maintenance of the weir was not visible.
6. **Oum-er-R'bia RBA - Beni Mellal**
7. Information system Modern computer network was partly funded by the WB WRMP. It is composed of two systems. The first is for management (accountability, logistics, HR, and user fees) and the second for technical information and decision making. With the help of this Oracle software, water allocations can be based on actually available water resources. The mission noticed a number of staff using the system for updating information on surface and groundwater levels.
8. Laboratory The mission visited the office laboratory stocked with new equipment (a UV-Visible Spectrometer, an Avanta Σ Atomic Absorption Spectrometer, and a distillator) under the WRMP. The three-room lab was well equipped for chemical, physical and biological analyses. On-site measurement devices were also available. Three old kits procured under the WRMP were stored away, while five newer ones seemed to be in use.
9. Irrigation mitigation work The mission visited the rehabilitation of a flood evacuation channel crossing the city to prevent future floods. The section visited was 800 m long, about 2 m deep and about 4 m wide. The site was identified as a black spot by the flooding study funded by the WB under the WRMP. As a result of this study, flood protection works were undertaken with the agency's own funds. The agency not only addressed flooding in the city, but it protected hillsides with check dams and gabion structure to prevent torrential rains from damaging topsoil and causing flooding further downstream.
10. Meteorological station Simple station equipped with a pluviometer, a flow meter, and a water level meter. The station was under the

surveillance of a ward living on-site.

11. Illegal drilling site The mission noticed a drilling station in the fields. Officials from the basin office asked to see the driller's permission. Since no such document was issued, the basin officers exercised their role of policing against illegal drilling, and the drilling was stopped. It was to be taken up again only after the acquisition of a permit, which the agency had to issue.

12. **Oum-er-R'bia Basin –
Azilal**

13. Provincial Agriculture Meeting with staff from the implementing agency under the Direction Office LWMPP (extension agents, coordinators). The NGO (AADEC) provides continuous support for the local population, building on the achievements of the LWMPP. AADEC provides some continuity, and makes project achievements sustainable.

14. Rural community of Ait The mission met with seven members of Bernat's and M'Hamed Amzray's villages. These two villages benefited from the LWMPP. They appreciated the new species of fruit trees planted (apple production multiplied by five), the improvements of the irrigation system, and the access roads built. The mission visited 14 gabion structures to prevent erosion and saw 50 hectares of forest replanted. Tree planting had a 100 percent success rate. Replanting forest was one of the project outcomes, even if not funded under the LWMPP. The community was sensitized not to enter the forest, and the forest department was motivated to plant trees in order to prevent soil erosion in the watershed.

15. Rural Community of Ait The mission visited three villages with seven members of Bououli – Douar the village association, a forest officer and a local Association of Asamer government official. It saw the improvement of the irrigation system, three gabion structures, the water storage tank, and a spring, which was framed by a concrete structure.

16. Rural Community of Ait The mission met with about 10 representatives of the Bououli – Douar village. Villagers had participated in the initial screening Association of Aarous process for the project, but decided that they did not want to participate. Therefore, no infrastructure construction or awareness raising took place in this village. While villagers were aware of the environmental degradation in the hills, they did not want forest to be planted there, because of their customary right to have their animals graze in the hills. The mission also visited the local irrigation system of earthen

channels and dams. A dam to store and deviate the irrigation water had been destroyed a few days earlier by floods. The whole system from the dam to the channels was poorly designed and materials used were prone to large water losses through seepage.

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| 17. | Fkih ben Salah
Office Régional de Mise
en Valeur Agricole du
Tadla | Meeting on the irrigation component under the WRMP. |
| 18. | ORMVA water and soil lab | Large and very well equipped lab for water and soil quality monitoring. The lab currently undertakes a study on soil parameters for more than 2,500 farmers to optimize the fertilizer use and gather data to feed into the information system. Two staff work full time and three have been hired for this particular mission. The farmers pay for this test. The WRMP bought 25 lab devices (verified by the mission) as well as chemicals. Most of the equipment is being used on a regular basis and well maintained. |
| 19. | Laboratoire du Système
d'Information
Géographique et de
Télé-détection Spaciale | A database collects information from about 500 stations for water quality monitoring and about 200 for soil analysis. Parameters on salinity, water table, boreholes, etc. are regularly updated. This database is being analyzed to produce regular reports for monitoring and decision making. In addition, satellite images are used to assess concrete structure in the irrigation perimeter. A law has been issued to prevent new construction in the perimeter. This GIS tool based on satellite imagery provides information on illegal construction. |
| 20. | Drip Irrigation Farm | The WRMP equipped a five ha farm with one ha drip irrigation devices under the condition that the farmer would extend the equipment over all 5 ha. Thanks to drip irrigation, the farmer more than doubled his production and used 50 times less water. |
| 21. | Station des
Expérimentations Hydro
Agricoles de l'Oued Gnaou | The mission visited a water and agricultural experimentation station, which was equipped under the WRMP by a basin and drip irrigation devices. |
| 22. | Agrohealth | 282 ha olive trees plantation equipped with a drip irrigation system. The trees were planted eight months ago. The olives are processed on site for oil production. |

Source: IEG

Annex F. Informants and Agencies Consulted

World Bank Resident Mission in Rabat / Mission Résidente de la Banque Mondiale à Rabat

Francoise Clottes, Country Manager
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Ministry of Economic Affairs / Ministère des Affaires Economiques et Générales

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High Commission for Water, Forests and for Fighting Desertification / Haut Commissariat aux Eaux et Forêts et a la Lutte Contre la Désertification

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Tadla Regional Agricultural Development Authority / Office Régional de Mise en Valeur Agricole du Tadla

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Mohamed Laakali, Bureau des Techniques d'Irrigation

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Rachid Amediaz, Ingénieur d'Etat à la Gestion Environnement

Boudrouss Abdelali, Technicien Supérieur en Système d'Informations Géographiques et Télédétection

Oued Gnaou Experimental Station for Water and Agriculture / Station des Expérimentations Hydro Agricole del'Oued Gnaou

Sidi Boudahoihen, Chef des Expérimentations

NGO / ONG

Lahoucine Ouall, Responsable de l'Association Azilal pour le Développement, l'Environnement et la Communication (A.A.D.E.C)

Rural Community of Ait M'Hamed

Seven members of Bernat and Amzray village committees

Local forest officer

Local government official

Rural Community of Ait Bououli – Village Committee of Assamer

Seven members of the Assamer village committee

Rural Community of Ait Bououli – Village Committee of Aarous

10 villagers of the Aarous village committee (this village committee did not benefit from the LWMPP)

Annex G. Maps

Figure 7. Oum-er-R'bia Basin

