

## Morocco

### The Abda-Doukkala Upper Scheme Irrigation Project (MR-P9)

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Field Survey: February-March 2006

#### 1. Project Overview and Japan's ODA Loan



Abda-Doukkala Irrigation Facilities

Project Site Map



Main Water Canal and Access Road

#### 1.1 Background

Morocco is located on the northernmost edge of the African continent facing the Atlantic Ocean and Mediterranean Sea and has a total land area of 446,000km<sup>2</sup> (approximately 1.2 times the size of Japan) and a population of approximately 30 million (2003, about one-fourth that of Japan). The plains along the northern coast have a Mediterranean climate, the inland area a continental climate, and the Atlas Mountains to the east a desert climate. Mountain ranges are found in the north and southeast, and these are subject to frequent droughts due to their geographic and climatic characteristics, which prevents the stable supply of water and makes water resource management an important issue.

Agriculture is a basic industry of Morocco, which raises grain, fruit, and legumes, and accounts for 12% to 17% of the country's GDP, but crop yields vary widely depending on the amount of rainfall. Approximately 50% of the workforce is employed in agriculture with 60% of female workers employed in the agriculture sector. Of the 8.4 million hectares of cultivated land in total, irrigation facilities have only been installed for 1.2 million ha (14%), so production of agricultural produce and crop yields are easily impacted by drought. For this reason, since the 1990s approximately half of the country's budget for the agriculture sector has gone to the construction of irrigation

facilities<sup>1</sup>.

Moroccan agriculture consumes over 90% of the usable water resources<sup>2</sup>, so considering the increase in demand for industrial-use water and water supply as the country's industry develops and its cities grow, there is a strong possibility that in the future the proportion of irrigation water could be limited, so the efficient use of water through the construction of irrigation facilities has been an urgent issue. In addition, in years when agricultural production dropped, such as during droughts, the growth of the overall Moroccan economy stalled or declined, so the stable development of agriculture was the key to stabilizing the overall economy, which makes the installation of irrigation facilities to free agriculture from dependence on rainwater a pressing need.

The plan for constructing irrigation facilities in the Doukkala Plain was to irrigate 32,400ha in El Jadida Province and 31,550ha in Safi Province. Phase 1 (16,000ha) had already been executed with financial assistance from the African Development Bank, European Investment Bank, and Arab Fund for Economic and Social Development, so it was decided to use the yen loan for the 18,901ha of Phase 2<sup>3</sup>.

## 1.2 Objective

The purpose of this project was to construct irrigation facilities in Abda-Doukkala for the supply of irrigation water, to increase agricultural production and create employment and thereby increase farmer income and promote rural economic development.

## 1.3 Borrower/Executing Agency

Doukkala Regional Agricultural Development Public Corporation (Office Regional de Mise en Valeur Agricole des Doukkala: ORMVAD) (Guaranteed by the Kingdom of Morocco)

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<sup>1</sup> This is 6% to 8% of the total public investment.

<sup>2</sup> Of the annual average rainfall of 150 billion m<sup>3</sup>, the amount of water used by dams and irrigation facilities was 10.9 billion m<sup>3</sup>, and 90% of this was used for agriculture (at the time of 1990).

<sup>3</sup> The plan was to divide the overall plan into four phases, but the Moroccan government decided not to execute the project after Phase 2.

#### 1.4 Outline of Loan Agreement

Loan Amount/ Disbursed Amount	13,548 million yen/13,426 million yen
Exchange of Notes/ Loan Agreement	February 1996 June 1996
Terms and Conditions - Interest Rate - Repayment Period (Grace Period) - Procurement	2.7% 30 years 10 years General untied
Final Disbursement Date	November 2001
Main Contractors	BECAM(Morocco) • STAM(Morocco)(JV)/ GRUPO ACCIONA. S.A.(Morocco) • S.T.A.I.P.(Morocco) (JV)/ S.T.A.I.P. ( Morocco ) / EMT ( Morocco ) • SOCA(Morocco) • SOGEA(Morocco) (JV)/ AIC(Morocco) • OMCE(Morocco) • SOGETRAMA(Morocco) (JV)/ DIAMATIT (Morocco) • SNCE(Morocco) (JV)
Consulting Services	HYDROPROJECTO ( Portugal ) • EWI MAROC (Morocco) • SCET—MAROC (Morocco) (JV)
Feasibility Study	INGEMA (1994)

## 2. Evaluation Result

### 2.1 Relevance

#### 2.1.1 Relevance at the time of appraisal

The National Development Plan (1993-1997) made increasing agricultural production through expansion of the irrigated acreage one of priority government policies, and the Irrigation Development Plan (1993-2000) also made this a priority issue and called for expanding irrigated acreage by 200,000ha by 2000 to increase agricultural production and create employment. Further, the Agricultural Sector Development Plan (1994-2005) aimed to reduce poverty in rural villages by constructing irrigation facilities. This project covered part of the plan to build irrigation facilities to irrigate 64,000ha of farmland in the southern Doukkala Plain 200km southwest of the capital city of Rabat, and therefore had a high priority.

#### 2.1.2 Relevance at the time of evaluation

The National Development Plan (2000-2004) makes increasing agricultural production, agricultural income, and economic and social development in the regions through expansion of the irrigated acreage one of the priority issues, and the Agricultural Sector Development Plan (1994-2005) also makes reducing poverty in

rural villages by constructing irrigation facilities a priority issue. This project contributes to increasing agricultural production through constructing irrigation facilities and therefore, it still has high priority.

## 2.2 Efficiency

### 2.2.1 Outputs

There was little difference between the actual performance and the plan targets at the time of the appraisal. A comparison of the actual performance with the main outputs planned at the time of the appraisal is shown in Table 1. There were some minor changes to the construction areas, such as in the irrigation network and drainage network, resulting from the switch from a pressurized aqueduct to a pipe gravity pressure method for 7,433ha of the irrigated land. In addition, after reviewing the role of government and based on the policy of using the private sector resources wherever possible, the project called off the construction of the milk collection facilities, which were in the end constructed by the private sector.

Table 1. Outputs

Item	Project (At Appraisal)	Actual Performance
(1) Construction of irrigation facilities	18,901ha	As planned
(2) Main water canal Secondary water canals Water management system installation	17.3km 33.7km 1 location	As planned As planned As planned
(3) Irrigation network Drainage network Agricultural roads Land development	654km 700km 205km 18,901ha	703km 676km 193km As planned
(4) Drainage canal outside the district	75km	As planned
(5) Milk collection facilities	21 locations	Cancelled

### 2.2.2 Project period

The project period planned at the time of the appraisal was June 1996 to December 1999 (42 months) and the actual project period was June 1996 to September 2002 (75 months). Construction was interrupted several times in 1997 due to heavy rain and flood, which caused delays in construction. In addition, the executing agency changed the water distribution method and revised the execution plan to use a gravity pressure

method instead of a sprinkler method, which caused further extensions of the construction period.

### 2.2.3 Project cost

The total project cost planned at the time of the appraisal was 18,064 million yen (of this, 13,548 million yen covered by the yen loan), and the actual total project cost was 17,090 million yen (of this, 13,426 million yen covered by the yen loan), so it was nearly as planned.



Elevated Water Canal



Executing Agency (ORMVAD)

## 2.3 Effectiveness

### 2.3.1 Area benefited by the project

The actual area benefited by the project was 18,901ha, which was as planned at the time of the appraisal. Droughts in recent years, however, have prevented the supply of irrigation water during the dry season, so the double cropping that was planned at the time of the appraisal was not conducted at the time of the post-project evaluation.

### 2.3.2 Area under cultivation

The area under cultivation planned at the time of the appraisal was 25,108ha (2004), but the actual performance was 14,036ha (2004). The main reason for this was that they could not conduct the planned double cropping as the result of the inability to supply irrigation water during the dry season due to drought. The area under cultivation during the rainy season was slightly less than the planned 17,000ha (2004) due to insufficient water. (The impact of the project, however, has not realized due to the three-year delay in completing the project.)

As is shown in Table 2, the main water source for Doukkala irrigation is the Al

Massira Dam on the Oum er Riba River, but the annual water flow to the dam has decreased since the rainy seasons of 1989 to 1999, and is far below the long-term average water amount of 1,040 million m<sup>3</sup>. As a result, the amount of water that can be used for agriculture is less than half the water required for the Doukkala area since 2001-2002. The water shortage has become serious since Phase 2 was completed in 2002, and the water required for double cropping in the Phase 1 irrigation area completed in 2000 (16,000ha) could not be secured. Since 2002 when Phase 2 construction was completed, scarce water resources needed to be distributed over an area of 35,000ha, so supplying enough water is difficult, which leaves farmers no choice but to leave irrigated land fallow or to once again depend heavily on rain.

Table 2. Change in the Al Massira Dam Water Level and Irrigation Water

(Unit: 1 million m<sup>3</sup>)

	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05
Water Flow	1223	574	285	511	454	350	678	490
Rate of the increased amount of water to the average amount of water in the dam (%)	118	55	28	49	44	49	66	47
Amount of Water for irrigation	410	494	542	500	231	318	370	500
Amount of Water Required by Doukkala (downstream) */	550	550	550	550	550	550	550	550
Amount of Water Required by Doukkala (upstream) **/	--	--	--	--	300	300	300	300

Source: ORMVAD \*/Cultivation rate of 136% of 61,000ha. \*\*/Cultivation rate of 100% of 35,000ha.

The analysis at the time of the appraisal (1995) indicated that water shortages were a concern and noted that during the 15 years since the construction of the Al Massira Dam, there were only two years when there was enough water to meet the demand from irrigation and other applications. In response to this, ORMVAD said a 15-year water amount analysis was insufficient and presented the data that went as far back as 1939

and was the basis for the Doukkala Irrigation Project and replied that the long-term water supply would not be a concern<sup>4</sup>. In the end, however, there was little rainfall and the dam only remains half full, so the decline in rainfall has prevented the required pondage from being secured, which was probably difficult to foresee during the appraisal stage. ORMVAD plans to protect water resources and support agricultural production activities by introducing water-saving irrigation techniques.

### 2.3.3 Crop yields of major crops

Table 3 shows the plan targets at the time of the appraisal and actual performances for the crop yields of the major crops. While the performances of wheat, legumes, and feed grains markedly exceeded or at least met the plan targets, the yield for sugar beets was significantly below the plan target. The main reason for this is that because sugar beets require much more water than wheat, for example, they are difficult to grow on farmland scarce in water. The plan at the time of the appraisal estimated there would be an increase in yield by beginning to plant sugar beets in 2002 and double-cropping corn, feed crops, and vegetables. Although the planned target was not attained, the sugar beet crop had increased nearly tenfold by 2005. Crops of corn, feed crops, and vegetables also increased.

Before the construction of irrigation facilities, agriculture in the Doukkala area depended on rainfall, so the main crops were grains like wheat and corn, but after the construction of the irrigation facilities, crops that require much water, such as sugar beets and feed crops like alfalfa, were planted. The increase in feed crops in turn increased the amount of milk collected from 2,000 tons to 4,300 tons, so this also contributed to creating local employment at the approximately 20 milk collection centers run by cooperatives. Rainfall is used to grow grains when water for irrigation is scarce, and since there is no crop yield data for rain-dependent agriculture during the 1990s, the increase in crop yields cannot be quantified, making it difficult to measure the contribution of the irrigation facilities.

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<sup>4</sup> The Doukkala upstream irrigation was planned based on the national water master plan (1992) after the analysis on long-term water quality data (1939 to 1986) confirmed that the total demand for water could be met for eight out of ten years.

Table 3. Yields of Main Crops

(Unit: Tons)

	2002 Plan	2003 Plan	2003 Actual	2004 Actual	2005 Actual
Wheat	29,309	29,534	13,105	32,476	22,422
Corn	6,922	6,528	285	1,090	1,291
Sugar beet	329,180	355,457	47,568	125,254	158,984
Soybean	521	567	—	—	—
Legumes	1,206	1,360	1,239	4,359	2,173
Feed crops	8,384	9,394	20,675	29,052	41,160
Vegetables	—	—	60	101	151
Total	375,522	402,840	82,932	192,332	226,181

#### 2.3.4 Economic Internal Rate of Return (EIRR)

At the time of the appraisal, the economic rate of return was calculated using the increased production of agricultural produce as the benefit, and the civil engineering costs, consulting service fees, land acquisition costs, reserve fund, operation and maintenance costs, administrative expenses, and operation expenses as the cost to obtain an EIRR of 18.6%. The post-project evaluation found this to be a low 3%, which was mainly the result of low crop yields and low price for planted grains due to insufficient water.

### 2.4 Impact

#### 2.4.1 Sugar Production<sup>5</sup>

There is a sugar beet factory (COSMAR)<sup>6</sup> in Doukkala that uses the sugar beets grown on the Doukkala irrigated farmland as the raw material for producing sugar. An 80 million DH increased capitalization last year expanded the production capacity to approximately 18,000 tons/day. This increase in capacity would be expected to increase the amount of sugar beets grown in Doukkala, but there are still uncertain factors due to the large amount of water required to grow sugar beets and the low rainfall after project execution.

The sugar beet factory, farmers, and ORMVAD mutually depend on each other. The sugar beet factory provides funds for procuring agricultural inputs, such as fertilizer and farm tools, the repayments for which are deducted from the amount paid to farmers when the factory buys their sugar beets. In addition, the water fees the farmers pay are withheld from the money they receive for their beets. The collection of water fees is

<sup>5</sup> The government protects domestic sugar production and pays a subsidy of 2,000 DH per ton of refined sugar.

<sup>6</sup> This is owned by Omnium Nord-African, the largest private company in Morocco.

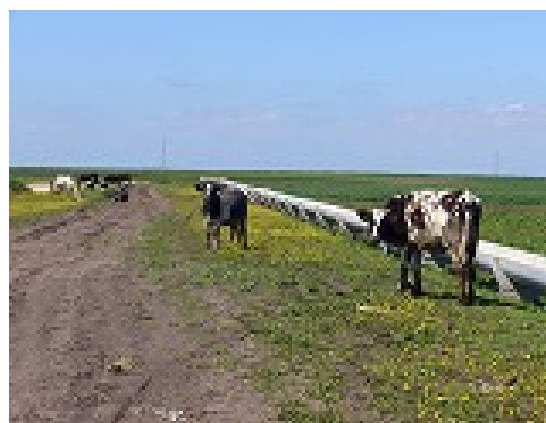


contracted to the sugar beet factory, which accumulates and periodically pays the withheld water fees to ORMVAD. This has resulted in a good water fee collection rate of over 90%. The water fees are paid to ORMVAD once a year when the sugar beets are harvested. According to ORMVAD, it gives priority to supplying irrigation water to sugar beet farmers. Since the sugar beet factory employs several thousand people, the growing and harvesting of sugar beets is important for supporting industry in the Doukkala area, but since a revision of the government's protectionist policies or an increase in the rate for irrigation water could result in lower income from sugar beet farming, future trend needs to be monitored.

In addition, the beneficiaries survey conducted there in March found that the time spent performing farm labor increased for women and children in many farm households<sup>7</sup>. This is because the growing of sugar beets, which is made possible by the irrigation facilities, requires more labor than the growing of wheat, etc. It was reported that while this has reduced the opportunities to exchange information among neighboring farmers, families and relatives, people are using television, radio, and mobile telephones to acquire information.



Farmer caring for sugar beets



Cattle walking along an irrigation canal and access road

#### 2.4.2 Farmer income

At the time of the appraisal, it was estimated that farmer income would be 15,000 DH to 19,740 DH per hectare due to increased harvests resulting from double cropping and other means, but a preliminary calculation based on current yields and agricultural commodity prices arrives at a beneficiary farm household income of 8,500 to 9,000 DH (excluding expenses for agricultural inputs). There are 7,099 beneficiary farm

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<sup>7</sup> The unemployment rate in the project area is around 20%, which is somewhat higher than in the cities (average 19.3%, men 17.4%, women 25.8%).

households for this project (achievement of over 90% of the plan target), and these families are responsible for 40% of the capital expenditure for the irrigation facilities (4,200 DH per hectare), which consumes nearly half of their income. To reduce the burden on farmers, ORMVAD is studying extending the payment period for the capital expenditure for the irrigation facilities, reducing the interest rate, lowering the contribution percentage, and other measures.

#### 2.4.3 Other

Although a small amount of land was acquired, such as for earthwork in the corners of farmland to facilitate irrigation facility operation and maintenance and to secure space for traffic, the compensation has been paid to the farmers in line with rules. In addition, the project required no relocation of residents.

### 2.5 Sustainability

#### 2.5.1 Executing Agency (ORMVAD)

The executing agency for the project is the Office Regional de Mise en Valeur Agricole des Doukkala (ORMVAD), which was established by government ordinance in October 1966 as a development corporation that includes participation by the Ministry of Agriculture, Rural Development and Sea Fisheries. The headquarters of ORMVAD are located in El Jadida, which is southwest of the capital city of Rabat, and it provides support for farmers such as the preparation of farmland and guidance in farm operation.

##### 2.5.1.1 Technical capability

The staff of ORMVAD consists of irrigation engineers and technicians as well as those who are dispatched from the Ministry of Agriculture, Rural Development and Sea Fisheries which is the government agency that oversees the company. Experienced engineers are given field assignments to operate and manage facilities, so there are no technical problems.

##### 2.5.1.2 Structure

ORMVAD has been promoting outsourcing for the past several years and is in the midst of a large-scale staff reduction. While it had 1,168 employees at the time of the appraisal, the number has been reduced to the current 780. A prompt restructuring of the organization and operations is required to prevent hindering the operation and maintenance of the irrigation facilities accompanying this staff reduction plan.

ORMVAD also implements agriculture and fishery dissemination operations in

addition to irrigation operations. Because the Ministry of Agriculture, Rural Development and Sea Fisheries also is in charge of the same operations, there is some overlap. In addition, the government provides no subsidy for the implementation of agriculture and fishery operations. ORMVAD depends on its own budget, but the allocation of irrigation water income to farming operations does not leave sufficient funds for the operation and maintenance of the irrigation facilities.

To achieve the self-sufficient system of ORMVAD and provide sufficient funding to cover the cost of operating and maintaining the irrigation facilities, the government is studying the restructuring of the ORMVAD system to allow revenues from the irrigation business to be used only for irrigation operations, and the utilization of the private sector for the operation and maintenance of irrigation facilities. In doing this, it is also important for the government to consider options for reducing the agriculture-related project responsibility of ORMVAD where this overlaps with the Ministry of Agriculture, Rural Development and Sea Fisheries and for shifting the company's role to overseeing irrigation operation through utilization of the private sector.

#### 2.5.1.3 Financial status

Because irrigation water is scarce and water fees are low, there are insufficient funds for operating and maintaining the irrigation facilities. For this reason, the government provides subsidies. Table 4 below summarizes the financial status of ORMVAD and Table 5 shows the subsidy received from the government.

The cost of supplying water was 1.05 DH/m<sup>3</sup> in 2003 and 0.77 DH/m<sup>3</sup> in 2004, but the average water fee was a low 0.29 DH/m<sup>3</sup>. The current irrigation water fee is 28% to 38% of the water supply cost, and because the fees were set so that the water fee paid by farm households was 20% of the price (6% to 8% of cost) the initial year, 40% the next year, and reaching 100% in five years, it is difficult to obtain the required funds. The finances are further stressed by having to conduct agriculture and fishery promotion activities with no prospective income.

Table 4: Financial Status of ORMVAD  
(Unit: 1 million DH)

	2002	2003	2004
Annual revenues	138,090	207,483	269,460
Annual expenditures	497,902	527,020	515,695
Balance of payments	-359,810	-319,537	-246,235

Table 5: Subsidies from the Government  
(Unit: 1 million DH)

	2002	2003	2004
Government subsidies	300,717	296,938	299,496

#### 2.5.1.4 Water associations

There are 39 water associations, and although 24 of them conduct activities to exchange information, they rely technically and financially on ORMVAD for the operation of the irrigation facilities, and they do not operate or maintain irrigation facilities or collect water fees. The water usage association committee members and chairperson are elected. ORMVAD dispatches staff to serve as association committee members and participate in committee activities.

#### 2.5.2 Operation and maintenance

Operation and maintenance of the irrigation facilities is conducted by ORMVAD. According to ORMVAD, the estimated operation and maintenance budget required to maintain the irrigation facilities for the entire 96,000ha of irrigated land is 90 million DH annually, but since the facilities are still new and the need for major repairs, such as pump replacement, has not occurred, the current operation and maintenance expenses are 50 million DH. During the last several years the annual operation and maintenance budget has been below 16 million DH, which is a low appropriation rate. Currently, the total expenses required by ORMVAD are approximately 108 million DH (of this, 35 million DH is for operation expenses, 23 million DH for labor costs, and 50 million DH for irrigation facility operation and maintenance). At the current point in time, income from irrigation water is 105 million DH, which is theoretically nearly the entire amount required to cover the irrigation-related expenses. However, since ORMVAD is also in charge of agricultural activities other than irrigation, the problem is that income from irrigation water must be allocated to cover expenses of other activities, in addition to those for irrigation. When greater operation and maintenance expenses are generated in the future, operation and maintenance will be a concern if the current water fee income system remains unchanged.



Scene of the beneficiary survey



The construction of irrigation facilities has allowed this former banker (center) to move from the city to become a “new” farmer.

### 3. Feedback

#### 3.1 Lessons Learned

The agricultural subsidies for sugar production and artificially low water fees are not generating any incentive for conserving the precious resource of water in arid regions. To improve agricultural productivity and alleviate poverty in rural villages through the effective use of water resources, a study should be made of what crops should be planted and what farm operation guidance given while taking into consideration the irrigation facility expenses, water fees, agricultural subsidies, and all the factors that can influence the price of the crops grown with the irrigation project.

#### 3.2 Recommendations

3.2.1 When a country like Morocco that has scarce water resources is planning a large-scale irrigation facilities investment, it needs to take a comprehensive approach

that includes conserving water resources and revising agricultural policy. The government must promote effective use of water through demand-side management and switching to crops that will increase agricultural income while considering how to use irrigation to effectively utilize scarce water resources and how to increase the economic benefits of constructing irrigation facilities.

3.2.2 The government is planning to review the operation of the Abda-Doukkala irrigation facilities including using the private sector. When doing this, it is important for the government to reduce ORMVAD's responsibility for agriculture-related operations where these overlap with the role of the Ministry of Agriculture, Rural Development and Sea Fisheries and to consider alternatives, such as shifting to the role of administering irrigation operations of the private sector. It is also important at that time for ORMVAD to take into consideration the long-term view of its technical and financial capabilities, implementing water-conserving irrigation, and providing support for agricultural production activities that match these while working to support and invigorate the water usage associations.

3.2.3 To secure the sustainability of the Abda-Doukkala Irrigation Project, it is important for the government to help ORMVAD achieve financial self-sufficient system and to allow ORMVAD to allocate sufficient funds for the operation and maintenance of irrigation facilities. This will require setting appropriate water fees and restricting the use of irrigation income to irrigation operations.

### Comparison of Original and Actual Scope

Item	Plan	Actual
(1) Outputs		
Construction of irrigation facilities	18,901ha	As planned
Main water canal	17.3km	As planned
Secondary water canals	33.7km	As planned
Water management system installation		As planned
Irrigation network	654km	703km
Drainage network	700km	676km
Agricultural roads	205km	193km
Land development	18,901ha	As planned
Drainage canal outside the district	75km	As planned
Milk collection facilities	21 locations	Cancelled
(2) Project Period	June 1996 to December 1999 (42 months)	June 1996 to September 2002 (75 months)
(3) Project Cost		
Foreign currency	5,656 million yen	94 million yen
Local currency	12,408 million yen	16,996 million yen
Total	18,064 million yen	17,090.27 million yen
Yen loan portion	13,548 million yen	13,426 million yen
Exchange rate	1 dirham = 11.0 yen	1 dirham = 11.0 yen