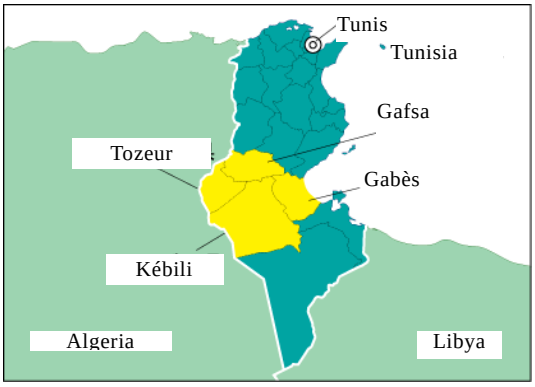
The Republic of Tunisia

Irrigation Perimeters Improvement Project in Oasis

External Evaluators: Yuriko Sakairi, Yasuhiro Kawabata
Sanshu Engineering Consultant Co., Ltd.

Field Survey: October 2007-March 2008

1. Project Profile and Japanese ODA Loan



Map of the project area

Water distribution facilities in an oasis

1.1 Background

Since 2003, Tunisia's economy has been growing steadily at an annual rate of 5–6%, while inflation has been kept at around 3%. In addition, Tunisia has been actively promoting economic liberalization by, among other things, reaching an agreement with the EU to establish a free trade zone, abolishing tariffs on industrial goods, and concluding an agreement with Arab countries in the Mediterranean region. In Tunisia, the agricultural sector is extremely important, as 35% of the population live in rural areas; agriculture accounts for 11% of its GDP; and agricultural products comprise 9.3% of all exports.[1] Date palms, an important export product, are a major agricultural product in the southern oases. The southern oases are, however, in an arid region that receives only 100–200 mm of rainfall per year; consequently, groundwater has been used to irrigate the land in this area since ancient times. But in the oases, due to a lack of adequate terminal channels, the irrigation systems are often beset with water leakage, resulting in a low usability level and a lowering of the groundwater level. Since development of new water resources is not dependable, improvement in the effective use of irrigation systems through water conservation is now urgently needed.

1.2 Objective

The objective of this project is to provide stable supply of irrigation water and

[1] The data for rural population cover the period from 2003 to 2005; the data on the ratio of GDP in the agricultural sector to GDP as a whole is for 2006, and the data on exports is for 2005.

conserve groundwater through the renovation of terminal earth canals and development of drainage systems in the oases of Tunisia's four southern governorates – Gabès, Gafsa, Kébili and Tozeur – thereby contributing to the stability of agricultural productivity and development of the local economy.

1.3 Borrower/Executing Agency

Government of the Republic of Tunisia / Ministry of Agriculture and Water Resources

1.4 Outline of Loan Agreement

Loan Amount/Loan Disbursed Amount	8,106 million yen / 6,417milllion yen
Exchange of notes/Loan Agreement	October 1996 / December 1996
Terms and Conditions - Interest Rae - Repayment Period (Grace Period) - Procurement	 2.7% 25 years (7 years) General untied (2.3% consultant portion)
Final Disbursement Date	December 2005
Main Contractors (Only those with at least 1 billion yen in capital)	None
Consulting Services (Only those with 100 million yen in capital)	None
Feasibility Study (F/S), etc.	1996: JICA Development Survey

2. Evaluation Results (Rating: C)

2.1 Relevance (Rating: a)

2.1.1 Relevance at the Time of Appraisal

In the 8th Five-Year National Development Plan (1992–1996), challenges for the stable production of food cereals and export crops were: (i) the spread of irrigation-based agriculture; and (ii) agriculture-related infrastructure development. Particularly, since the average annual rainfall is lower in the south than in the north, oasis agriculture based on the use of groundwater resources had historically flourished in the south. In order to conserve limited groundwater resources, top priority was given to the development of irrigation facilities in oases. In the Water Resources Development Plan (1991–2000), overall management of water resources – including reduction of the disparity between the supply and demand of water resources and development of new water resources for narrowing the regional gap in water supply – was regarded as a key challenge, and providing a stable supply of irrigation water was cited as a priority issue. Furthermore, the Long-Term Water Sector Strategy 2030 (Eau XXI: FY1998) calls for a reduction of the amount of water used for irrigation per 1 ha of land to one third of the present level by

2030. This project, which aims to develop terminal irrigation facilities in the southern oases, responds to the need for conserving water resources and fostering agriculture, and so it is recognized that this project is highly necessary.

2.1.2 Relevance at the Time of Evaluation

In the 10th Five-Year National Development Plan (2002–2006), the goal was to raise Tunisia's food self-sufficiency ratio by protecting the environment and increasing crop yields through the development and maintenance of land and water resources. Enhancement of water conservation projects throughout Tunisia and streamlining of irrigation systems through the development of terminal earth canals in 12,000 ha of oasis land were also identified as important issues.

Similar goals are set in the 11th Five-Year National Development Plan (2007–2011), and the goal is to increase the ratio of agricultural production based on irrigation to total production in the agricultural sector to more than 50% by 2009. In the Water Resources Development Plan (2001–2012: revised in 2000), water resource management, including development of new water resources, introduction of irrigation as well as effective use of water in agriculture are cited as priority issues. Enhancement of agricultural production through the introduction of water-conservation irrigation is consistently given high priority in Tunisia's Five-Year National Development Plan, Water Resources Development Plan, and long-term water sector strategy. Moreover, in oasis areas, due to the difficulty in developing new water resources resulting from declining groundwater levels, there was a pressing need to prevent water leakage caused by the lack of adequate terminal channels. This project is the first project of its kind involving conservation of water resources in the southern oasis area, and is consistent with the country's development needs.

Implementation of this project was consistent with the national development plans and the like, both at the time of appraisal and at the time of evaluation. Therefore, the project is evaluated to be highly relevant.

2.2 Effectiveness (Rating: b)

2.2.1 Output

The outputs of this project are shown in Tables 1-3. At 153 oasis sites spread over 23,435 ha of farmland, the original plan called for the conversion of earth canals into concrete canals, installation of PVC pipes in all of the canals, building of drainage canals, and provision of consulting services. In actuality, however, the conversion of earth canals into concrete canals, building of drainage canals, and provision of consulting services were implemented at only 88 oasis sites spread over 14,425 ha of farmland. Table 1 shows the number of oases where the project was implemented, and the benefitted area.

Table 1: Number of Oases Where the Project Was Implemented and the Benefitted Area (ha)

Governorate	Planned		Actual	
	No. of Oases	Area Benefitted	No. of Oases	Area Benefitted
Gafsa	8	3467	8	As planned
Tozeur	30	5622	20	3,143
Kébili	67	7213	30	3,700
Gabès	48	7133	30	4,115
Total	153	23,435	88	14,425

(Source: Ministry of Agriculture and Water Resources)

The number of targeted oases was reduced by 42%; the benefited area from the project, by 38%. The reason the actual number and area were less than the planned number and area is that, when it became apparent that the total project cost would exceed the cost estimated at the time of appraisal, the executing agency picked out areas judged to be in greater need of stable supply of irrigation water and implemented this project in those selected areas. The judgment that the total project cost would exceed the cost estimated at the time of appraisal is based on, among other things, the fact that (i) when the detailed design was implemented, it was found that the cost of the civil engineering works was greater than expected; and (ii) when the bidding fell through, the cost of the consulting services increased. The oases that were removed from the list of targeted areas under this project are currently covered by a new ODA loan.[2] Another reason this much difference emerged between the planned and actual performance is that, because the F/S based its assessment on a sample of 5% of the oasis area, it was unable to anticipate the high cost and difficulty of submitting bids and engineering works in specific areas that are difficult to access.

Table 2 shows the conversion of terminal earth canals to terminal concrete canals and the installation of PVC pipes; however, the length of the canals that were actually laid was 48% shorter than planned. Installation of PVC pipes was halted because local farmers adamantly opposed them and only open-type concrete canals were adopted. Farmers opposed the PVC pipes because the water flowing through them cannot be seen and because they wanted canals to be designed in a way that would allow livestock raised in the oases to drink from them.

[2] Water Saving Agriculture Project in Southern Oasis Area (signed in March 2007)

Table 2: Conversion from Terminal Earth Canals to Concrete Earth Canals and Installation of PVC Pipes (unit: meters)

Governorate	Planned			Actual	Actual/Planned Ratio (%)
	Concrete	PVC Pipe	Length	Length	
Gafsa	465,893	17,349	483,242	325,124	-32.7
Tozeur	494,217	236,811	494,454	157,971	-68.1
Kébili	311,479	769,204	1,080,683	870,240	-19.5
Gabès	825,031	208,157	1,033,188	370,791	-64.1
Total	2,096,710	1,231,521	3,328,231	1,724,126	-48.2

(Source: Ministry of Agriculture and Water Resources)

Table 3 shows the development of drainage systems. The number of drainage systems actually developed was 43% of what was planned, and the number of actual cases where terminal earth canals were converted to terminal concrete canals was reduced to 48% of what was planned. However, as noted earlier, the actual number of oases targeted was 42% fewer than planned, and the area that actually benefitted from the project was 38% less than planned. Consequently, the reduction in the actual number of drainage systems developed from the number that was planned is believed to be primarily the result of a reduction in the actual number of oases targeted and the areas that benefited from the project.

Some farmers expressed concern that their fruit trees may be damaged because traditionally there are no drainage systems in oases. Farmers were strongly against building drainage canals underground because their croplands had to be dug up to build drainage canals. Particularly, among farmers in Gabes where a wide variety of cash crops such as henna and pomegranate are grown, there were concerns about the effect drainage canals may have on crops. As a result, the actual number of drainage canals laid was reduced to 70% of the planned number of drainage canals to be laid, and the area to benefit from the project was reduced to 42% of that initially planned.

Table 3: Development of Drainage Systems (unit: meters)

Governorate	Planned	Actual	Actual/Planned Ratio (%)
Gafsa	37,465	31,888	-14.9
Tozeur	352,500	353,614	+0.3
Kébili	573,782	347,095	-39.5
Gabès	649,681	193,730	-70.2
Total	1,613,428	926,327	-42.6

(Source: Commissariat Régional au Développement Agricole (CRDA) offices of each governorate)

The original plan required 78 M/M (June 1997 – June 2003) for consulting services, but the actual consulting services required 87 M/M (October 1998 – December 2005), or 11.5% more than planned.

2.2.2 Period

The implementation period planned at the time of appraisal was for 6 years and 7 months (December 1996 – June 2003), but the actual implementation lasted for 9 years and 1 month (December 1996 – December 2005), or 38% longer than planned. As noted earlier, since the F/S was not very accurate, the period it set was not realistic.[3] The reasons why the actual period lasted longer than planned are: (i) the executing agency thoroughly implemented a strictly competitive bidding process and strengthened its supervision over the process; (ii) because the F/S sampled only 5% of the targeted areas, the differences between oases were underestimated and the operations required for renovation of the irrigation facilities were not fully brought into consideration, making the construction project incompatible with reality and thus necessitating a review of the plan; and (iii) time was required to prepare the construction plan to include discussions with farmers so that their needs would be reflected in the construction plan. Moreover, although a fair amount of time was required to inform reluctant farmers on the merits of the project, thanks to the efforts of the authorities concerned, the farmers finally came around to accepting the project.[4]

2.2.3 Project Cost

The total project cost planned at the time of appraisal was 10,808 million yen (Japanese ODA loan portion: 8,106 million). The actual cost, at 8,102 million yen (Japanese ODA loan portion: 6,417 million), was 25% less than the planned cost, and the planned Japanese ODA loan portion was 21% less than planned. As in the case of the project period, it is difficult to compare the difference between the project cost before and after the project implementation. While the overall cost was pushed up by a number of factors, by reducing the scale of the project, the total project cost was reduced. The overall cost increase was due to, among other things: (i) the decision to switch to concrete with

[3] The construction period was estimated in terms of four periods: 1 year if the oasis area was 100 ha or less; 2 years if it was between 100 and 300 ha; 3 years if it was between 300 and 400 ha; and 4 years if it was 400–700 ha.

[4] The Ministry of Agriculture and Water Resources, CRDA and the farmers' association (GDA) undertook the educational activities from the time this project was formulated. GDA members are farmers, and each GDA is operated by a council comprised of a chairman of the board, an accountant and a few members of the board – all selected by GDA members. The ministry and CRDA explained the merits of converting terminal earth canals to terminal concrete canals and the drainage network development to GDA board members, and then the latter explained the same to GDA members. The important things were: (i) the water flowing through the canal should be visible; and (ii) the livestock should be able to drink from the canal. Accordingly, under this project, steps were taken to meet farmers' needs, including changing the canal design to an open-type.

stronger resistance to salt damage, which led to increase in the cost; (ii) the dearth of bidders resulting from the bidding for construction work being held simultaneously in the four project areas, which caused an absence of competition; and (iii) the cost of accessing the project sites being much higher than originally expected (e.g., there was no gravel in Tozeur, so it had to be shipped over a long distance).

Although comparing the actual output, period and cost of the project to its planned output, period and cost, is difficult, in this project, the difference in each case was pronounced. Thus, its efficiency is judged to be moderate.

2.3 Effectiveness (Rating: b)

2.3.1 Operation/Effect Indicators

2.3.1.1 Farmers Who Benefitted from the Project

Table 4 shows the total number of farmers who benefitted from the project. Due to the reduction in project scale, the total number of farmers who benefitted from the project in the four target areas was 18% fewer than planned. Meanwhile, in some oases in Gafsa and Kébili, the project was partially expanded to accommodate a gradual increase in the number of farmers wishing to participate, resulting in more farmers benefitting from the project.

Table 4: Number of Farmers Who Benefited from the Project

Governorate	Planned	Actual	Actual/Planned Ratio (%)
Gafsa	5,620	6,212	+10.5
Tozeur	7,060	5,855	-17.0
Kébili	9,020	10,122	+12.2
Gabès	17,900	10,171	-43.1
Total	39,600	32,360	-18.2

(Source: Commissariat Régional au Développement Agricole (CRDA) offices of each governorate)

2.3.1.2. Growing Area

The growing area is shown in Table 5. In Gafsa, the area that benefited from the project not only went according to the plan but increased. By contrast, in Tozeur, Kébili and Gabès, the area that benefited from the project was less than planned; the area that benefited fell short of the plan by 40–60%.

Meanwhile, a field survey revealed that the area under cultivation increased in Gafsa and Kébili year after year. In all four target areas, the cropping ratio was nearly as planned, and according to the Commissariat Régional au Développement Agricole

(CRDA) offices of each governorate, the cropping ratio is improving year after year.

Table 5: Growing Area (ha) and Cropping Ratio

Governorate	Planned		Actual		Planned Ratio (%)	
	Growing Area	Cropping Ratio[5]	Growing Area	Cropping Ratio	Growing Area	Cropping Ratio
Gafsa	5,359	1.55	5,891	1.54	＋9.9	-0.6
Tozeur	6,501	1.16	2,337	1.37	-64.0	＋18.1
Kébili	12,130	1.68	5,968	1.55	-50.7	-7.7
Gabès	10,690	1.5	6,336	1.65	-40.7	＋10.0
Total	34,680	－	20,532	－	-40.7	－

(Source: Commissariat Régional au Développement Agricole (CRDA) offices of each governorate)

2.3.1.3 Crop Yields

Crop yields are shown in Table 6. After the project was completed, a sizable percentage of farmers planted date palms and young fruit trees, which bear fruit in five years' time. Thus, the crop yields are expected to gradually expand in the coming years.

Table 6: Crop Yields (unit: t/ha)

Area	Crop[6]	Planned	Actual
Gafsa	Fruits	11.7	2.45[7]
	Summer vegetables	18.0	26.8
	Winter vegetables	23.6	25.4
	Animal feed	59.3	52.3
Tozeur	Fruits	2.5	4
	Summer vegetables	9.6	9
	Winter vegetables	12.5	10

[5] Cropping ratio = Growing area / benefitted area

[6] Summer vegetables refer to chili pepper, tomatoes, etc. Winter vegetables refer to turnips, carrots, onions and fava beans. Date palms and olives are fruits.

[7] Since there are no data on olives, the numerical values are rather low.

	Animal feed	79.7	44
Kébili	Fruits	2.8	N/A
	Summer vegetables	10.1	6
	Winter vegetables	12.8	
	Animal feed	20.1	40
Gabès	Fruits	11.8	31.3
	Summer vegetables	15.2	34.7
	Winter vegetables	28.1	29.2
	Animal feed	59.4	50.2

(Source: Commissariat Régional au Développement Agricole (CRDA) offices of each governorate)

Additionally, according to the Ministry of Agriculture and Water Resources, as a result of converting terminal earth canals to terminal concrete canals under this project, loss of water for irrigation due to water leakages decreased by 25–30%; the irrigation interval was reduced from three weeks to two; and water conservation and irrigation efficiency were improved. Furthermore, enhancements in cropping intensity and crop yields as well as in crop quality and crop profitability were reported.

2.3.2 Internal Rate of Return

The project's economic internal rate of return (EIRR) at the time of appraisal at the time of evaluation are shown in Table 7. Expenditure is calculated as comprising civil works expenses, consulting services fees, relevant reserve funds, and operation and maintenance expenses, while benefits are calculated as an increase in revenue gained from the sale of agricultural products.[8] EIRR decreased because the area that benefitted from the project decreased and because the manifestation of the revenue increase was setback due to the delay of the project completion.

[8] Data at the time of the ex-post evaluation is from the Ministry of Agriculture and Water Resources.

Table 7: Internal Rate of Return

	At the Time of Appraisal	At the Time of Ex-post Evaluation
EIRR	10.1–15.7%	9.0%

2.3.3 Qualitative Effects

In a beneficiary study, some respondents expressed the view that the reduction in ground submergence as a result of the conversion of terminal canals to concrete canals for irrigation has enhanced irrigation effectiveness. Others said that the construction of drainage canals has contributed to groundwater conservation and decrease in salt damage inflicted on the soil.

2.4. Impact

2.4.1 Environment

In a beneficiary study, some respondents pointed out that the number of birds in oases was reduced. However, since no scientific survey on biodiversity was conducted under this project, data were not available to determine the validity of this claim.

According to the Ministry of Agriculture and Water Resources, this project had other positive impacts such as the protection of oases, protection of nonrenewable resources like fossil water, protection of soil, and prevention of desertification.

2.4.2 Beneficiary Survey

In this ex-post evaluation, a beneficiary survey was conducted from October 2007–February 2008).[9]

2.4.2.1 Economic Impact

Thirty-nine percent of the respondents said that crop yields increased, while 36% said the growing area expanded (animal feed: 9%; palms: 9%; fruit trees: 5%). Additionally, 58% said that their income increased as a result of increased production.[10] Of the 100 respondents, four returned to farming after the project was completed. Many farmers said that before the project was implemented, the terminal irrigation canals were earth canals, so they could not get enough water to irrigate their farmland downstream. Yet, because of the new concrete canals, they are now able to distribute irrigation water evenly across their fields. Furthermore, many farmers pointed out that they now have access to a steady

[9] JBIC conducted a beneficiary survey involving interviews of 100 oasis farmers randomly selected in the four areas targeted by this project. Oasis farmers were all male (3% under age 30, 22% in their 30s, 24% in their 40s, 23% in their 50s, 16% in their 60s, and 12% of 70 years or older. Forty percent had completed primary school education, 40% had completed secondary education, and 3% were college graduates). Nearly all were owner farmers, and 42% owned cropland of 1 ha or more.

[10] On average, 440 dinar/month increase in revenue.

supply of water and this has enabled them to expand their growing area by cultivating multiple crops in the same oasis,[11] which has led to the cultivation of vegetables with high market value and the enhancement of livestock raising through increased animal feed production. These developments have contributed to an improvement in centralized productivity, increase in the output and export volume of date palms, improvement in the quality of fruits, and a resultant rise in farmers' income.

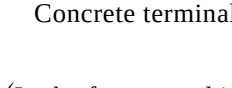
2.4.2.2 Social Impact

Since water conservation has become possible as a result of this project, the latter is also contributing to the improvement of economic and social life in neighboring areas through the use of surplus water to develop farmland in the perimeters of oases. The project has received high praise from the Commissariat Régional au Développement Agricole (CRDA) offices of each governorate, and many agreed that thanks to this project they have been able to secure the water necessary to irrigate the oases, realize water conservation by promoting the conversion of terminal earth canals to terminal concrete canals, improve irrigation efficiency, and expand the area under irrigation. Many expressed the view that in all target oases, the project has contributed to the promotion of the younger generation returning to farming, higher employment rates, and halting movement of people from rural to urban areas. Even in the beneficiary survey, there are examples of young people who had left their rural communities to work in cities but have now returned to farming (see 2.4.2.1). It is believed that this project has contributed greatly to the stabilization of social and economic conditions in local communities and to their development.

At the time the project was planned, it was assumed that some land acquisition would be required, but in actuality, there was neither resident relocation nor land acquisition. Thus, a certain level of effects was manifested with the project implementation, and the effectiveness of the project is evaluated as moderate.

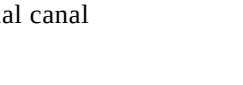
[11] In oasis, polyculture is adopted in which the top layer is used to grow date palms, the middle layer is used to grow fruits, and the bottom layer is used to grow field crops.

Concrete terminal canal



(In the foreground is farmland not irrigated with water supplied from an irrigation facility)

Farmland irrigated with water supplied from an irrigation facility



2.5 Sustainability (Rating: b)

Although some of the concrete canals built under this project show signs of deterioration, it is judged that it does not undermine the sustainability of the project.

2.5.1 Executing Agency

In this project, under the supervision of the Ministry of Agriculture and Water Resources and the Direction Générale du Génie Rural et de l'Exploitation des Eaux (DG/GREE), the Commissariat Régional au Développement Agricole (CRDA) offices of each governorate adopted a project execution plan and executed and managed the project. DG/GREE, the central project coordination institute, provided comprehensive guidance and support related to planning, coordination and technical assistance necessary for the project.

2.5.1.1 Operation and Maintenance System

Operation and maintenance of facilities and equipment are done by the CRDA and GDA.[12] As a general rule, the CRDA is responsible for large-scale operation and maintenance works that require a high level of expertise related to project monitoring and supervision, irrigation facilities (wells, cooling facilities, etc.), arterial waterways and secondary irrigation networks, while the GDA is responsible for small-scale or mundane operation and maintenance works. In each CRDA office, there are one or two engineers in addition to 10–20 professional staff members.

The Maintenance Services Department of Exploitation des Perimetres Irrigues is the department in the CRDA responsible for operation and maintenance. Most operation and maintenance work is carried out either directly by the CRDA or outsourced to contractors, but most operations that require special equipment and materials are implemented by outsourcing through competitive bidding. In accordance with the policy of the Ministry of Agriculture and Water Resources, in recent years, the percentage of the CRDA's shared operation that is outsourced has tended to rise as the GDA's share of operation and maintenance has increased.

2.5.1.2 Technical Capacity in Operation and Maintenance

The CRDA and GDA have their respective training programs under which CRDA

[12] By law passed on March 15, 2004, in 2006, the Water Users Association (AIC) and the Beneficiary Association (GIC) were merged into the Farmers' Association (GDA).

engineers provide technical support to the GDA. Regarding water conservation, CRDA's technical crew on water conservation provides technical guidance. In addition, each region has a training center to increase the professional skills and knowledge of CRDA and GDA personnel. At these centers, classes in water saving irrigation, the latest irrigation techniques and so on are offered for CRDA and GDA engineers. Recently, the GDA has tended to favor hiring engineers and other professionals. In particular, it has been reported that several professionals have already been hired in Tozeur. The Ministry of Agriculture and Water Resources is promoting the hiring of professionals by granting subsidies.

Additionally, the Ministry conducts campaigns via television commercials and television programs targeting ordinary farmers to promote water conservation. GDA members are assembled in one place to take part in workshops and the like, while experts give explanations on water conservation and answer questions from farmers. In this way, the Ministry provides guidance that meets local needs.

2.5.1.3 Operation and Maintenance Financial Status

Beneficiary Associations (GIC) (the GDA of today) were formed in the 1990s, and water rates are collected from the members. The rates are set on the basis of operation and maintenance expenses, labor costs, and electricity costs involved in running pumps for drawing water from the wells. In recent years, revenue from water supply has tended to increase, and so there are no outstanding issues so far in terms of the balance of payments. However, as can be seen in Table 8, in 2006, expenditure exceeded revenue in some areas, including Tozeur, which had a deficit of 85,681 dinars, and Kebili, which had a deficit of 62,990 dinars. In principle, revenue generated from irrigation water charges covers the GDA's activity expenses, but the CRDA has also subsidized the GDA's activities. Operation and maintenance expenses vary from one location to the next depending on the conditions of each oasis, but the cost sharing ratio of the CRDA and GDA is more or less 3:7, and, as is indicated in Table 9 below, the GDA's share has increased in recent years. The main reason is that the government adopted a policy of curtailing its budget for operation and maintenance expenses, but the view of the Ministry of Agriculture and Water Resources is that the GDA's own cost cutting efforts are also a factor. GDAs are engaged in sales of water and conducting operation and maintenance activities. There are also reports that after the completion of the project, the number of farmers who benefited from irrigation increased, and the number of farmers joining the GDA has increased and that their eagerness to buy farm machines and the like has intensified, and so the GDA can be expected to continue to be actively engaged in these economic activities.

Table 8: Balance of Payments of the GDA in Four Areas (unit: dinar, 2006)

Governorate	Revenue	Expenditure (O&M)
Gafsa[13]	620,060	424,226
Tozeur	2,601,124	2,686,805
Kébili	2,563,425	2,626,415
Gabès	N/A	N/A

(Source: GDA, CRDA)

Table 9: Ratio of Owned Funds to Operation and Maintenance of the GDA

2002	2003	2004	2005	2006
71%	83%	88%	107%	118%

(Source: GDA, CRDA)

Many southern oasis areas have adopted the pay-by-the-hour system for the irrigation water charge. The collection rate of the irrigation water charge is nearly 100% in all governorates.

The water rate is 28–30 milim per 1 m^3.[14] The amount of water used in Kébili and Tozeur (from 15,000 to 17,000 m^3/year) and the amount of water used in Gafsa and Gabès (from 9,000 to 10,000m^3/year) is different because there is a huge demand for date palms in Kébili and Tozeur, while in Gafsa and Gabès, most agricultural products are resistant to aridity such as olives.

2.5.2 Operation and Maintenance Situation

The field survey confirmed signs of deterioration in the concrete canals built under this project. According to the CRDA, these signs began to appear the year after the conversion of terminal earth canals to terminal concrete canals. However, drawing a lesson from the deterioration, some CRDA and GDA offices paid due attention to this issue when concrete was produced, and decided to build the new canals with thick concrete. According to the Ministry of Agriculture and Water Resources, since the design of the terminal canals and the selection of concrete and other materials were made in accordance with the quality standards set by the government, there were no problems at the time of the conversion from terminal earth canals to terminal concrete canals. However, the likelihood of the concerete deteriorating was raised and recognized at the time the project design was adopted. However, since the deterioriation was apparently

[13] The data r Gafsa is of 2005.
[14] 1 milim is equal to 1/1000 of dinar, so 30 milim is about 3 yen.

caused in part by a chemical reaction triggered by the high temperature and sunlight peculiar to Tunisia, it cannot be said with certainty that the deterioation was caused by the salt content of the concrete. In fact, the cause is currently under investigation. Despite budgetary constraints, the ministry, for its part, intends to strengthen the inspection of water distribution networks by the CRDA and GDA, as well as conduct careful investigation of the state of deterioration, water quality analyses, and study of remedial measures.

Additionally, a large amount of scales adheres to (i) transmission pipes used to transmit hydrothermal groundwater to cooling facilities, and to (ii) wooden grids inside cooling towers. These scales are removed periodically. Imported and chemically treated wood, in particular, used to be employed to make wooden grids, but today, to cut costs, rachises of palm leaves are used. Palm leaves are available in the oases, so it is easy and cheap to replace them. The scales are removed periodcially, transmission pipes and the wooden grids inside the cooling towers are replaced two to three times a year. In this way, operation and maintenance works are carried out thoroughly; therefore, on this front, there are no problems.

3. Feedback

3.1 Conclusion

Based on the foregoing discussion, all in all, the project is evaluated as moderately satisfactory.

3.2 Lessons Learned

In order to accurately measure the effectiveness of a project, precise plan values (scope, project cost, project period, etc.) should be set at the time of project appraisal.

Additionally, when new concepts (in this project: conversion of terminal earth canals to terminal concrete canals, provision of drainage canals, etc.) are incorporated, in addition to designing these new concepts while keeping in mind their appropriateness to the site conditions, at the preliminary construction stage, the executing agency should hold consultations with local farmers so that their wishes may be properly embraced.

In Southern Tunisia, where a nonrenewable deep water-bearing stratum is used as the water source, it is especially important to provide guidance on water conservation. Thus, incorporating technical guidance and training for the GDA and farmers into irrigation projects is an effective way of maximizing their effects.

3.3 Recommendations

None

Comparison of Original and Actual Scope

Item	Breakdown	Planned	Actual
Output	Number of oases		
	Gafsa	8	As planned
	Tozeur	30	20
	Kébili	67	30
	Gabès	48	30
	Area of target sites (ha)		
	Gafsa	3467	As planned
	Tozeur	5622	3,143
	Kébili	7213	3,700
	Gabès	7133	4,115
	Construction of terminal earth canals (meter)		
	Gafsa	483,242	325,124
	Tozeur	494,454	157,971
	Kébili	1,080,683	870,240
	Gabès	1,033,188	370,791
	Construction of drainage canals (meter)		
	Gafsa	37,465	31,888
	Tozeur	352,500	353,614
	Kébili	573,782	347,095
	Gabès	649,681	193,730
	Consulting Services	78 MM	87 MM
Period	Dec. 1996 – Jun. 2003 (6 years and 7 months) 79 months		Dec. 1996 – Dec. 2005 (9 years and 1 month) 109 months
Project Cost			
Foreign Currency	5,847 million yen		*[15]
Local Currency	4,961 million yen (Local currency: 45,106,000 TD)		
Total	10,808 million yen		8,102 million yen
ODA Loan Portion	8,106 million yen		6,417 million yen
Exchange Rate	1TND = 110 yen (As of Dec. 1996)		1TND = 95.45yen (Average Dec. 1996 – Dec. 2005)

[15] There are no data on the breakdown.