Tunisia

Sewage System Development Project in 4 Cities

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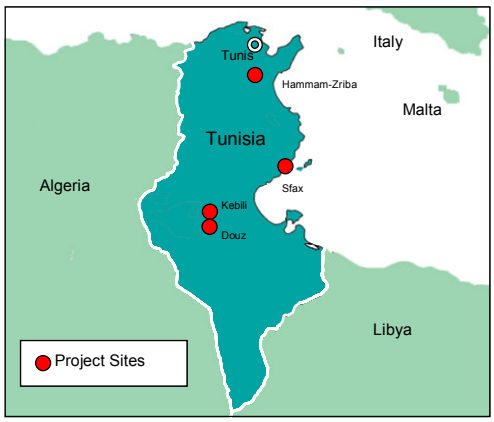
Field Survey[1]: April 2009 and July 2009

1. Project Profile and Japanese ODA Loan



Map of Project Area

(Clockwise from upper left) Zriba Sewage Treatment Plant, Sfax North Sewage Treatment Plant, Kebili Sewage Treatment Plant, Douz residential area

1.1. Background

In the latter 1980s, Tunisia experienced an economic crisis triggered by a decline in the price of crude oil, a major export, and a precipitous drop in tourism income, but subsequent economic deregulation proved successful, leading to a recovery of growth in the 1990s. On the other hand, against the backdrop of a high population growth rate not only in the urban area but also in the rural area and the associated environmental problems, construction of social infrastructure including water and sewage systems was recognized an urgent issue in 1996.

In particular, regional cities such as Sfax, the second largest city in Tunisia, and Kebili and Douz in the south shared the following issues: (1) Sewage has flowed into rivers and seeped into the ground from sewage tanks (called *Puis Perdu*) since ordinary households have not been connected to a sewage system, (2) due to the un-connection to the system mentioned in (1), groundwater and surface water was polluted, lowering the quality of water for agricultural use and drinking water as well as inducing environmental destruction in the city fringes, and (3) discharging untreated wastewater from ordinary households has deteriorated sanitary condition in urban areas. There was a concern that

[1] Consultation with the Tunisian government concerning the results of the preliminary evaluation took place in April 2009. The beneficiary survey was conducted during late April through early May 2009. The feedback seminar on the evaluation results was held in July 2009.

these shared issues would become increasingly severe, coupled with the high population growth rate in the regional cities.

Given the above concern, Tunisia's public sewage corporation, Office National de l'Assainissement (ONAS), which controlled sewage infrastructure, took steps to comprehend the cities' needs for sewage infrastructure by carrying out a sewage development demand survey in 199 cities with populations over 2,000 persons and by preparing a sewage master plan with the assistance of the World Bank. Based on the results, of the cities that had a strong need for sewage development in the above-mentioned survey and plan, four cities were selected as targets of this project. They were the three cities of Sfax, Kebili, and Douz, which had particularly high priority and were prepared to implement development smoothly. In addition, the city of Hammam Zriba, which was a target of investment for sewage development in the 8th National 5-Year Plan was included.

1.2. Project Objective

The objective of this project is to enhance the capacity of sewage treatment system by constructing and rehabilitating sewage treatment plants and sewage pipelines in 4 cities (Sfax, Kebili, Douz and Hammam Zriba) in Tunisia, thereby contributing to the improvement of living conditions of local residents and to the protection of environment in peripheral areas of each city.

1.3. Borrower / Executing Agencies

Government of the Republic of Tunisia / Office National de l'Assainissement (ONAS)

1.4. Outline of Loan Agreement

Loan Amount / Disbursed Amount	6,389 million yen / 6,386 million yen
Exchange of Notes / Loan Agreement	October, 1996 / December, 1996
Terms and Conditions	Interest Rate:2.5% (2.1% for Consulting Services) Repayment Period:25 years (Grace Period:7 years) Conditions for Procurement: General untied
Final Disbursement Date	April, 2006
Main Contactors (over 1 billion yen)	EPPM (Tunisia)・SOTUTRASM (Tunisia)・CHAABANE ET CIE (Tunisia) (JV) / GRANDS TRAVAUX MEGHAEITH (Tunisia)・ENVIRONNEMENT INDUSTRIE

	ET AMENAGEMENT (Tunisia) (JV)
Consulting Services (over 100 million yen)	N.A.
Feasibility Studies, etc.	1993 Sewage system development master plan for Sfax (by World Bank)

2. Evaluation Result (Rating: B)

2.1. Relevance (Rating: a)

The project has been highly relevant with Tunisia's development needs and national policies at the times of both appraisal and ex-post evaluation.

2.1.1. Relevance at Appraisal

While industrialization and tourism development were put at the center of economic development in the 8th 5-Year Plan (1992−1996), another priority issue in the plan was promotion of social infrastructure development including sewage systems, from the standpoint of correcting regional disparities and encouraging sustainable development that is environmentally sound. At the time of the appraisal, sewage development was the priority issue in overall national policy, and within that, four cities targeted by this project were prioritized in the demand survey[2] by ONAS and in the master plan[3] prepared with the assistance of the World Bank.

At the time in 1996, none of these cities except for Sfax had a sewage treatment plant, and the sewage from the existing sewage pipes was discharged untreated into nearby rivers, raising concerns about the impact on oasis agriculture in Kebili and Douz and about degradation of the image of the tourist city, Hammam Zriba. Even in Sfax which did have a sewage treatment plant, lack of sewage treatment capacity was a problem, making construction of a new treatment plant an urgent issue, to lighten the burden of the existing plant.

In view of the above, this project, which aims to boost the sewage treatment capacity of

[2] In the sewage development demand survey conducted by ONAS in 1992, 17 cities were selected as having a strong need for sewage development, based on criteria such as (1) investment efficiency indexes (i.e., investment amount per resident required for new sewage connections and the return on investment (ROI), (2) environmental considerations (related to public health such as groundwater pollution and offensive odors), (3) impact on tourism and agriculture, etc. Among these 17 cities, Kebili and Douz, which are two of the four target cities in this project, were included.

[3] A sewage development master plan was prepared in major five cities (Tunis, Sfax, Sousse, Kairouan, and Nefza) in 1993 with the assistance of the World Bank, bearing in mind the development of a systematic sewage system as outlined in the 9th National 5-Year Plan (1997-2001). Among these cities, Sfax thoroughly reviewed the old master plan prepared by ONAS in 1974, divided the city into three sections (northern, central, and southern), and planned to construct a new sewage treatment plant in the northern section. This project of Sfax's northern sewage treatment plant is consistent with Sfax's master plan.

each city by constructing new sewage treatment plants and promote resolution of multiple environment-related problems in the cities, may be deemed to have had high priority in order to resolve and support the development issues and development policy in Tunisia at the time.

2.1.2. Relevance at the time of ex-post evaluation

The 11th 5-Year Plan (2007-2011) sets forth development of water and sewage systems as a priority issue that should be addressed quickly from the standpoint of continued correction of regional disparities, improvement of living standards of local residents, and environmental conservation. Moreover, the most recent five-year plan mentioned above clearly states the following five points as the major policy goals related to sewage development: (1) expansion of the sewage network, (2) improvement of residents' living environment, (3) repair and expansion of old sewage-related facilities, (4) promotion of usage of treated sewage water, and (5) promotion of participation by the private sector in operation and maintenance.[4]

In the ex-post evaluation, high priority is placed on sewage development in the overall national policy. Moreover, the policy goal of utilization of PPPs (public-private partnerships) in repair and expansion of old facilities, promotion of recycling of treated sewage water, and operation and maintenance is wholly consistent with the content of this project, therefore this project is highly consistent with the sector policy.

In addition, there remains an extremely high need for sewage treatment and improvement of public health environment in the four cities targeted by this project. Particularly in Sfax, the demand for sewage treatment has nearly doubled[5] since the time of the appraisal due to the population growth[6]. If this project had not been implemented, it would be impossible for Sfax to cope with the current above-mentioned demand for sewage treatment, and it may be assumed that the city's public health environment would not have attained its current level (and exactly the same issue can be pointed out in the

[4] Specifically, it mentions (1) further spread of sewage service in urban areas and regional cities and prefectures (target connection rate in 2011: 91%), (2) improvement of the living environment of low-income residents, (3) improvement of the water quality of treated sewage water through the repair and expansion of old facilities as well as improvement of the quality of customer service through repair and expansion of the sewage pipe network, (4) further promotion and expansion of PPP (Public-Private Partnership) and BOT (Build, Operate, and Transfer) projects through strengthening of public-private collaboration, (5) promotion of increased usage of treated sewage water (by reducing the cost related to treated sewage water in the Tunis metropolitan area and in coastal areas and expanding delivery of water to regions where there is a demand (i.e., the central western and the southern regions), (6) continuation of study related to the action plan for recycling sludge and launch of specific action based on the results of the study, (7) promotion of construction of sewage treatment plants that specialize in industrial sewage treatment, and through that, achievement of drastic improvement in the management of industrial wastewater, and (8) improvement of the financial status of ONAS.

[5] From approximately 15,000 ㎥/day in 1997 to approximately 34,000 ㎥/day in 2007 (source: ONAS).

[6] In 1996 when the appraisal was conducted, the population was 430,000, and in 2007, it had increased to approximately 500,000 (an increase of approximately 16%) (Source: same as above).

other three cities which did not possess sewage treatment plants). On the other hand, considering the fact that the rate of population growth remains lower (discussed below in the section on "Effectiveness") and that the demand per person for water is approximately half of the amount compared to the projection at the time of appraisal, the future need for sewage treatment is expected to grow more slowly than planned.

Each component of this project discussed below is tailored to the actual conditions and issues mentioned above. The sewage-related facilities built by this project (sewage treatment plants, sewage networks, etc.) meet the demand for sewage treatment in the four target cities as the only infrastructure facilities for sewage treatment operations.

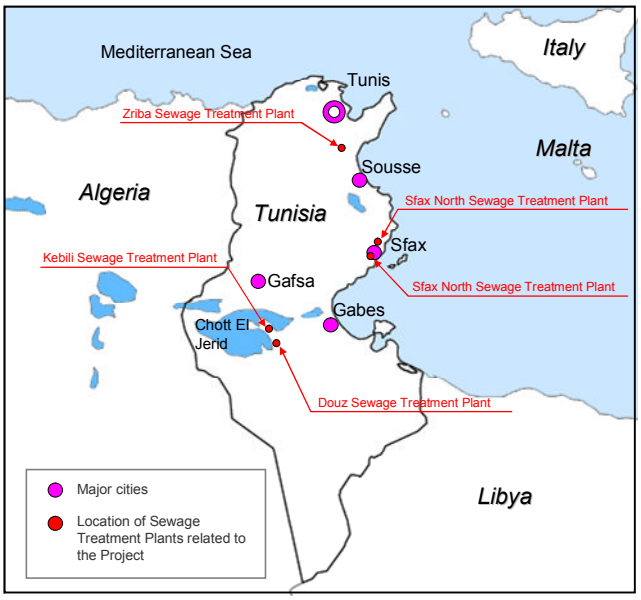


Figure-1: Location of Project Sites

2.2. Efficiency (Rating: b)

The actual cost was lower than planned whereas the project period was much longer than planned (217% of the original plan); therefore the evaluation for efficiency is fair.

2.2.1. Outputs

The table below presents a comparison of the planned output and the actual output. In addition to the significant increase in the treatment capacity of the Sfax Sewage Treatment Plant (North), the area covered by sewage pipes was extended in all cities except Hammam Zriba. Moreover, in terms of the materials and machinery procured for operation and maintenance, the number of the items procured increased by approximately 30%. The main reasons for changes in each output are as follow.

Table-1: Changes in Output

Project Components	Original	Actual	Differences
1. Sfax			
1.1 Construction of new plant (North)	Design capacity: 10,000m^3/day	17,900m^3/day	7,900 m^3/day (+)
1.2 Expansion of existing plant (South) Design capacity: 24,000m^3/day (before rehabilitation)	Design capacity: Doubling the existing plant	49,500m^3/day (after rehabilitation)	Mostly as planned
1.3 Construction of sewage pipelines	Total length: 156.5km	289km	132.5km (+)
1.4 Construction of pumping stations	11 stations	9 stations	2 stations (-)
2. Kebili			
2.1 Construction of new plant	Design capacity: 3,130m^3/day	3,110m^3/day	Mostly as planned
2.2 Construction of sewage pipelines	Total length: 29.6km	36km	6.4km (+)
2.3 Construction of pumping stations	2 stations	3 stations	1stations (+)
3. Douz			
3.1 Construction of new plant	Design capacity: 4,700m^3/day	4,700m^3/day	As planned
3.2 Construction of sewage pipelines	Total length: 36.7km	62km	25.3km (+)[1)]
3.3 Construction of pumping stations	2 stations	2 stations	As planned
4. Zriba			
4.1 Construction of new plant	Design capacity: 2,000m^3/day	1,800m^3/day	200 m^3/day (-)
4.2 Construction of sewage pipelines	Total length: 6.6km	7.0km	Mostly as planned
4.3 Rehabilitation of sewage pipelines	Total length: 6.5km	7.0km	Mostly as planned
4.4 Construction of pumping stations	4 stations	4 stations	As planned
5. Operation and maintenance equipment (High-pressure washer trucks for cleaning pipes, Vehicles with investigative cameras, Business vehicle, Other equipment)	51 items in total (High-pressure washer trucks (15), Vehicles with cameras (1), Business vehicles (24), Other equipment (11 items))	68 items in total High-pressure washer trucks (17), Vehicles with cameras (3), Business vehicle (44), Vaccuum machine (4)	17 items (+)
6. Consulting Services (C/S)	30 M/M	34.57 M/M[2)]	4.57 M/M (+)

Source: JICA internal documents and results of interviews

Note 1): Total length of 10km, out of 25.3km, is the additional output which connected Douz Sewage Treatment Plant and sewage network in Golaa (the neighboring district of Douz).

Note 2): 31.57 M/M out of 34.57 M/M is for consulting service of Sfax component while 3 M/M out of 34.57 M/M was for that of environmental impact assessment on Chott El Jerid.

Note 3): (+) and (-) are, respectively, indicating the increase and decrease compared to the original plan.

✓ Sfax project component: The significant increase in the treatment capacity of the Sfax Sewage Treatment Plant (North) (10,000m^3/day → 17,900m^3/day) was a result of the decision to include central Sfax in the treatment target area at the detailed design (D/D) stage to cope with the expected increase in population. The significant expansion of the area covered by sewage pipes (156.5 km→289 km) was due to the above-mentioned expansion of the target area. Moreover, the reduction in the number

of pumping stations (from 11 to 9) was made accompanying reconsideration of placement of the sewage network.

- ✓ Kebili project component: The extension of the sewage pipes (29.6 km→36 km) was carried out to expand the sewage pipe network in keeping with Kebili's city development plan designed in 2006. The increase in the number of pumping stations (from two to three) was necessitated by the above-mentioned extension of sewage pipes.
- ✓ Douz project component: The extension of sewage pipes (36.7 km→62 km) was carried out to (1) further expand the sewage pipe network in the city of Douz (approximately 15 km) and (2) connect sewage pipes from Golaa area to the Douz Sewage Treatment Plant.[7]
- ✓ Hammam Zriba project component: The reduction in the treatment capacity of the sewage treatment plant (2,000m^3/day → 1,800 m^3/day) was carried out in response to actual sewage treatment demand which was ascertained in the detailed design (D/D) stage. (The figure of 2,000m^3/day was obtained in the small-scale feasibility study conducted prior to the start of the project.)
- ✓ Purchase of operation and maintenance equipment: The reason for the increase in the high-pressure washer trucks for cleaning sewage pipes, vehicles with investigative cameras, and business vehicles was increase of the operation and maintenance area accompanying the extension of the sewage network (due to additional output and other construction). The new purchase of suction equipment (total of 4) used for draining rainwater, etc., was to provide better service in operation and maintenance activities.[8]
- ✓ Consulting service (C/S): The increase in the amount spent on consulting service in Sfax (24 M/M→31.57 M/M) was due to the delay in implementation at the Sfax Sewage Treatment Plant (South) as mentioned below, which was to be carried out at the same time of the Sfax Sewage Treatment Plant (North). The time lag of implementation between the two plants required to increase the M/M for the civil engineering specialist (team leader) who supervised both components.

2.2.2. Project period (Rating: c)

The project period was much longer than planned.

The project was scheduled from January 1996 to December 2000, a period of 60

[7] Because there was no sewage treatment plant in the Golaa area and there was concern about environmental degradation in the area due to untreated wastewater discharge, it was decided to lay additional sewage pipes (source: ONAS).

[8] The 11 pieces of machinery and materials scheduled for procurement (listed as "Other machinery and materials" on Table 1) were not procured, and in their place were ordered high-performance equipment such as small-size suction equipment and vehicles with investigative cameras (source: ONAS).

months, but it extended to 130 months, from January 1996[9] to October 2006[10], which was equivalent to 217% of the original plan[11].

The main factor causing the delay was the significant setback in the Sfax component because it was the critical path for the entire project. Specifically, the two points to be mentioned are (1) the significant delay in the selection of the detailed design (D/D) consultant (procured by World Bank funds, separate from this project) for the Sfax Sewage Treatment Plant (North), which construction (expansion of treatment capacity from 10,000 m^3/day to 17,900 m^3/day) was under the project loan and (2) the delay caused by the repeat of the bidding on repair work for the Sfax Sewage Treatment Plant (South).

Against the above backdrop, the contractor agreement for the Sfax Sewage Treatment Plants (North and South) lingered on until September 2003. This resulted in a delay of 64 months (5 years 4 months) from June 1998, which was the scheduled date at the time of the appraisal. As a result, the delay until the end of the contractor agreement was the direct cause of the significant delay of the entire project.

Table-2: Comparative Table of Project Periods

Task	Original Schedule（months）	Actual (months)	Differences (months)
Tender Preparation	Jan.1996 - Dec.1997 (24.0)	Jan.1996 - Feb.2001 (62.0)	38.0
Tender / Evaluation / Contract	Mar.1997 - Jun.1998 (16.0)	Jan.1997 - May.2005 (101.0)	85.0
Land Acquisition	Oct.1996 - Dec.1997 (15.0)	Apr.1997 - Jan.2002 (58.0)	43.0
Civil Works	Oct.1997 - Sep.2000 (36.0)	Nov.1997 - Oct.2006 (108.0)	72.0
Consulting Service	Oct.1997 - Dec.2000 (39.0)	Dec.2002 - Oct.2006 (46.0)	7.0

Source: JICA internal documents, answers to the questionnaire to ONAS and results of interviews

2.2.3. Project cost (Rating: a)

Total project cost was lower than planned (99% of the original plan).

The total cost of the project was originally 8,518 million yen (the Japanese ODA loan share was 6,389 million yen) but the actual project cost was 8,436 million yen (the Japanese ODA loan share was 6,386 million yen), which was equivalent to 99% of the original plan. As shown in the Comparison of Original and Actual Scope which appears at

[9] While the signing of the loan agreement took place in December 1996, preparation for the Kebili bidding was started in January 1996 by ONAS. According to ONAS, preparation for bidding (preparation of bidding documents, etc.) was executed prior to the loan agreement signing in order to save time because it had been instructed by JICA (the Former Japan Bank for International Cooperation (JBIC)) that "implementation of bidding prior to the loan agreement signing is impossible" . Therefore, it is appropriate to consider January 1996 as the start of the project (e.g., the starting date of practical work related to the project).

[10] The completion date of the project is defined as preliminary acceptance date for transference of the facilities constructed at the Sfax sewage treatment plant (south) (Source: Answers to the questionnaire to ONAS and results of interview with ONAS).

[11] The loan disbursement deadline was extended twice (in March 2002 and May 2005) in this project, a total of four years.

the end of this report, foreign currency portion significantly declined and local currency portion significantly increased. According to the interview with ONAS, the cause was that "at the time of appraisal, a large foreign currency portion was estimated because it was assumed that most of the project contractors would be foreign companies, but it turned out that most of the contractors were Tunisian companies, which caused payments in local currency to expand more than initially anticipated."[12]

2.3. Effectiveness (Rating: b)

Among five operation and effect indicators (population treated, percentage of population served, rate of wastewater treated, Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS)) that can be compared with a target value, some of them have not achieved the target as planned. On the other hand, many positive impacts were recognized. Therefore, this project has produced certain effects, and its effectiveness is fair.

2.3.1. Quantitative effects - Operation and Effect Indicators

(1) Population treated and percentage of population served

Shown on the table below are the base level (1996), achieved level (2007), and target level (2011) for the population treated and the percentage of population served in the project target areas (a total of five cities and areas including Sfax North, Sfax South, Kebili, Douz, and Hammam Zriba). Whereas Kebili and Hammam Zriba have achieved 94% of the 2011 target level, Sfax (North and South) and Douz have reached only 60% to 70%. Given that there remain only four years until 2011, achievement of the target in these two areas is expected to be somewhat difficult.

The reason why the growth of population treated is lower than expected is due to the low percentage of population connected. There are many possible reasons as to why the percentage of population connected is low, such as topographical factors and Tunisian social customs, etc., but the main reason that is frequently pointed out is that "the sewage connection fee for which ONAS charges contracting households is extremely high given the disposable income[13] of ordinary households in Tunisia." (The fee is 260 Tunisian dinars, equivalent to approximately 20,000 yen.)[14]

To improve the percentage of population served, it would be desirable to implement measures such as further expansion of connection fee discount schemes (currently, low

[12] Source: Result of interview with ONAS.
[13] Gross national disposable income per capita in 2008 in Tunisia was 4,912 dinars (approximately 370,000 yen, annually) (source: Tunisia's National Statistics Institute).
[14] Source: Interviews with ONAS and JICA senior volunteers in Tunis (sewage specialists) and JICA's internal material, etc.

income earners are charged 130 Tunisian dinars, which is half of the regular fee) and further expansion of the sewage network.

Table-3: Population Treated

Unit: people

Cities/Area	Baseline (1996)	Actual (2007)	Target (2011)	Achievement Ratio
Sfax North	Unknown	38,829	62,530	62%
Sfax South	Unknown	299,843	395,420	76%
Kebili	7,725	17,663	18,850	94%
Douz	0	23,254	31,800	73%
Zriba	6,102	8,964	9,530	94%

Source: Prepared from JICA internal documents and data received from ONAS

Note 1): Achievement ratio is calculated from the current value of 2007 divided by the target value of 2011

Note 2): Population treated = Number of households connected to sewage services * Number of people per household

Table-4: Percentage of Population Served

Unit: %

Cities/Area	Baseline (1996)	Actual (2007)	Target (2011)	Achievement Ratio
Sfax North	30	43.0	65.0	66%
Sfax South	Unknown	73.5	91.0	81%
Kebili	45[3)]	91.0	92.0	99%
Douz	Approx.0[3)]	65.5	84.8	77%
Zriba	80[3)]	95.4	95.8	Approx.100%

Source: Prepared from JICA internal documents and data received from ONAS

Note 1): Achievement ratio is calculated from the current value of 2007 divided by the target value of 2011

Note 2): Percentage of population served = Population treated / Total population of the area

Note3): Baseline as of 1994 (Source: JICA internal documents)

(2) Rate of wastewater treated and rate of facility utilization

As shown on Table 5 below, the rate of wastewater treated at each treatment plant as of 2007 was low compared to the maximum treatment capacity (at Sfax North, Sfax South, Kebili, Douz, and Hammam Zriba, the figures were 31%, 57%, 67%, 40%, and 19%, respectively, and these figures also represent the rate of facility utilization). ONAS states that "the maximum treatment capacity of each sewage treatment plant is designed to cope with the demand in 2016." According to this statement, the rate of wastewater treated and the rate of facility utilization are increasing basically as expected at the treatment plants in Sfax South and Douz, which have been in operation since 2004, and in Kebili, which currently has a utilization rate of 67% (see Figure 2 below for details). Meanwhile, the rates of facility utilization in 2007 of the treatment plants in the Sfax North and Hammam Zriba were 5% and 17% lower than the standard to be achieved, respectively.[15]

[15] According to JICA's internal materials, the 2011 target level for the rate of facility utilization of Sfax North and Sfax South is 100%, but ONAS states that "100% will be achieved in 2016." Because completion of the facilities was delayed by five to six years compared to the original schedule, it is likely that ONAS reset the target year.

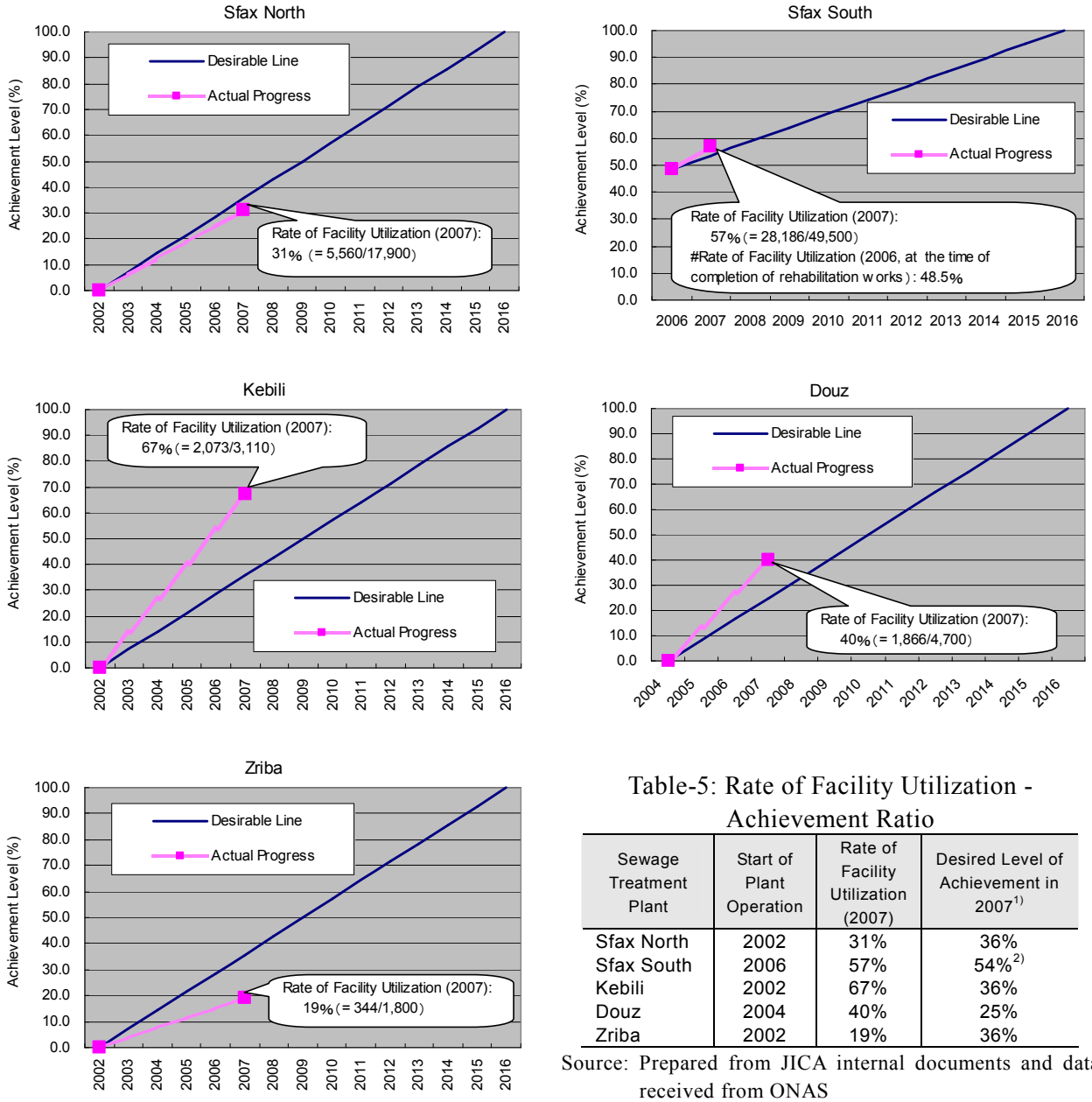


Table-5: Rate of Facility Utilization - Achievement Ratio

Sewage Treatment Plant	Start of Plant Operation	Rate of Facility Utilization (2007)	Desired Level of Achievement in 2007[1)]
Sfax North	2002	31%	36%
Sfax South	2006	57%	54%[2)]
Kebili	2002	67%	36%
Douz	2004	40%	25%
Zriba	2002	19%	36%

Source: Prepared from JICA internal documents and data received from ONAS

Figure-2: Comparison of Desirable and Actual Rates of Facility Utilization

Source: Prepared from JICA internal documents and data received from ONAS

Note 1): The calculated (desired) level of facility utilization rate in 2007, supposing that the rate of facility utilization will reach 100% in 2016 and it will continue to increase at the same pace every year, from the commencement of plant operation until 2016.

Note 2): Assumed that the rate of facility utilization in 2006 achieved 48.5% (＝24,000/49,500) since Sfax Sewage Treatment Plant (South) had the capacity of 24,000 ㎥/day before the rehabilitation works.

Note 3): Rate of facility utilization＝ The amount of wastewater treated (daily average) / Treatment capacity of the plant

Since the amount of sewage produced is proportional to the amount of water used, it is necessary to consider amount of water used per person, which greatly impacts on the rate

of wastewater treated and the rate of facility utilization.

Table 6 below shows the forecast demand and actual demand per person for water at the time of the appraisal. The forecast at the time of the appraisal predicted a demand as 92 to 128 liters/day/person in 2011 in the project's four target cities. However, the actual demand in 2007 was only about half of the prediction.[16] It has been pointed out that the reasons for the low growth in water usage per person include the quality of the water (high salt content) and the water-saving campaign, etc. promoted by the Tunisian government as a part of national policy.[17]

Table-6: Forecast and Actual Demand per Person for Water

Unit: liter/day/person

Cities/Area	2001	2007	2011
Forecast demand at the time of project appraisal (forecasted in 1996)			
Grand Sfax	117[1)]	123	128
Kebili	90	-	100
Douz	100	106	110
Zriba	76	-	92
Actual demand			
Average Demand of 4 Cities in Total	-	Approx. 50-60	N.A.
National Average	-	Approx. 90	N.A.

Source: JICA internal documents (for forecast demand) and ONAS (for actual demand)

Note 1): Data in 2002

Note 2): "—" means data is not available.

Note 3): Actual demand per person for water in Tokyo Metropolitan Area (in 2007) is 239 liter/day. (Source: Bureau of Waterworks, Tokyo Metropolitan Government)

Regarding the low rate of facility utilization in Hammam Zriba, it has been pointed out that, in addition to the above reasons, wastewater from hot springs was expected to compose part of the rate of wastewater treated, but because part of the hot spring area was excluded from the project, wastewater from that excluded area does not flow into the current sewage network.[18]

(3) Achievement of Emission Standards for Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS, MES)

As shown on Table 7, the standards for both BOD and TSS (MES) are being met at Sfax North, Kebili, and Douz, but Sfax South and Hammam Zriba are not meeting the emission standard (of 30 mg/liter).

The surrounding area of the Sfax Sewage Treatment Plant (South) is an industrial zone. Companies with factories in Tunisia are required to either (1) set up their own wastewater treatment plant, treat the discharge in order to meet the effluent standards, and directly

[16] This is lower than the 90 liters/day which was the national average in that year.
[17] Source: Results of interview with ONAS.
[18] Source: Same as above.

release it into rivers, etc., or (2) treat the wastewater at a required level at the plant and release it into the sewage pipes. However, there are said to be many factories in this area without their own wastewater treatment plants, and they release large amount of industrial wastewater that greatly exceed the standards into sewage pipes.[19] Thus, the quality of the sewage water flowing into the treatment plant is originally poor, and many experts point this out as the main cause of the poor quality of the discharge from the treatment plant.[20]

Table-7: BOD and TSS for Each Sewage Treatment Plant (Average Data in 2007)

Unit: mg/liter

Sewage Treatment Plant	Influent Quality	Effluent Quality	Rate of Removal	Below/Over the National Standard
BOD (Biochemical Oxygen Demand)				
Sfax North	544	29	95%	Below Standard
Sfax South	574	40	93%	Over Standard
Kebili	309	21	93%	Below Standard
Douz	168	17	90%	Below Standard
Hammam Zriba	424	33	92%	Over Standard
National Standard / National Average		30 / 41		
TSS (Total Suspended Solids)				
Sfax North	622	27	96%	Below Standard
Sfax South	609	45	93%	Over Standard
Kebili	498	17	97%	Below Standard
Douz	338	23	93%	Below Standard
Hammam Zriba	348	44	87%	Over Standard
National Standard / National Average		30 / 45[1)]		

Source: Prepared from JICA internal documents and answers to the questionnaire to ONAS

Note 1): National average data in 2006 (Source: JICA (2009) *Ex-Post Evaluation of Treated Sewage Irrigation Project*, pp10.)

Note 2): National standard in Japan - BOD: 20 mg/liter, TSS: 25 to 50 mg/liter (depends on rivers and lakes)

As the reason why the quality of the discharge at the Hammam Zriba Sewage Treatment Plant does not meet the standards, ONAS states that "the rate of wastewater treated is extremely small compared to the treatment capacity, and the quality of the incoming water is low."

Furthermore, Tunisia's national averages (2007) for both BOD and TSS (MES) were originally 41 mg/liter and 45 mg/liter, respectively, which fall short of the emission standard of 30 mg/liter. Therefore, the water discharged from all the sewage treatment plants in this project is either equal to or below the national average.[21]

2.3.2. Qualitative effects

Recycling of Sludge Produced

The sludge produced at the sewage treatment plants is not being recycled in the four treatment plants of Sfax North, Sfax South, Kebili, and Douz (see the section on "Impact"

[19] Source: Results of interview with ONAS (and it is also consistent with the trend shown in Table 6).

[20] Source: Interviews with multiple engineers at ONAS and with JICA senior volunteers (sewage specialists) in Tunis.

[21] The emission standards in Tunisia are strict and are the same as in Japan (see Note 2 of Table 7).

below for details; also, the plant in Hammam Zriba uses the natural lagoon treatment method which does not produce sludge). Research on effective usages of sludge is currently being conducted through the cooperation of three bodies, the Ministry of Agriculture, Ministry of Health, and ONAS. As a part of the research, verification tests are planned in Kebili and Douz.[22]

Recycling of sludge has hardly moved beyond the planning stage yet, but at the same time, according to the results of the beneficiary survey,[23] a very large number of farmers showed expectations for usage of sludge (52 out of 83 farmers hope to recycle sludge), and so the results of the verification tests, etc., by the three bodies are eagerly awaited.

Moreover, as already stated under "Relevance," national studies related to recycling of sludge are currently going on under the 11th 5-Year Plan, and there are plans to prepare a specific action plan during this five-year period. In the medium to long term, promotion of sludge recycling can be anticipated, and it may be surmised that the following trends related to this project will accelerate in the future.

2.3.3. Financial Internal rate of return (FIRR)[24]

The financial internal rate of return (FIRR) was recalculated using the terms and conditions on the table below as the base scenario. A sensitivity analysis was also conducted on the recalculated FIRR value, taking the sewage charge as a parameter and assuming two cases, one slightly more pessimistic than the base scenario (scenario-1) and another slightly more optimistic (scenario-2). The table below shows the results of the recalculation.

The recalculated FIRR value was negative (minus 9% in the case of the base scenario). There are two conceivable reasons: (i) the population growth rate in the target cities was significantly lower than assumed at the time of the appraisal, and so the revenue from sewage charge was lower than initially assumed, and in addition, and (ii) sewage charge system remained extremely lower than initially expected (because it is politically difficult to raise the charges). (Given that these two reasons are considered to be external factors that the implementing agency cannot control, the recalculated FIRR was not included in the evaluation of "Effectiveness".)

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[22] Source: Results of interview with ONAS.

[23] Outline of beneficiary survey: The survey consisted of face-to-face interviews with 263 persons and companies, including ordinary residents (110 persons in all the four target cities), local companies (22 companies in Sfax South only), agricultural workers (89 workers in all the four target cities), and tourism workers (42 workers in Douz and Hammam Zriba only) in the cities and regions of Sfax, Kebili, Douz, and Hammam Zriba

[24] Furthermore, the economic internal rate of return (EIRR) was not calculated due to limited resources for this study because it would have been necessary (1) to grasp, through individual interviews, input data from the beneficiary side, such as the target area residents' WTP (Willingness to Pay) for water quality improvement and (2) to convert into monetary terms the environmental value of the effect of improving the water quality in public waters (i.e., agricultural water sources, etc.).

Table-8: Recalculation of FIRR

Timing	Preconditions and Assumptions for Recalculation (Project Life: 15 years after the completion of the Project for each case)[25]	FIRR
At the time of Appraisal (in 1996)	Costs: Civil works cost, consulting service cost, land acquisition cost, physical/price contingency, operation & maintenance cost (which assumed as 1% of the total project cost) Benefits: Revenue from sewage charges (assuming 15% increase every year up to 2000 and 10% increase every year after 2001, average charge in 1997 is 1.5 Tunisia Dinar per 1 ㎥ per household.)	7%
At the time of ex-post evaluation (in 2009)	**Base Scenario** Costs: Civil works cost, consulting service cost, operation & maintenance cost (which applies actual cost until 2007, then decreases by half every 5 years after 2008, due to the introduction of PPP) Benefits: Revenue from sewage charges (assuming 6% increase in 2009 and 5% increase every two years after 2010, average charge in 2008 is 0.427 Tunisia Dinar per 1 ㎥.)	Minus 9%
	Scenario-1 (pessimistic than base scenario) Costs: The same with base scenario Benefits: Revenue from sewage charges (assuming 6% increase in 2009 and remaining the same level after 2010)	Minus 10%
	Scenario-2 (optimistic than base scenario) Costs: The same with base scenario Benefits: Revenue from sewage charges (assuming 6% increase in 2009 and 15% increase every two years after 2010	Minus 5%

The results of the sensitivity analysis were minus 10% for scenario-1 and minus 5% for scenario-2. Scenario-2 is the case which takes an extremely optimistic view of the size of hikes in sewage charges, but even so FIRR value remained negative. In order to improve the profitability of the project, it is necessary to institute a substantial fee hike, increase the percentage of population connected, and gradually decrease the operation and maintenance costs.

2.4. Impact

It is very much difficult to observe the medium- to long-term impacts (ex. accelerated regional development due to the improvement in the peripheral areas of target cities) because only two years and four months have passed since the project completion and we are still in the build-up period of such impacts. Given these considerations, results of beneficiary surveys (social impact assessment) were mainly referred to when evaluating the “Impact”.

2.4.1. Improvement of sanitation in residents’ housing and living environment (in the four cities overall)

As shown on the table below, the number of beneficiaries who perceived some sort of problem in the housing or living environment dropped approximately by half after

[25] Incidentally, if the project life is set at 20 years, then FIRR value is minus 3% in the base scenario, minus 5% in scenario-1, and 1% in scenario-2.

installation of a sewage connection in comparison to before the installation.

Problems such as foul odors and outbreaks of insects have not been completely resolved (the main cause of the foul odor, however, is thought to be the low level of the percentage of population connected, as mentioned above), but it may be concluded that implementation of this project produced a certain amount of environmental improvement effect.

Table-9: Improvement on Living Conditions before and after the Connection to Sewer

(N=218)

Type of Beneficiaries	No. of Respondents in Total	Before connection to sewer: Beneficiaries who felt problems[1)]		After connection to sewer: Beneficiaries who still feel problems[2)]	
		No. of Respondents	% of Total	No. of Respondents	% of Total
Local Residents	110	84	76%	47	43%
Farmers[3)]	44	38	86%	25	57%
Private Companies	22	14	64%	2	9%
Tourism Workers	42	36	86%	14	33%
Total	218	172	79%	88	40%

Source: Results of beneficiary survey

Note 1): The number of beneficiaries who answered "there were some problems before connecting to the sewer"

Note 2): Among the above respondents (who perceived some sort of problem before connection), the number of beneficiaries who answered "there are still some problems even after connecting to the sewer"

Note 3): 45 farmers, out of 89 farmers who participated in the beneficiary survey, are excluded from this question because they have not yet connected to the sewer.

Table-10: Breakdown of the Problems Answered by Beneficiaries (Multiple Answers)

Type of Beneficiaries	Before connection to sewer: Beneficiaries who felt problems			After connection to sewer: Beneficiaries who still feel problems		
	Malodour	Insects	Others[1)]	Malodour	Insects	Others[2)]
Local Residents	57	30	56	36	13	20
Farmers	23	18	47	18	6	16
Private Companies	7	2	5	1	1	0
Tourism Workers	30	27	18	10	7	13
Total	117	77	126	65	27	49

Source: Results of beneficiary survey

Note 1): Contamination of surface water, soil pollution, salt pollution on surface water, etc.

Note 2): High sewage connection charge, low connection rate to sewer, etc.

2.4.2. Environmental conservation of peripheral area through sewage treatment

(1) Environment conservation of farmland in Sfax North, Kebili, Douz, and Hammam Zriba

According to the Table-11, approximately 60% of all farmers (48 out of 83) perceived some sort of problem in the farmland environment (contamination of surface water, insects, foul odor, etc.) prior to the implementation of the project. However, approximately 90% of the 48 farmers who had perceived the problem responded that "the farmland environment has been improved" following implementation of the project (see the Table-12). That is to say, it may be concluded that the farmland environment

surrounding the project site was significantly improved by the implementation of the project.

Table-11: Conditions of Farmland before the Project (N=83)

Answers from Farmers	No. of Respondents	% of Total
There were some problems around the farmland. [1)]	48	58
There were no problems around the farmland	23	28
Don't know / No answers	12	14
Total	83	100

Source: Results of beneficiary survey

Note 1): Breakdown of the problems: i) Contamination of surface water, ii) Outbreak of insects, iii) Malodour, iv) Soil pollution, v) Pollution on agricultural crops, etc.

Note 2): 83 respondents in total (6 out of 89 did not answer to the question.)

Table-12: Conditions of Farmland after the Project (N=48)

Answers from Farmers	No. of Respondents	% of Total
Environmental problems have largely been solved.	19	40
Environmental problems have been solved to some extent.	23	48
No changes between before and after the project.	1	2
Don't know / No answers	5	10
Total	48	100

Source: Results of beneficiary survey

Note): Giving this question to 48 respondents who answered "there were some problems around the farmland before the project" (see Table-11).

(2) Environment improvement of surrounding rivers

Discharge of untreated sewage into River El Melah and Chott El Jerid (the largest saltwater lake in northern Africa which is also the final discharge site of sewage) in Kebili and Douz was reduced to some extent by implementation of this project, and as a result, environmental improvement has been recognized in the river and lake.[26] Likewise in Hammam Zriba, it was stated in an interview with ONAS that "because discharge of untreated sewage into River El Hammam was reduced to some extent, environmental improvement can be recognized in the river."[27]

Prior to the project, all types of sewage from Kebili, Douz, and Hammam Zriba were discharged untreated into surrounding rivers and the saltwater lake. Given the significant improvement in the quality of the untreated sewage due to the construction of sewage treatment plants, it may be concluded that environmental improvement effects are being expressed (one example of which is the improvement in the water quality of the inflow and discharge of BOD and MES, as stated in the section on "Effectiveness").

[26] Answers to the questionnaire to ONAS and results of interviews at ONAS's Kebili regional office.
[27] Answers to the questionnaire to ONAS and results of interviews at ONAS's Zaghouan regional office.

2.4.3. Expansion of irrigation by recycling treated sewage water

The irrigation area has been expanded in some areas (Sfax South) by recycling treated sewage water. As shown on the table below, similar plans are progressing in other cities (as of April 2009, Sfax North had plans for irrigation).

Given the historical circumstances[28] of Tunisia with relation to usage of treated sewage water, application of the water for irrigation in the four cities is expected to increase in the future. In the long term, there is a high potential for expression of the impact of the project in improvement in agricultural productivity.

Table-13: Irrigation by Reuse of Treated Wastewater

Cities/Area	Irrigated Area[1)] (As of April 2009)	Target Area	Rate of Reuse of Treated Wastewater[2)3)] (2008)
Sfax North	0 ha	400 ha	N.A.
Sfax South	537 ha	1,000 ha	23%
Kebili	0 ha	Under review	Approx. 20%
Douz	0 ha	Under review	N.A.
Total	537 ha	1,400 ha	-

Source: Results of interview with ONAS

Note 1): Total irrigated area by treated wastewater (in Tunisia) is approx. 8,000 ha. (Source: Results of interview with Ministry of Agriculture)

Note 2): Rate of reuse of treated wastewater varies from year to year because it highly depends on rainfall fluctuation. (Incentives for the utilization of treated wastewater will decline if there is a large amount of rainfall.)

Note 3): The target rate of reuse of treated wastewater set by Tunisian government is 35%. (Source: ONAS)

Note 4): The crops cultivated at irrigated area in Sfax South are mainly fodder ones. (Source: Results of interview with Ministry of Agriculture)

2.4.4. Impact on natural and social environment

(1) Environmental impact

Aside from the foul odor and outbreak of insects pointed out by residents, no particularly serious problems have occurred with regard to negative impact on the environment.[29]

The foul odor, as mentioned above, improved considerably following the implementation of the project, but some residents still state that they are dissatisfied. However, it seems unlikely that the main source of the foul odor is the sewage treatment

[28] In Tunisia where rainfall is sparse, difficulty in securing irrigation water for farming during the dry season is the largest bottleneck in improvement of agricultural productivity. Given this circumstance, attention turned long ago to usage of treated sewage water, and the government began agricultural irrigation using treated sewage water in 1965. As a result of long years of research on the safety and usage methods of treated sewage water, the government issued a presidential order concerning recycling of treated water in 2006 and formally took the stance that there was no problem with the safety of treated water. Taking this as an opportunity, the Ministry of Agriculture and ONAS accelerated their collaboration on usage of treated sewage water (source: interview at the Ministry of Agriculture). Crops for which usage of treated sewage water is permitted are (1) crops for animal feed, (2) flowers, and (3) tobacco, etc. In addition to crop, treated sewage water is used on tree farms and golf courses, etc. (source: same as above).

[29] Adjacent to the Sfax Sewage Treatment Plant (South) is an extensive phosphorous storage site and a waste disposal site. At the current time, no negative environment impact from the storage site or the disposal site on the treatment plant has been confirmed.

plants because (although it is not the case that the treatment plants produce absolutely no odor) the five sewage treatment plants, which were constructed or repaired by this project, are located at a distance of several kilometers from the city centers and the nearest houses are at least 500 meters away. Meanwhile, as stated under "Effectiveness," the percentage of population connected remains low in each city. Because of the effect, there is a high possibility that the main source of the foul odor is the sewage tanks (called *Puis Perdu*) still used by households not connected to a sewage system. It is desirable for ONAS to make further efforts to increase the percentage of the population connected.

(2) Recycling of sludge

The current state of sludge treatment is shown on the table below. None of the treatment plants carries out recycling, which is still in the planning stage (as stated under "Effectiveness").

Table-14: Recycling of Sludge at Sewage Treatment Plant

Sewage Treatment Plant	Sludge Produced (Dry weight base)	Current State of Sludge Treatment
Sfax North	500 ton/year	Dried, then stored at the plant site
Sfax South	2,000 ton/year	Dried and mechanically dewatered, then stored at the plant site
Kebili	0.96 ton/year	Stored at the plant site
Douz	0.08 ton/year	Stored at the plant site
Zriba	N.A.	No sludge produced. (lagoon treatment process)

Source: Answers to the questionnaire to ONAS and results of interview with ONAS

Currently, a basic study is being conducted on reuse of sludge nationwide in Tunisia by funds from Germany's KfW Bankengruppe. The safety and specific usage method for recycling (at the current time, distribution to farmers and recycling as concrete aggregates is under study) is being analyzed and studied, and the final report is to be submitted in 2011.[30] Moreover, separate from the above-mentioned study, ONAS is currently launching a nationwide pilot project involving recycling of sludge (however, this project's four target cities are not included).

ONAS plans to make the final decision on sludge recycling methods once it receives the results of the KfW study and the pilot project. A law related to sludge recycling was enacted in Tunisia in 2002, completing the preparation of the legal system for recycling.(The above-mentioned pilot project began following the passage of this law.)

(3) Implementation status of Environmental Impact Assessments (EIA) and environmental monitoring

The table below shows the implementation of environment impact assessments (EIA)

[30] Source: Results of interview with ONAS.

by ONAS and approval by Agence Nationale de Protection de l'Environnement (ANPE). In three cities (encompassing four sewage treatment plants) excluding Hammam Zriba, EIAs were implemented prior to the start of the project, and the results were approved by ANPE. It appears that each type of environmental monitoring was implemented during the construction period of each sewage treatment plant.

Table-15: Environmental Impact Assessment (EIA) and Approval by ANPE

Project Component	Implementation of EIA	Approved by ANPE
Sfax (North & South)	Completed before the project	Approved
Kebili	Completed in May 1996	Approved
Douz	Completed in May 1996	Approved

Source: JICA internal documents and results of interview with ONAS
Note): No data about Hamman Zriba

Currently, periodic environmental monitoring is conducted at the sewage treatment plants and treated sewage discharge sites, including at Sfax South around the discharge waterway which empties into the Mediterranean Sea. (Water quality inspections are conducted 5 to 11 times per month. The items measured include BOD, etc.) Systematic environmental monitoring is being carried out periodically, and there is no problem in ONAS's environmental monitoring structure.

(4) Implementation status of resettlement and land acquisition

In this project, land was acquired when constructing new sewage treatment plants and laying sewage networks. No resettlement occurred in conjunction with the land acquisition, but more time than initially anticipated was required land acquisition at three sites, Sfax North, Douz, and Hammam Zriba. The reasons for the delay at each site were as follow.

- ✓ Sfax North: It took some time to negotiate with landowner
- ✓ Douz: The landowner had agreed to sell the land prior to project implementation, but due to incomplete documentation on the landowner's part, it became necessary to secure other land.
- ✓ Hammam Zriba: Public land had been secured prior to project implementation, but difficulties arose concerning land acquisition during consultation with the government offices in charge.

2.5. Sustainability (Rating: a)

No major problem has been observed in the capacity of the executing agency and its operation and maintenance system, therefore, sustainability of this project is high.

2.5.1. Executing Agency

2.5.1.1. Operation and maintenance system

Operation and maintenance (O&M) of the sewage treatment plants and related equipment constructed or expanded by this project is under the control of ONAS,[31] the executing agency. O&M is organized as shown on the table below. Of the four operations departments within ONAS, the South Department is in charge of O&M for Sfax, Kebili, and Douz and the North Department is in charge of O&M for Hammam Zriba.

Table-16: Operation and Maintenance System by ONAS (for this Project)

Department	Office in Charge	Facilities and Equipment in charge of O&M (related to this Project)
South Department	Sfax Regional Office (160 staff including 8 engineers)	✓ Sfax Sewage Treatment Plant (North) ✓ Sfax Sewage Treatment Plant (South) ✓ Sewage pipeline network constructed by this project (in Sfax) ✓ Other related facilities and equipment (incl. pumping stations)
	Kebili Regional Office (23 staff including 3 engineers)	✓ Kebili Sewage Treatment Plant ✓ Douz Sewage Treatment Plant ✓ Sewage pipeline network constructed by this project (in Kebili & Douz) ✓ Other related facilities and equipment (incl. pumping stations)
North Department	Zagouan Regional Office (6 staff including 2 engineers)	✓ Hammam Zriba Sewage Treatment Plant ✓ Sewage pipeline network constructed by this project (in Hammam Zriba) ✓ Other related facilities and equipment (incl. pumping stations)

Source: Results of interview with ONAS Sfax Regional Office and Kebili Regional Office

Under the South Department there are seven regional offices. The Sfax Regional Office, the largest of the regional offices, has jurisdiction over O&M of the Sfax Sewage Treatment Plant (North), the Sfax Sewage Treatment Plant (South), and the related sewage network facilities. The Kebili Regional Office, which is also under the South Department, is in charge of O&M of the Kebili Sewage Treatment Plant, the Douz Sewage Treatment Plant, the sewage network in both areas, and related facilities and equipment. Also, there are seven regional offices under the North Department, and the Zaghouan Regional Office is in charge of O&M of the Hammam Zriba Sewage Treatment Plant, its sewage network, and related facilities and equipment.

Amidst a situation that increasing the number of staff members is difficult due to the reform of public companies,[32] ONAS is promoting the introduction of public-private

[31] ONAS was established in 1974. It is a public company affiliated with the Ministry of the Environment, and its main funding sources are (as state below) income from sewage fees and government subsidies. ONAS had five operations departments at the time of the project appraisal, but subsequently the Northeast Operations Department and the Northwest Operations Department were merged to create the North Operations Department, resulting in four operations departments.

[32] The number of ONAS staff members in 2008 (3,456 persons) increased by approximately 300 persons compared to the time of the appraisal (3,003 persons), but there was no large change in the number of staff members during the three years starting from 2006. There are restrictions on the total number of employees at public companies, and so it is difficult to aggressively increase the number of staff members.

partnerships (PPPs) for O&M of sewage treatment facilities as part of its streamlining operations (see details below). Henceforth, ONAS's policy is to actively introduce PPPs for O&M of sewage treatment plants and sewage networks nationwide and to promote reduction of O&M costs.[33] As stated under "Relevance," because "promotion of PPPs" is firmly maintained as an overall goal for the sewage sector in the 11th 5-Year Plan, this series of movements involving introduction of PPPs is, in no small measure, likely to exert a positive impact to no small extent on the financial sustainability of ONAS.

Table-17: Introduction of PPP to Operation and Maintenance (for this Project)

Project Component	PPP Introduced	Private Companies Contracted (Duration of Contract)	Details of PPP Contract
Sfax North	Oct.2008	SOMEDEN Ltd.(Consortium by French and Tunisian private companies) (5 years contract)	✓ O&M activities of Sfax Sewage Treatment Plant (North), related pumping stations and sewage network in Sfax North
Sfax South	Under review	-	-
Kebili & Douz	Jun. 2007	Ameur-Plastics Ltd. (Tunisian private companies) (5 years contract)	✓ O&M activities of Kebili Sewage Treatment Plant and related pumping stations (Sewage network in Kebili is directly operated and maintained by ONAS Kebili Regional Office.) ✓ O&M activities of Douz Sewage Treatment Plant, related pumping stations and sewage network in Douz
Zriba	Under review	-	-

Source: Results of interview with ONAS Sfax Regional Office and Kebili Regional Office

2.5.1.2. Technical capacity

Technical skills of engineers and workers

ONAS had 1,807 technical experts as of the end of 2008. Of these, 272 persons had a baccalauréat＋2 or above[34] (equivalent to a college degree), and 464 persons had a baccalauréat +2 (equivalent to a college-level general education course). There is no problem with the quantity or quality of the engineers and technical staff, and their technological level is also high.

The above-mentioned two private companies which participate in O&M at Sfax North, Kebili and Douz have abundant experience in O&M of sewage treatment plants, and there is no problem in their technical level.

Training programs provided by the contractors of the Project

For the technical experts at ONAS in charge of O&M, the project contractor implemented training concerning O&M technology for sewage treatment plants. Details

[33] There is discussion of introducing the PPP method at 80% to 85% of the sewage treatment plants. (Source: Interview with the head of the Planning Department of ONAS.

[34] Tunisia has adopted the French educational system.

are shown below.

Table-18: O&M Training Provided by the Contractors

Item	Results of Training
No. of Trainees	15 staff in total (Sfax North: 4 engineers, Sfax South: 4 engineers, Kebili: 3 engineers, Douz: 3 engineers, Zriba: 1 engineer)
Implementation Period	For two months during commissioning of each sewage treatment plant
Details of Training Provided	✓ Operation skills of plant facilities ✓ Programming skills and techniques of facility control programs ✓ Manipulation skills of computerized equipment, etc.

Source: Results of interview with ONAS Sfax Regional Office and Kebili Regional Office

The various types of training conducted by the contractor have been implemented without delay as shown above. The trainees gave a high rating to the content of the training.[35] Furthermore, ONAS manages 98 sewage treatment plants in 160 cities nationwide (including the 5 in this project) and a sewage network totaling 13,800 km in length (as of the end of 2007). Many sewage treatment plants similar to those in this project are located in other cities, and so ONAS appears to have accumulated adequate technological expertise and experience related to operation of sewage treatment plants. It is likely that the number of above-mentioned trainees (a total of 15 persons) was determined taking this context into account.

2.5.1.3. Financial status

The profit base is weak due to the low level of sewage fees, but income and expenditure are in equilibrium thanks to government subsidies. Therefore, there is no problem with the financial base.[36]

Revenue and operating profit

As shown on the table on the left below, the sales cost price exceeds the sales, and so deficits are posted annually. Sales have displayed an uptrend for the past three years, but the increase in personnel expenses exceeds the increase in sales (i.e., sales growth during three-year period: 6.6%; personnel expenses growth in same period: 14.9%); thus, the size of the deficit is expanding each year. The increase in depreciation costs is also large. Because new hires of young employees are restrained due to the above-mentioned restriction on the total number of employees, the average age of the employees is rising, and this is likely to be one of the causes of the increase in personnel expenses. Moreover,

[35] Source: Interviews with staff who had received training.
[36] Data for 2008 was not released because auditing of the financial reports was not finished.

because it is politically difficult to hike sewage fees, the deficit is being offset by subsidies from the government.[37]

To sum up the above, although ONAS's profit base is somewhat weak, government subsidies make it possible to maintain equilibrium in income and expenditures.

Table-19: Profit and Loss Statement of ONAS

Unit: million TD

Item	FY2005	FY2006	FY2007
Sales	113.9	120.0	121.4
Revenue from	97.9	102.0	103.8
Sewage Charge			
Cost of Sales	144.4	153.9	160.1
Personnel Expenses	58.2	62.1	66.9
Depreciation	48.4	54.8	55.2
Gross Operating Profit	▲30.5	▲33.9	▲38.7
Profit before Tax	▲36.8	▲41.6	▲46.0

Source: ONAS Audit Reports and JICA internal documents

Table-20: Balance Sheet (B/S) of ONAS

Unit: million TD

Item	FY2005	FY2006	FY2007
Assets			
Current Assets	129	157	163
Quick Assets	81	120	132
Fixed Assets	1,116	1,148	1,204
Total Assets	**1,245**	**1,305**	**1,367**
Liabilities and Equity			
Equity Capital	814	894	927
Current Liabilities	175	113	118
Fixed Liabilities	256	298	322
Total Liabilities and Equity	**1,245**	**1,305**	**1,367**
Recurring Income to Total Assets Ratio (%)	▲3.0	▲3.2	▲3.4
Income to Sales Ratio (%)	▲32.3	▲34.7	▲37.9
Current Ratio (%)	73.7	139.9	138.9
Quick Asset Ratio (%)	46.3	106.2	111.9
Capital Ratio (%)	65.4	68.5	67.8

Source: ONAS Audit Reports and JICA internal documents

Balance Sheet (B/S)

Regarding the Balance Sheet, as shown on the table on the right above, ONAS has a capital adequacy ratio of 68%, current ratio of 139%, and quick assets ratio of 112%. There are no major problems in financial stability or its ability to make short-term payments.

Operation and maintenance expenditure of the Project facilities

The main expenses constituents of O&M costs are (1) electricity expenses, (2) fuel expenses, and (3) personnel expenses. All sewage treatment plants are endeavoring to reduce electricity expenses; however, electricity fees have been rising recently in Tunisia, and so expenditures are in an uptrend.[38]

Meanwhile, through the introduction of PPP mentioned above, a significant decrease in O&M costs is anticipated. At the current time, the effects of such introduction are still unclear because it is in the early stage of introduction, but in the medium to long term, gradual reduction of O&M costs is expected. Incidentally, the total O&M expenditure

[37] The subsidies amount to approximately 30% of annual total income and in FY2007 amounted to 39.5% (source: ONAS Annual Report 2007).

[38] Source: Interviews at the ONAS Sfax Office and the ONAS Kebili Office.

(including O&M expenditures for the sewage treatment plants, sewage network and related facilities) at Kebili and Douz decreased in FY2008 by 80,000 Tunisian dinars year-on-year (from 340,000 dinars to 260,000 dinars). This appears to be the early effects of expense reduction due to the introduction of PPPs in 2007 (see table below for details).

Table-21: Operation and Maintenance Expenditure of the Project (FY2005 to FY2008)

Unit: million TD

Fiscal Year	Sfax North	Sfax South	Kebili	Douz	Zriba
FY2005	1.1	1.0	0.07	0.16	0.06
Fy2006	1.5	1.8	0.08	0.28	0.04
FY2007	1.5	2.3	0.07	0.27	0.08
FY2008[1)]	*0.29*	*0.94*	0.15	0.11	0.05

Source: JICA internal documents and answers to the questionnaire to ONAS

Note 1): O&M expenditure of Sfax (North & South) in FY2008 only includes the expenditure relating to the sewage treatment plant. (O&M expenditure of sewage network is excluded.)

2.5.2. Operation and maintenance status

Generally speaking, there seems to be no problem with the operation and maintenance status, thereby, they can be judged as extremely good.

Basically, there is no problem in the operation or maintenance of the treatment plants. The two previously mentioned private companies are in charge of operation and maintenance, and they are encouraged to carry out efficient operation and maintenance in Sfax North, Kebili, and Douz, by a results-based incentive payment according to the volume of sewage treated. Moreover, they submit monthly reports to the ONAS authorities. (Of the above-mentioned two companies, a field manager of Amuer-Plastics, the company in charge of Kebili and Douz, stated in an interview that there were no particular difficulties in operation and maintenance.)

In Sfax South and Hamman Zriba, the ONAS staff in charge periodically inspects each sewage treatment facility and the sewage network, and remote management is also conducted using surveillance cameras. No particular problems were observed in the onsite survey conducted in April 2009.

No problems have occurred in the procurement of spare parts. Replacement of pumping station equipment is also being carried out in a timely manner.

As stated under “Effectiveness,” the rate of wastewater treated remains at low levels at the Hamman Zriba Sewage Treatment Plant and the Sfax Sewage Treatment Plant (North); however, the main causes are the low percentage of population connected and the low sewage volume per person, and there are no problems caused by operation and maintenance.

3. Conclusion, Lessons Learned and Recommendations

3.1. Conclusion

The components of the project are highly relevant to the related national policies and there seems to be no problem with the operation and maintenance systems. Although some treatment plants are facing slower growth rate of facility utilization (mainly stemming from the external factors such as the declining population growth rate), a certain number of positive impacts has been developed through the implementation of the project. In light of the above, this project is evaluated to be satisfactory.

3.2. Lesson Learned

Regarding the main cause of the large delay in the project period, which was "the large delay in the selection of the detailed design (D/D) consultant due to the increase in treatment capacity of the Sfax Sewage Treatment Plant (North)," it was decided at the time of the appraisal to procure the above detailed design consultant using World Bank funds. So, the tasks of procurement of the consultant and the supervision of the work were not included in the project in advance. Particularly in cases where critical pass activities which decisively impact the project period (such as detailed design) are funded by other donors (i.e., the World Bank in this project) and not included in the project's tasks, it is desirable to have closer communication and better all-around coordination with the said donor (to check the progress of tasks outside the project and to accelerate that progress).

Moreover, in southern Tunisia where Kebili and Douz are located, landownership is historically not clear, and it has been pointed out that, for that reason, land acquisition invariably involves time and money. In view of this situation, when organizing a project that includes project sites in southern Tunisia, it is desirable to endeavor to understand the social and cultural background of the region and to anticipate corresponding risks in advance at the stage of project planning, even if agreement has been reached on land acquisition prior to project implementation. (Furthermore, it appears that the Tunisian government is currently following a strict rule that "projects cannot be started unless land acquisition is complete" when implementing public projects such as sewage installation. Thus, the likelihood of the above situation occurring again is small.)

3.3. Recommendations

(For executing agency)

Because the harmful effect (e.g., lack of increase in the rate of wastewater treated and foul odor due to lack of sewage connections, etc.), resulting from the low rate of

population connection to sewage system, has been pointed out, it is hoped that ONAS, the executing agency, will redouble its efforts to boost the percentage connected. For example, it would be desirable to have detailed studies as soon as possible on the further expansion of connection fee discount schemes (currently there is a scheme for charging low-income earners half of the usual connection fee of 260 Tunisian dinars) and on measures for further developing the sewage network.

Comparison of Original and Actual Scope

Item	Plan	Actual
A) Output		
1. Sfax		
1.1 Construction of new plant (North)	Design capacity: 10,000m^3/day	17,900m^3/day
1.2 Expansion of existing plant (South) Design capacity :24,000m^3/day (before rehabilitation)	Design capacity: Doubling the existing plant	Mostly as planned (49,500m^3/day)
1.3 Construction of sewage pipelines	156.5km in total	289km in total
1.4 Construction of new pumping stations	11 stations	9 stations
2. Kebili		
2.1 Construction of new plant	Design capacity: 3,130m^3/day	3,110m^3/day
2.2 Construction of sewage pipelines	29.6km in total	36km in total
2.3 Construction of new pumping stations	2 stations	3 stations
3. Douz		
3.1 Construction of new plant	Design capacity: 4,700m^3/day	As planned
3.2 Construction of sewage pipelines	36.7km in total	62km in total (10km for connecting Golaa network and Douz new plant as an additional output)
3.3 Construction of new pumping stations	2 stations	As planned
4. Zriba		
4.1 Construction of new plant	Design capacity: 2,000m^3/day	1,800m^3/day
4.2 Construction of sewage pipelines	6.6km in total	Mostly as planned (7.0km)
4.3 Rehabilitation of sewage pipelines	6.5km in total	Mostly as planned (7.0km)
4.4 Construction of pumping stations	4 stations	As planned
5. Operation and maintenance equipment	51 items in total High-pressure washer trucks (15 vehicles), Vehicles with investigative cameras (1 vehicle), Business vehicle (24 vehicles), Other equipment (11 items)	68 items in total High-pressure washer trucks (17 vehicles), Vehicles with investigative cameras (3 vehicles), Business vehicle (44 vehicles), Vaccuum machine (4)
6. Consulting services (C/S)	30 M/M	34.57 M/M
B) Project Period	January 1996 – December 2000 (60 months)	January 1996 – October 2006 (130 months)
C) Project Cost		
Foreign currency	2,126 million yen	348 million yen
Local currency	6,393 million yen (58,114 thousand TD)	8,088millon yen (92,570 thousand TD)
Total	8,518 million yen	8,436 million yen
Japanese ODA loan portion	6,389 million yen	6,386 million yen
Exchange rate	1 Tunisia Dinar＝110 yen (as of April 1996)	1 Tunisia Dinar＝87.32 yen (Average for 1998 - 2006)

Appendix – Operation and Effect Indicators

Operation and Effect Indicators (1/2): Sfax North, Sfax South and Grand Sfax

Indicators (Unit)	Sfax North			Sfax South			Grand Sfax		
	Baseline (1996)	Actual (2007)	Target (2011)	Baseline(1996)	Actual (2007)	Target (2011)	Baseline (1996)	Actual (2007)	Target (2011)
Operation Indicators									
Total Population (people)	Unknown	90,300[2)]	96,200[2)]	Unknown	407,950[2)]	434,530[2)]	430,000[8)]	498,250[2)]	53,0730[2)]
Population Treated (people)	Unknown	38,829[2)]	62,530[2)]	Unknown	299,843[2)]	395,420[2)]	193,500[3)]	338,672[2)]	457,950[2)]
Wastewater Treated (㎥/day)	-	5,560[2)]	17,900[4)]	15,111[9)]	28,186[2)]	49,500[4)]	15,111[9)]	33,746[2)]	67,400[4)]
Rate of Facility Utilization (%)	-	31[5)]	100[5)]	63[5)10)]	57[5)10)]	100[5)]	63[5)10)]	50[5)11)]	100[5)]
BOD (Mg/L)	400[12)]	544, 29[6)]	No Target	Unknown	574, 40[6)]	No Target	-	-	-
TSS (MES) (Mg/L)	400[12)]	622, 27[6)]	No Target	Unknown	609, 45[6)]	No Target	-	-	-
Rate of Sludge Recycled (%)	-	0[8)]	50	Unknown	0[8)]	50	Unknown	0[8)]	Unknown
Effect Indicators									
% of Population Served (%)	30[8)]	43.0[2)]	65.0[2)]	Unknown	73.5[2)]	91.0[2)]	45[7)]	68.0[2)]	86.3[2)]
Improvement of Water Quality at treated water discharge			No Target	Unknown		No Target	-	-	-
BOD (Mg/L)	-	29[4)]			40[4)]				
COD (Mg/L)	-	Unknown			Unknown				

Note 1): "－" means "not applicable", because BOD/TSS data of Grand Sfax does not exist and there was no sewage treatment plant in Sfax North in 1996.
Note 2): Source: JICA internal documents
Note 3): Percentage of population served in 1990, 45%, (source: JICA internal documents) multiplied by the total population in 1996, 430,000 people
Note 4): Source: JICA internal documents
Note 5): The amount of wastewater treated (daily average) divided by the treatment capacity of the sewage treatment plant (Rate of facility utilization＝ The amount of wastewater treated (daily average) / Treatment capacity of the plant)
Note 6): Influent quality (left) and effluent quality (right) (Source: JICA internal documents)
Note 7): Baseline data in 1990 (Source: JICA internal documents)
Note 8): Source: Answers to the questionnaire to ONAS
Note 9): Actual data in 1997 (Source: JICA internal documents, forecasted by ONAS)
Note 10): Facility utilization rate in 1996 is calculated for the treatment capacity of 24,000m^3/day, while that in 2007 is for the treatment capacity of 49,500m^3/day.
Note 11): Facility utilization rate in 2007 is calculated for 67,400m^3/day (＝17,900＋49,500).
Note 12): Influent quality in 1997 (forecasted data, Source: JICA internal documents). No data for Sfax South
Note 13): "No Target" means "There was/is no clear target at the time of project appraisal and as of now". (answered by ONAS)

Operation and Effect Indicators (2/2): Kebili, Douz and Hammam Zriba

Indicators (Unit)	Kebili			Douz[12)]			Hammam Zriba		
	Baseline (1996)	Actual (2007)	Target (2011)	Baseline(1 996)	Actual (2007)	Target (2011)	Baseline (1996)	Actual (2007)	Target (2011)
Operation Indicators									
Total Population (people)	17,166[2)]	19,410[3)]	20,490[3)]	25,204[2)]	35,520[3)]	37,510[3)]	7,627[2)]	9,396[3)]	9,950[3)]
Population Treated (people)	7,725[4)]	17,663[3)]	18,850[3)]	0[4)]	23,254[3)]	31,800[3)]	6,102[4)]	8,964[3)]	9,530[3)]
Wastewater Treated (㎥/day)	-	2,073[3)]	Unknown	-	1,866[5)]	Unknown	-	344[3)]	Unknown
Rate of Facility Utilization (%)	-	67[6)]	Unknown	-	40[6)]	Unknown	-	19[6)]	Unknown
BOD (Mg/L)	512[9)]	309, 21[7)]	No Target	509[9)]	168, 17[7)]	No Target	Unknown	424, 33[7)]	No Target
TSS (MES) (Mg/L)	486[9)]	498, 17[8)]	No Target	Unknown	338, 23[8)]	No Target	Unknown	348, 44[8)]	No Target
Rate of Sludge Recycled (%)	-	0[8)]	Unknown	-	0[8)]	Unknown	-	0[8)]	Unknown
Effect Indicators									
% of Population Served (%)	45[10)]	91.0[3)]	92.0[3)]	Approx.0%[10)]	65.5[3)]	84.8[3)]	80[10)]	95.4[3)]	95.8[3)]
Improvement of Water Quality at treated water discharge			No Target			No Target			No Target
BOD (Mg/L)	-	21[5)]		-	17[5)]		-	33[5)]	
COD (Mg/L)	-	Unknown		-	Unknown		-	Unknown	

Note 1): "－" means "not applicable", because there were no sewage treatment plants in 1996.
Note 2): Source: Answers to the questionnaire to ONAS
Note 3): Source: JICA internal documents
Note 4): Percentage of population served in 1994 (Source: JICA internal documents) multiplied by the total population in 1996
Note 5): Source: JICA internal documents
Note 6): The amount of wastewater treated (daily average) divided by the treatment capacity of the sewage treatment plant (Rate of facility utilization＝ The amount of wastewater treated (daily average) / Treatment capacity of the plant)

Note 7): Influent quality (left) and effluent quality (right) (Source: JICA internal documents)
Note 8): Source: Answers to the questionnaire to ONAS
Note 9): Influent quality in 1996 (forecasted data, Source: JICA internal documents)
Note 10): Baseline data in 1994 (Source: JICA internal documents)
Note 11): "No Target" means "There was/is no clear target at the time of project appraisal and as of now". (answered by ONAS)
Note 12): Baseline and actual data regarding total population, population treated and percentage of population served shown in this column consider the connection between Douz Sewage Treatment Plant and sewage network in Golaa.