JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

GENERAL DEPARTMENT OF
AGRICULTURAL ENGINEERING AND WATER MANAGEMENT
MINISTRY OF AGRICULTURE AND HYDRAULIC RESOURCES

No.

THE STUDY ON THE RURAL WATER SUPPLY PROJECT (PHASE II) IN THE REPUBLIC OF TUNISIA

FINAL REPORT

VOLUME I (MAIN REPORT)

MARCH 2006

TAIYO CONSULTANTS CO., LTD.
NIPPON KOEI CO., LTD.

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EXCHANGE RATE

Basis of Cost Estimate

Sub-projects for 2005 : As of October 2004 Price Level

Currency Exchange Rate : US$1.0 = 1.277DT = JP¥107.80

Sub-projects for 2006 : As of October 2005 Price Level

Currency Exchange Rate : US$1.0 = 1.314DT = JP¥113.90

LIST OF VOLUMES

PREFACE

In response to a request from the Government of Japan, the Government of Japan decided to conduct a study on Rural Water Supply Project (Phase II) and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr.TSUCHIYA Toshihiro of TAIYO CONSULTANTS Co., LTD. and consists of TAIYO CONSULTANTS Co., LTD. and NIPPON KOEI Co., LTD. between December, 2003 and December, 2005.

The team held discussions with the officials concerned of the Government of Tunisia and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Tunisia for their close cooperation extended to the study.

March 2006

Ariyuki MATSUMOTO,
Vice President
Japan International Cooperation Agency

March 2006

Mr.Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to submit to you herewith the Report on the Study on the Rural Water Supply Project (Phase II) in the Republic of Tunisia.

The Study was conducted from October 2003 to March 2006, for the rural water supply projects scheduled to be executed in the year 2005 and 2006 using Yen Loan committed by Japan Bank for International Cooperation (JBIC).

The Study aimed at implementing the Basic Survey, Detailed Design and preparing the draft Tender Document for the above projects. In the course of the Study, to attain full understanding of the counterpart agency on the issues to be improved was also included. The Study was conducted by the joint venture of two companies, Taiyo Consultants Co.,Ltd.and Nippon Koei Co., Ltd. represented by the former.

In the survey and the design, full consideration was paid to the particular nature of the rural water supply in Tunisia, where the Water Supply Systems are owned, operated and managed by beneficiary population. The systems were planned to be as easy as possible for their operation and management.

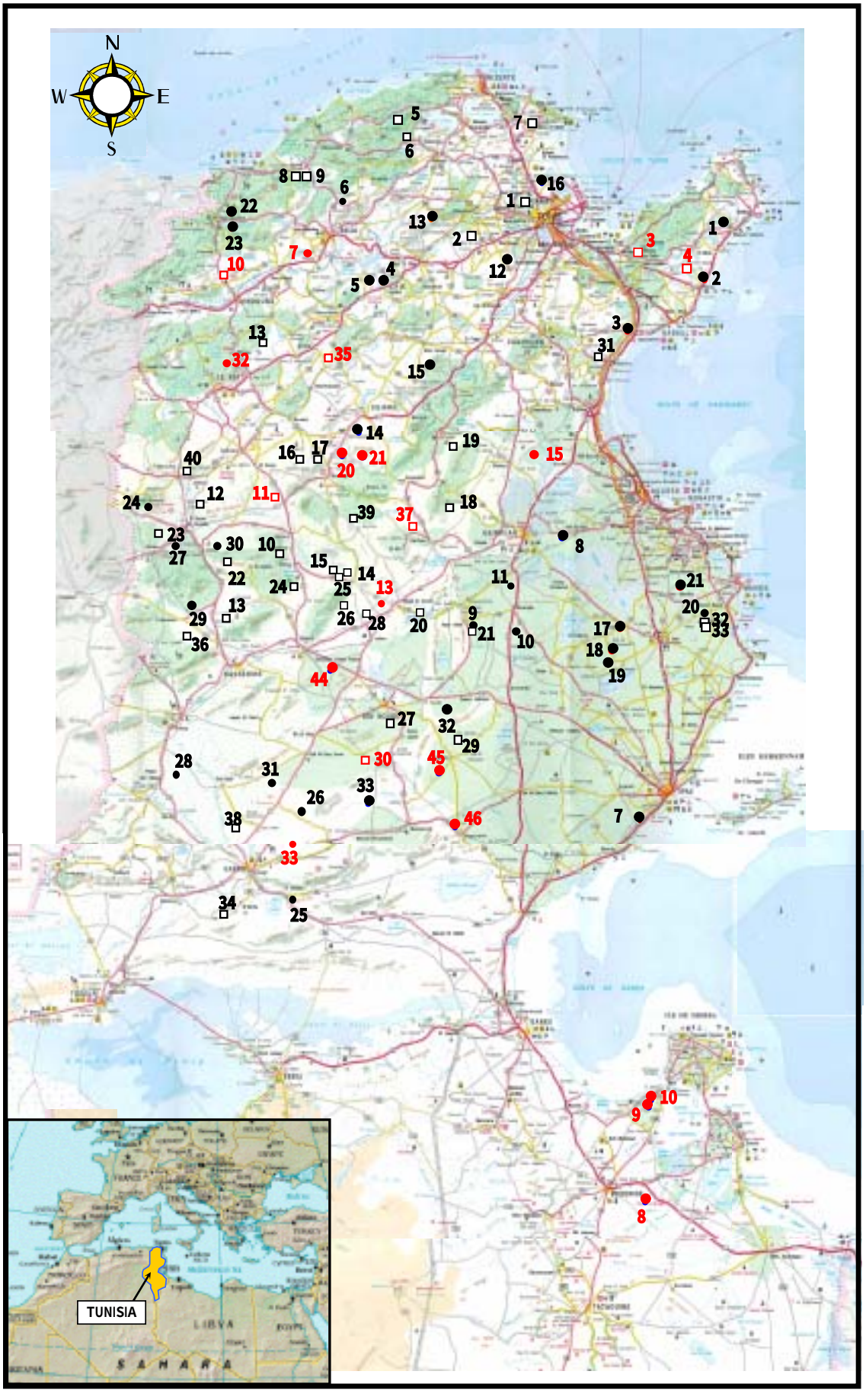
Therefore, it is sincerely hoped that this report will be useful for the improvement of rural water supply in Tunisia.

We wish to express our deep appreciation to the Staff members of the Global Environment Department and the Office in Tunisia of your Agency for their cooperation and assistance extended to the members of the Study Team during their stay in Tunisia. We also express our sincere gratitude to the Embassy of Japan in Tunisia, the Ministry of Agriculture and Water Resources of the Government of Tunisia and other authorities for their close cooperation and assistance extended to our team during the studies in Tunisia.

Very truly yours,

TSUCHIYA Toshihiro
Leader
The Study on the Rural Water Supply Project
(Phase II) in the Republic of Tunisia

Location map of sub-projects for 2005 and 2006



Project 2005

1 BASSATINE
2 BEN THAMEUR ET BKIR
3 BIR BEN ZAHRA
4 MZOUGHA-ZELDOU (1st)
5 MZOUGHA-ZELDOU (2nd)
6 KEF DAROUGUI-SFAYA
7 GASR HDID A BEJA SUD
8 CITE KRICHID
9 CITE KRID
10 CITE MARS
7 GUERGOUR-BRAHMIA FKAYHIA
8 OULED FALEH
13 GRAIRIA
9 DOUAR EL BELDI
15 ROUAOUNA
10 OULED ABBES
11 OULED BOUDABOUS
12 EL MAAFRINE
13 TIRASSET
20 BIR EZZOUZ
21 SFINA
14 FEJ-ASSEKRA
15 KSAR-OULED BOUHANI
16 CEBALET BEN AMMAR
17 SLAYMIA
18 SKHAIBIA
19 KHIOUR
20 RMADHNIA
21 SOUALHIA
22 EL ISLAH
23 EZZAGUAYA
32 OULED GANA
33 HENCHIR BONCHMEL
24 HCHACHNA
25 OUED ZITON
26 AIN DEFLA
27 FAKET EL KHADEM
28 OULED BARKA
29 SIDI SHIL
30 M'BARKIA
31 OULED NAOUI
32 OULED YUOSSEF GALLEL
33 RQUIAT
44 OUAMRIA -ABABSIA
45 GOULEB
46 GHRIST EST

Project 2006

1. EL ACHICH
2. SIDI ACHOUR
3. BOULAHOUADH
4. TASSELMINE ET SOUASSI
5. ETRAMIS-EDMAIN
6. EL KALBOUSSI
7. SIDI HASSEN
8. AIN DAM-NEFZA
9. GMARA
10. EL FRACHICHE
11. EL ARGOUB-ERRHAMNA
12. FORNA
13. EL OUENA
14. GHANGUET ZGALASS
15. SIDI DAHER
16. AGBA
17. NSIRAT
18. GHANZOUR
19. GOUAAD
20. KHOUALDIA
21. HSAINIA
22. BNANA / OULED BENAJEH
23. MKIMEN
24. CHAAIBIA
25. OUED LAHTAB
26. AIN JAFFEL
27. GARD HADID
28. OULED MOUSSA
29. SLATNIA
30. SOUASSIA
31. CHRAIFIA
32. AMMAR
33. ESSAAFI
34. ENJAIMIA
35. NFOUTA
36. OULED MASSOUD RIZG
37. FRATHIA
38. SMAIDIA
39. MAAMRIA
40. ESBIAAT, EL ARGOUB ET SOUALHIA

● Subprojects for 2005
□ Subprojects for 2006
● The Study is cancelled (Subprojects for 2005)
□ The Study is cancelled (Subprojects for 2006)

OUTLINE OF THE PROJECT

Following are described as the outline of the 66 sub-projects for 2005 and 2006 under the Study for the Rural Water Supply Project (Phase II).

1. Location

Location of the sub-projects: Following 15 governorates shown in Figure 4.1.1.

ARIANA, MANOUBA, NABEUL, BIZERTE, BEJA, JENDOUBA, LE KEF, SILIANA, KAIROUAN,KASSERINE, SIDI BOUZID, SOUSSE, MAHDIA, SFAX, GAFSA

2. Organizations Concerned

1) Implementing Agency: Regional Directorate General for Agricultural Development (CRDA) of the governorates
2) Coordinating Agency: General Department of Agricultural Engineering and Water Management (DGGREE), Ministry of Agriculture and Hydraulic Resources
3) Management Organization of the Projected Water Supply System:
   GIC (Water Users Group) will be established during the construction

3. Sub-project Period:

	32 sub-project*	34 sub-project*
Construction	2005	2006
Starting the water supply service	2006	2007
End of the observation period	2020	2021

* The Study of Rquiat sub-project of CRDA MAHDIA was completed with the sub-projects for 2005, however, it is scheduled to be constructed in 2006.

4. Benficiaries of the Project

1) Beneficiary Population: 55,082 (77 for the smallest sub-project, 3,622 for the biggest sub-project, 835 on average)
2) Number of localities[1]: 1,064 (2 for the smallest sub-project, 52 for the biggest sub-project, 16 on average)
3) Domestic animal[2] to be supplied with water: Sheep and Goats – 122,535
   Horses, Cows and Donkeys – 9,778

5. Outline of the Projected Water Supply System

Water is transmitted to a distribution tank by the gravity or pumping from a water source. If the pressure is insufficient for transmission, a relay pumping station is projected. In case that a sub-project will purchase water from an existing water supply system, if the available dynamic pressure at a

[1] The area where several houses are grouped and considered as the basis to install a water service installation.
[2] The project can supply the domestic animals with water up to 40% of the domestic water supply.

connection point is sufficient for the distribution, the distribution tank is not projected.

The branched distribution system by the gravity flow is designed for 65 sub-projects and the looped system is applied to one (1) sub-project. The sub-projects will supply beneficiaries with water through communal taps and potences. Public institutions are also covered by the sub-projects by directly connecting to the facilities. The disinfection is , in principle, made by chlorination in the discharge pipe of pump or in the connection pipe to existing system as the water source.

6. Water Supply Planning

(m^3/day)

	Starting water supply service (2006, 2007)				End of the observation period (2020, 2021)			
	Total	Smallest	Biggest	Average	Total	Smallest	Biggest	Average
Projected Population (person)	56,330	80	3,774	853	65,405	103	4,591	991
Domestic water demand	1,381.71	2.00	88.63	20.94	2,202.18	3.64	144.60	33.37
Water demand for animal	669.92	0.53	44.02	10.15	669.92	0.53	44.02	10.15
Total water demand	2,051.63	2.53	132.65	31.09	2,872.10	4.17	188.62	43.52
Unaccounted-for water	308.14	0.44	18.96	4.67	430.74	0.68	27.35	6.53
Average daily water supply	2,359.72	3.35	145.36	35.75	3,302.84	5.23	209.72	50.04
Maximum Daily Water Supply	3,355.81	4.18	218.04	50.85	4,710.05	6.54	314.58	71.36

7. Projected Service Installations

Population（2004, 2005）	55,082
Grouped population in the Study year (2004, 2005)	48,765
Scattered population in the Study year (2004, 2005)	6,317
Communal taps	1,059
Existing communal taps	12
Potences	24
Existing potences	1
Particular connection for public institutions	83
Population / (Communalt taps + Potences)	50.3

8. Water Charge and Revolving Fund Applied

(TD)

	Average	Lowest	Highest
Cost of 1 m^3 water	0.657	0.384	1.414
Proposed water rate per 1 m^3	0.809	0.500	1.250
Monthly family flat rate	5.250	5.000	5.500
Amount of revolving fund applied	15.41	5.000	20.000

Only two (2) sub-projects apply the flat rate

9. Construction Cost

(TD)

	Total	Lowest	Highest	Average
Facilities for water source	61,900	1,000	5,000	952
Pipe material	9,559,964	10,706	756,270	147,076
Pipeline construction	9,680,534	25,720	472,875	148,931
Civil works	4,297,650	3,600	296,200	66,118
Electrification	1,094,950	3,000	230,000	16,845
Equipment	1,313,800	2,500	96,000	20,212
Contingency	3,901,221	5,659	227,272	60,019
Total construction cost	29,910,019	43,385	1,742,417	460,154
Per capita construction cost	-	164.0	764.6	457.3

10. Major Facilities and Installations to be Constructed

1) Distribution tank; Semi-buried type : 65 (8 – 150 m^3)
Elevated type : 13 (H=12-20m, 25-150m^3)
2) Relay pumping station with tank : 26 (10 – 100m^3)
3) Break pressure : 35 (8m^3)
4) Pump : 94 (Pump head: 18-249m, Discharge: 0.50-8 liter/s)
5) Pipe PN: Nominal Pressure (bar)

High Density Polyethylene Pipe				Inside Diameter (mm)	Ductile Cast Iron Pipe	Galvanized Steel Pipe
Outside Diameter (mm)	PN10	PN16	Total			
63	6,207	464	6,671			
75	386,741	48,578	435,319	80	1,853	50
90	231,629	43,911	275,540			
110	104,666	19,184	123,850	100	425	100
125	48,809	4,912	53,721			
160	68,286	2,142	70,428	150	4,682	
200	32,924	0	32,924			
250	23,490	0	23,490			
Total	902,752	119,191	1,021,943		6,960	150

6) Disinfection facilities : 49
7) Pump start/stop control : Water level sensor + Pilot cable transmission : 19
Pressure gauge with electric contacts : 24
Water level sensor + Radio transmission : 2
8) Air valves : 1062
9) Washouts : 334
10) Sluice valves : 558
11) Pressure reducing valves : 235

Abbreviations

AEP	Potable Water Supply (Alimentation en Eau Potable)
AGR	Regional Agricultural Engineering Department, CRDA (Arrondissement du Génie Rural)
AIC	Association of Water Users (Association D'Intérêt Collectif)
AME	Maintenance of Equipment Sub Division
ANPE	National Environment Protection Agency
API	Irrigation Sub Division
ARE	Water Resources Sub Division
BD	Board of Directors of GIC (Conseil d'Administration)
B/S	Basic Study under the Study on the Rural Water Supply Project (Phase II)
CEM	Ordnance Survey Map (Carte d'Etat Major)
CGIC	Unit in charge of GIC, CRDA (Cellule des Groupements à l'Intérêt Collectif)
CITET	International Center of Environmental Technology in Tunis (Centre International des Technologies de L'Environnmement de Tunis)
CRDA	Regional Directorate General for Agricultural Development (Commissariat Régional au Développement Agricole)
DEPER	Department of Drinking Water and Agricultural Equipment, Ministry of Agriculture, Environment and Hydraulic Resources (Direction de l'Eau Potable et de l'Equipement Rural)
DGGR	General Department of Agricultural Engineering and Water Management, Ministry of Agriculture, Environment and Hydraulic Ressources (Direction Générale du Génie Rural et de l'Exploitation des Eaux, Ministère de l'Agriculture, Environnement et des Ressources Hydrauliques)
DGRE	General Department of Water Resources, Ministry of Agriculture, Environment and Hydraulic Resources (Direction Générale Resource en Eau)
DHER	Hydraulic and Equipment Department, CRDA
DT	Tunisian Dinar (Dinars Tunisien)
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
F/S	Feasibility Study
GA	General Assembly of GIC
GDP	Gross Domestic Product
GIC	Water Users Group
GIH	Multi-Disciplinary Consultative Group (Groupement D'Intérêt Hydraulique)
GOJ	Government of Japan

GOT	Government of Tunisia (Gouvernement Tunisien)
GR	Agricultural Engineering Sub Division, AGR (Génie Rural)
IEE	Initial Environmental Examination
INS	National Institute of StatisticsInstitute (National de la Statistique)
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency (Agence Japonaise de Coopération Internationale)
KfW	Organization for Financial Assistance in Germany (Kreditanstalt für Wiederaufbau / Crédit pour la Reconstruction)
L/A	Loan Agreement
lpcd	liter per capita per day
MOA	Ministry of Agriculture and Hydraulic Resources (Ministère de l'Agriculture et des Ressources hydrauliques)
MOI	Ministry of Interior and Local Development (Ministère de l'Intérieur et du Développement local)
MOPS	Ministry of Public Sanitation (Ministère de la Santé publique)
MTD	Million Tunisian Dinar
ODA	Official Development Assistance
O/M	Operation and Maintenance (Exploitation et Entretien)
OM/M	Operation, Maintenance and Management
PCM	Project Cycle Management
PEHD	High Density Polyethylene
PISA	Agricultural Sector Investment Loan Program (Prêt d'Investissement au Secteur Agricole)
PRA	Participatory Rural Appraisal
PVC	Polyvinyl Chloride
SAPROF	Special Assistance for Project Formation (Assistance Spéciale pour les Projects en Formation)
SDR	Special Drawing Rights (Droits de Tirage Spéciaux)
SGIC	GIC Serving Agency, Ministry of Agriculture and Hydraulic Resources (Service GIC)
SONEDE	National Corporation for Water Development and Supply (Société Nationale d'Exploitation et de Distribution des Eaux)
STEG	Tunisian Corporation for Gas and Electricity (Société Tunisienne de l'Electrocité et de Gaz)
TD	Tunisian Dinar (Dinar Tunisien)
UFW	Unaccounted for Water
WHO	World Health Organization (L'Organisation Mondiale de la Santé)
WSS	Water Supply System

SUMMARY

1 INTRODUCTION

1.1 Background of the Study

The Government of the Republic of Tunisia (hereinafter referred to as “GOT”) planned to increase the coverage of the rural water supply up to 90% in 2006 by the Tenth 5-Year National Development Plan (2002-2006).

The GOT requested the Government of Japan (hereinafter referred to as “GOJ”) to extend the ODA loan to the 346 sub-projects. Japan Bank for International Cooperation (hereinafter referred to as “JBIC”) dispatched a Special Assistance for Project Formation (hereinafter referred to as “SAPROF 2002”) Team in June 2002. JBIC finally determined to finance 159 new sub-projects and 85 rehabilitation sub-projects. The loan agreement was concluded between JBIC and GOT in March 2003.

GOT requested JICA to conduct the Study on the Rural Water Supply Project (Phase II) (hereinafter referred to as “the Study”). JICA examined the request and dispatched a Preparatory Study Team for the implementation of the Study on 94 sub-projects scheduled for 2005 and 2006.

1.2 Objectives of the Study

The objectives of the Study are:

1) To prepare the basic design, , detailed design and tender documents of the sub-projects for 2005 and 2006, operation and management program of the water users group (hereinafter referred to as “GIC”) and
2) To pursue the transfer of knowledge to the counterpart personnel in the course of the Study

1.3 The Study area

The number of sub-projects under the Study has been revised to 46 and 34 for the programs of 2005 and 2006 respectively, for the reasons that the detailed design had already been completed for some sub-projects by CRDA.

The number of the sub-projects for 2005 of the Study was further reduced to 33 due to inappropriate projected water source judged by the water analysis or other problems identified.

The study area of sub-projects 2006 was examined in the similar manner. Thirty three (33) sub-projects for 2006 were finally selected for the Study after the examination of the projected water sources and the identification of the sub-projects.

1.4 Activities of JICA Study Team

The JICA Study Team had a series of consultation meetings with DGGREE from

December 8 to December 11, 2003. The minutes of meeting was signed by the both parties on January 11, 2004.

The Study Team conducted the following major activities for the Study in 2004:

- Entrusted the water analysis of projected water sources of sub-projects to a local laboratory
- Entrusted the Study of sub-projects in five (5) lots to the resident consultants
- Organized two (2) orientation workshops targeting the resident consultants and counterpart personnel respectively
- Initiated the stage-wise implementation of the Study, including organizing meetings with CRDA concerned for discussion of the feasibility report and socio-economic study report of sub-projects

The activities for the Study in 2005 are similar to the above. Particular activities were made as follows:

- Part of the water analysis of projected water sources had been conducted in advance.
- Introduction of new themes in the sensitization
- Survey about the impact on the relay persons

1.5 Organization of the Study

Organization of the Study consists of the JICA Study Team, DGGREE/DEPER: Department of Drinking Water and Agricultural Equipment and CRDA/ AGR.

DEPER of DGGREE is the principal executing agency for the Study assigned as the counterpart of the JICA Study Team. Major issues related to the Study were discussed between JICA Study Team and DEPER for mutual understanding

CRDA/AGR, the executing agency of sub-project, is the key organization at local level. CRDA/AGR provided all the major information and comments necessary for the execution of Study

The same staff were maintained, in principle, for the study organization over the past two years, which greatly contributed to the efficient and consistent execution of Study.

2 NATIONAL SOCIO-ECONOMIC BACKGROUND

2.1 General

Tunisia is situated in the eastern part of the Maghreb region, in the middle of North Africa. The country benefited from its location which has great strategic and commercial importance throughout the history.

The country can be divided into four geographical zones; the Tell, the Ridge, Steppe and the South. To the north lies Tunisia’s most fertile agricultural region. The coastal area constitutes the core of the Tunisia’s economy.

The main natural resources is for agriculture. Tunisia also has important fishery resources. Mining plays a minor part in the economy, but constitutes an important component of exports.

2.2 Demography

Tunisia has a population of 9.9 million in 2004. There have been notable achievements in family planning, with population growth declining to 1.21% according to the latest census[1].

The population is highly concentrated in the urban and coastal regions. With two-thirds of the population are now in urban area, unemployment is an important issue. Tunisia is very homogenous nation - 98% Arab-Berber by origin. Meanwhile, the country has been exposed to the enormous cultural diversity.

The level of human capital development in Tunisia is high. However there is still much room for improvement, for example, literacy rate. There is still a shortage of skilled labour in the 2.7 million domestic work forces.

2.3 Rural administration

The rural administration in Tunisia is based on the 24 governorates. Each governorate has 5 to 19 delegations administered by délégué. The administrative area of the delegation consists of several “sectors” which is administered by “Omda”. This administrative system is controlled by the Ministry of Interior and Rural Development.

On the other hand, there is the regional department of the ministries in each governorate. CRDA in each governorate is the regional department of the Ministry of Agriculture, Environment and Water Resources.

2.4 Economy

Tunisia has achieved average GDP growth rate of 4.8% during 1991-2001 and an almost equivalent growth between 2001 and 2004. Unemployment rate decreased for the first time from 15% in 2001 to 13.9% in 2004. However, poverty remains high in rural areas. Tunisia set the following primary targets in the 10th Economic Development Plan 2002-2006: improving per capita income, reigning in unemployment, promoting investment and consolidating exports.

Despite the fact that public companies are still dominant, the private sector is replacing the public ones and constituting the essential driving force in the economic growth. Tunisia is a member of the World Trade Organization (WTO) since 1995; it is scheduled to establish a free trade zone with the EU by 2008.

2.5 10th Development Plan

Tunisia develops its infrastructure which is considered as the key of the economic

[1] Source ; Preliminary Result of Population Census, INS, December 2004

development and therefore primary target of the investment. Under the 10th Development Plan (2002 - 2006), 10 billion TD(around 8 billion US$) was allocated for the infrastructure.

The water sector is one of national priorities. The 10th Development Plan allocated TD 1.9 billion to water mobilization including the drinking water supply to the rural population (TD 196.8 million) and water sector-related studies (TD 87.2 million).

2.6 National finance

The 2004 budget was estimated at 12,833BTD and the deficit of the central government in the same year was 800MTD that was 2.3% of GDP. The overall objective of Tunisia's monetary policy is to preserve currency value by keeping inflation rates as low as its trading partners and competitors.

In 2004 the price inflation rate was 3.6% which was attributed to higher prices for foodstuffs due to continued drought. Tunisian and IMF officials have forecasted an inflation rate of 3% for the coming years.

Tunisia has the distinction of never having to reschedule its debt. Foreign debt was around 60% of GDP during the last five years. According to the notice of June 2004, released by IMF, Tunisia shows an economic performance that ranks among the best in the Middle East and in North Africa.

3 PRESENT CONDITIONS OF THE RURAL WATER SUPPLY PROJECT

3.1 Background

3.1.1 Rural Water Supply Project

The MOA has been constructing the Rural Water Supply Systems since 1980'. The coverage of rural water supply system reached 81% at the end of 9th development plan.

However, there are several issues which require strengthening of GIC capability in the OM/M, particularly of autonomous management. In order to meet the requirements, DGGREE tries to take measures such as private sector participation, assignment of 'Technical Director" by GICs, preparation of a design guideline for private connection introduction, etc.

3.1.2 Tenth Rural Water Supply Program

The following are objectives of the Rural Water Supply in the 10th Development Plan:

(1) to increase the coverage of the water supply service to 90 % at the end of 10^{th} plan
(2) to intensify rehabilitation of existing rural water supply facilities
(3) to reinforce organization of GIC by sensitization and training of the beneficiaries
(4) to develop strategy for private connection in the rural water supply system
(5) to introduce private sectors for O/M and management of the water supply systems

The following table shows the detail of the 10th Rural Water Supply Program:

Table 3.1 Detail of 10th Rural Water Supply Program

Figures in parentheses show budget (million TD)

		2002	2003	2004	2005	2006	Total
JBIC	Rural Water Supply Project (Phase 2)			67 (19)	66 (17)	55 (16)	188 (52)
IBRD	Water Sector Investment Project	70 (20)	76 (25)	20 (5)			160 (50)
KfW	Scattered Villages Water Supply Program	10 (4.5)					10 (4.5)
TUNISIA					40 (7)	37 (6.5)	77 (13.5)
	Rehabilitation			25 (2.5)	25 (2.5)	25 (2.5)	75 (7.5)
Total		90	76	112	131	117	516
		(24.5)	(25)	(26.5)	(26.5)	(25)	(127.5)

Source: Report on SAPROF 2002

3.2 The Rural Water Supply Project financed by JBIC

3.2.1 PISA

OECF (former organization of "JBIC") implemented the Agricultural Sector Investment Loan Program (PISA). The implementation of PISA was completed in 1997.

3.2.2 The Rural Water Supply Project (Phase I)

In 2000, the GOJ determined to extend a loan for implementation of the Rural Water Supply Project, which consisted of "Project 2000" and "Project 2001", through JBIC. As of November 2005, 76 sub-projects was completed out of 80 in total.

A technical assistance consultant assisted CRDA/AGR on the implementation of the Rural Water Supply Project in the following technical aspects:

1) Improvement of participatory approach, execution/evaluation of sensitization program
2) Supervision of the construction work of Projects 2000 and 2001
3) Improvement of water supply system management

3.2.3 The Rural Water Supply Project (Phase 2)

The Rural Water Supply Project (Phase 2) covers 159 new sub-projects of which 65, 57 and 37 sub-projects were scheduled to be implemented in 2004, 2005 and 2006 respectively. As of November 2005, 48 sub-projects for 2004 covered by the JBIC finance have been completed or under implementation.

3.3 Organization for Rural Water Supply Project

3.3.1 Organization at national level

The MOA is the core agency responsible for implementation of the rural water supply project. The MOF, MOI and MOPS also play important roles at state level. The DGGREE in MOA is directly responsible at the central level for water supply in the rural areas.

In the DGGREE, the DEPER takes charge of planning, study and construction of the rural water supply systems. The SGIC of the Sub-department of Promotion of Water Users

Organization supports the CGIC of CRDA.

3.3.2 Organization at the governorate level

The GIH is an advisory committee to the governor with regard to creation and management of the GIC. The CRDA is the regional organization of the MOA. In the CRDA, the DHER is responsible for the rural water supply. The AGR in DHER is the core organization for implementation of the rural water supply projects comprises: (i) Unit for study (UE), Unit for construction (UT) and (iii) Unit for GIC (CGIC).

3.3.3 Organization at local level (GIC)

GIC is established for the purpose of operation and maintenance of the facilities related to irrigation, drinking water and drainage by beneficiary groups. GIC has the legal personality and should be created either by government initiative or by the request of the concerned parties. Board of directors (BD) is the management organ of the GIC. The members of BD are elected among GIC members in General Assembly (GA).

3.4 Current Situation of Sub-projects for 2005 and 2006

After the discussion in the Inception Meeting at the end of 2003, the sub-projects were examined through the water analysis and project identification, separately made for the sub-projects for 2005 and 2006. As aresult, the Study was made on 33 sub-projects in the Study in 2004 and the same in the Study in 2005.

The following are observed in the sub-projects identification of the Study:

1) Many localities in the vicinity of the sub-project areas had not been covered by WSS so that it was required to increase the service area in a number of sub-projects from the original plan of CRDA.
2) The private connection was practiced in a number of the Rural WSSs. In case that the GR extension sub-projects will connect to the distribution pipeline of such a WSS, particular consideration was taken to secure sufficient flow rate to meet its design.

Currently the whole study on sub-projects 2005/2006 has been completed by the Study Team. Construction works have started in 50% of the sub-projects for 2005 and the rest are under the tender procedures.

4 INTRODUCTION OF PROJECT AREA

This chapter describes the socio-economic conditions of the sub-project areas based on the results of a household survey, which was carried out on 2,349 households constituting 22% of the total number identified in all the sub-project areas.

4.1 Geography

The governorates where the RWS project exists are mainly classified into the following three regions considering geographical, climatic and economic conditions.

The Seacoast region[2] is located in the eastern part of Tunisia facing on the Mediterranean Sea and is affected by the Mediterranean climate. The altitude of this area is relatively low and the terrain is flat. This region is considered as the core of Tunisia's economy. Nevertheless, rural areas of this region present the essential traits of the Tunisian rural setting, such as high illiteracy, rural exodus, low income, etc.

The Northwest hilly region is located to the west of Tunis metropolitan area. The region's relief presents altitudes that can reach 500m. Annual precipitation in this region is reportedly over 400mm, providing almost 1/3 of the rainfall of the whole country, which gives relatively rich vegetation to this area and the Tunisia's most fertile agricultural soil to this area.

The Middle west semi-arid region is located in the easternmost part of the Atlas Mountains range. The terrain of the region is plateau rather than hilly. The annual precipitation is from 200mm to 300mm. Main agricultural products are olives, almonds and other fruits suitable for the climate.

4.2 Demography

4.2.1 Annual Population Growth Rate

The annual population growth rate by governorate level is calculated based on the statistic from 1996 to 2004.

The growth rate of the Seacoast region varies from 0.82% to 3.81%, while all the other governorates show less than 1 %. The Northwest region shows -0.51% to 0.02%, a little bit less than the rates of Middle west semi-arid region which are 0.25% to 0.64%. The population growth rate of the governorate of Ariana, which belongs to Tunis metropolitan area, is the highest among 15 concerned governorates followed by Sousse and Manouba, while that of the governorate of Le Kef is the lowest.

4.2.2 Population

The total beneficiary population of the 66 sub-projects is 55,082 with the number of household is 10,837.

18 sub-projects have over 1,000 populations while Guargour-Brahma-Fkayhia sub-project has 3,622 population which is the biggest among 66 sub-project and the smallest is Cebalet Ben Ammar sub-project of 77 population in the governorate of Ariana.

The average household size is 4.8 and 4.5 persons in the Seacoast and Northwest region, respectively and 5.5 in the Middle west region. The average number of persons per household of 6.5 is recorded as the biggest in the Enjaimia sub-project in the governorate of Gafsa among 66 sub-projects.

[2] 1) Sea coast region; Ariana, Manouba Nabeul, Sousse, Mahdia and Sfax, 2) Northwest hilly region: Be Ja, Jendouba, Le Kef and Siliana, 3) Middle west semi-arid region: Kairouan, Kasserine, Sidi Bouzid and Gafsa

4.3 Socio-economic Conditions

4.3.1 Social Characteristics

The three regions present common features, related to their belonging to the Tunisian rural world. These features are characterized by:

- High illiteracy rate, mainly among women,.
- Weak participation of women in the social life,
- Sharing the same beliefs and commitments to the same religion,
- Exodus to the urban centers to find income sources,
- Wishful for the lifestyle in city,
- Scarce organizations for dialogue and community life,

Apart from these similarities, each region has specific characteristics as described below:

Seacoast region

This region is characterized by a continued discord between an ancestral farming community and people coming from far rural areas. The reconciliation is taken place very slowly but the population is heterogeneous having diverse demands. The major feature of the people is the strong desire for the urban lifestyle.

The sensitization programs should account for such factors to promote the sustainability of water systems useful to them.

Northwest hilly region

This region is affected by the destruction of farming community due to urbanization of the fertile lands. Farmers depended on migration to the costal areas seeking to substitute their agricultural work. The absence of men and lack of motivation imposed on women heavy charges to ensure the survival of their family.

Family customs have been weakened and the mechanism of traditional solidarity was lost. This population requires an intense sensitization in order to evoke the community spirit.

Middle-west semi-arid region

After the Tunisian independence, the inhabitants of this region lost their custom of transhumance started to settle and diversified their income sources through arboriculture. They preserved stronger family customs and solidarity.

The social collective organizations are likely to be successful considering the community which are relatively homogeneous and stable.

Nevertheless, the habit of dialogue and consultation remain low and community and spiritual life is rather poor in the three regions. Mobilization of this population for social collective activities requires much effort. Women’s participation in social life is still

insufficient due to socio-cultural resistance. In this regard, it is necessary to prepare specific consolidation programs.

4.3.2 Hygiene

(1) Medical facilities

1) Medical Facilities in the sub-project area

Most of sub-projects have no health facilities in the project areas except for 11 sub-projects.

2) Access to medical facilities

The average distance to the nearest health facilities is 6.5 km in three regions. That of Middle west semi-arid areas is the longest; 7.5 km.

The target population of the Northwest hilly region considers the access to medical care more difficult than in the other areas, while the access to medical care in the coastal region is relatively easy.

(2) Sanitary Equipment (Latrines)

1) Coverage of latrine equipped in the house

The average coverage of latrine in all the sub-project areas is 74.5%. The middle west semi-arid region shows lower coverage of latrines than that of the other two regions.

2) Location of latrines

The latrine is generally installed outside the house. This condition is mainly due to the lack of reliable sewage system. It may cause bad smell that might affect the amenity.

3) Water availability in latrines and Sewage system

There is no water in most of latrines (81.4%), especially in the Northwest hilly region. Though it represents only 7%, these households have no latrine evacuating raw sewage outside the house. It may threat the vicinity environment.

(3) Diseases associated with water

1) Perception of the population

The population's awareness of the danger caused by bad quality water on health is not strong enough (66.7% in 2004 and 33.8% in 2005). The rate of unconsciousness of danger in the Seacoast region is relatively high, probably because the majority of the population can get water either from existing water systems or from water vendors.

2) Diseases perceived

The diseases perceived by the population in the sub-project areas are:

- The diarrhoea is in the first place mainly in the Seacoast region.
- Kidney diseases occupy the 2nd position in the Northwest hilly and Middle west semi-arid region;
- Hepatitis is underestimated in all the regions; stomach illnesses are mainly

considered in the Northwest hilly area.

4.3.3 Economy

(1) Economic activities

1) Seacoast region

This region is the core of economy of this country. Nonetheless, the principal economic activities in rural areas of this region are agriculture and day labor in the construction and agricultural sector in neighboring large cities.

2) Northwest hilly region

Main economy of this region is agriculture and pasturage. Agricultural products of the governorate of Jendouba and Beja are mainly wheat and barley. Most of the population in the sub-project areas of said two governorates, which are located in forest areas, engaged in the agro-forestry.

3) Middle west semi-arid region

Agriculture and cattle breeding are main industries in the region. Olives are much produced in the whole region and the governorates of Kairouan and Sidi Bouzid are famous for almonds and figs.

(2) Occupation of household heads

Day labour and agriculture, which represent 80% of household heads in all the regions, are the principal occupations. Diversified agriculture is insufficient to ensure an appropriate income to the households. Owing to the proximity to the metropolis, the day work is more developed in Seacoast region than the other regions.

(3) Revenue and water expenses

The average monthly income varies between 196.0 TD to 307 TD. Water expenses occupy 6.6% on average of the households' average income.

(4) Standard of living

The rapid growth of economy has led to a considerable progress in the living standard of all the population. Possessions of major household commodities in the sub-project areas are summarized below:

- TV is the most diffused commodity, of which coverage is almost the same as the national one.
- The refrigerator is equipped in 58% of households surveyed.
- The coverage of the mobile phone is remarkable, while the possession rate of fixed phone remains very low reaching 2%

4.3.4 Education

Primary school enrollment in Tunisia is reportedly quite high. In all the sub-project areas, it is similar to the national level.

Three is a primary school each in 33 sub-project area out of 66. Average distance to the primary school is 3.3 km. The population in some sub-projects prioritized the establishment of primary school in their needs due to the difficulty of access and long distance.

4.3.5 Basic infrastructure

(1) Roads

Since most of the rural roads are not paved, approximately 80% of total beneficiary population finds difficulty in transportation, especially in the rainy season. During the socio-economic survey, it was noticed that strong claims were made for the improvement of the pistes and roads. In the needs ranking, road ranks 2nd following the drinking water supply.

(2) Electrification

Electricity is widespread all over the country. The rate of electrification is 100% in 43 sub-project areas and over 75% in 16 areas; whereas, the Enjaimia sub-project area in Gafsa is completely deprived of electricity. In addition, the M'kimen sub-project in Kasserine is electrified only 13% and the area of Ben Thameur sub-project in Nebeul is electrified 58%.

As far as electric energy is concerned, the power line of three phase current is generally far from the sub-project areas. In 18 sub-projects, this distance varies from 1km to 6km.

(3) Mail and post office

The post office exists in only four sub-project areas. Telephone line is not common in the sub-project areas. 38% households in the sub-project areas have cellular phones.

(4) Public institutions

There are 31 mosques, 33 schools and nine (9) dispensaries to be supplied with water under the Project in all the sub-project areas.

4.4 Water Collection

4.4.1 Present Conditions

(1) Water sources presently used

Utilization of existing system (communal taps, potences or private connections of neighboring GIC or SONEDE water supply systems) is observed in all the areas. The rainwater is collected in winter for a complementary use, while water vendors offer their services primarily in summer. On the other hand, shallow wells and springs of which capacity is relative to precipitation, account for 78% of the water sources in the Northwest hilly region.

A number of population have to take water from other water sources farther than the one to which they are accustomed. The major causes are the low flow rate and the deterioration of water quality of their neighboring water sources in summer.

(2) Period of time to fetch water

The average distance to the water sources is 1.9 Km. There are inhabitants who have to walk to the water sources with an average distance of 6.7 Km. It takes around one and a half hours to fetch water regardless of the season. The longest time for fetching water is on average 2h40. The average distance/time spent for water in a year in the Middle west semi-arid region is the longest.

(3) Means of water transportation

In the Middle west semi-arid region, a big water tank hauled by a tractor or a domestic animal is used in transporting water. Domestic animals are mainly used in the Northwest hilly areas, reflecting topographical conditions.

(4) Price of water

The current practice of procuring water depends on three (3) types: a large tank of 3,000 to 5,000 liters, a portable tank of 20 liters and a water vendor.

The population pays 2.2TD/m^3, which is more than the double of the maximal price targeted by this study. The highest price can reach 5.1TD in the Northwest hilly area.

The price applied to big water tanks is lower than that to the 20 L tank and the price applied by water vendors is higher than that of others. This difference in applied water prices might be explained not only by the time used for water fetching but also by the business-oriented mind of the water vendors.

(5) Appreciation on water quality

Most of the population supplied from the existing systems through communal taps or potences is satisfied with the water quality; however, a third of the population supplied from conventional water sources is not satisfied with the water quality. Even those who appreciate the water sources take the disadvantages of these sources such as the risks of diseases.

(6) Present water consumption

The population in the Middle west semi-arid region apparently consumes nearly double the amount of the other regions exceeding the projected water demand applied to the sub-project design which is around 50 liters. The maximum water consumption exceeds the projected demand in all the regions.

The ratio of the average water consumption to that in the summer season is around 1.5 in all the three regions.

4.4.2 Inconvenience in drinking water collection

The most significant disadvantage of the present water collection for the population in the sub-project areas is the distance, followed by the low availability of water as well as the high price. It seems that the population considers acquisition of sufficient water more important than quality of water. Nevertheless, several households face problems of storing water in

hygienic conditions.

4.5 Viewpoints of target population on participation in the OM/M of the projected WSS

4.5.1 Water charge system

In all the sub-project areas, the majority of the population generally preferred the commodity charge system. 58% of the target population in the Northwest hilly region advocated the flat rate method (periodically fixed rates for a family). Considering the outstanding number of migrant workers from this region, cash seems not necessarily always available for the households in this region.

4.5.2 Type of participation motivated

The Study in 2005 shows that between 65% and 75% of the surveyed people accepted adhesion to the GIC. About half of them were ready to be the members of board of the directors of the GIC.

4.6 Needs of target population for improvement of living conditions

Drinking water is not only the first priority but also the most urgent issue for the target population. Even the sub-projects of which target population gave its first priority to subjects other than the water supply placed it to the second priority.

Road is also a very important needs next to drinking water supply because bad road condition makes the water transportation difficult in some of the sub-project areas. Increased employment and other income sources occupy the third of the priorities. It has a direct effect on the population affordability for water.

4.6.1 Seacoast region

Water, roads and employment are priority needs. Unpaved conditions of the tracks make the inhabitants' daily life difficult with regard to transport of water, access to the medical care, etc.

4.6.2 Northwest hilly region

Road is placed in second position followed by dispensary. The population in this region seems to face a lot of difficulties on medical care due to the long distance to dispensaries and hospitals, and the absence of a sanitary infrastructure in the sub-project areas.

4.6.3 Middle west semi-arid region

The second priority was given to roads and the improvement of the unpaved tracks. The irrigation seems to be important in the needs ranking for the extension of an irrigation system which is valuable for the agricultural development in the region.

5 WATER ANALYSIS AND WATER SOURCE ASSESSMENT

The water analysis of the projected water source of all the sub-projects under the Study

was executed referring to the Drinking Water Quality Standard of Tunisia (NT09.14-1983) and the WHO drinking water guideline (3rd edition). The result of the analysis and the projected water source assessment are presented in the volume of "Water Analysis and Water Source Assessment"

6 ENVIRONMENTAL STUDY

6.1 General

The objective of the environmental study is to assess the potential impacts on the environment due to implementation of the sub-projects for 2005/2006.

The JBIC Guidelines for Confirmation of Environmental and Social Considerations were applied to the Study. It is stipulated in the JBIC Guidelines that the environmental study should be conducted in three steps; (i) Screening, (ii) Environmental review and (iii) Monitoring. For projects classified as Category C, further study beyond screening will not be required.

On the other hand, judging from the environmental law of Tunisia, there is no requirement to carry out the environmental impact assessment for the Rural Water Supply projects.

6.2 Environmental law in Tunisia

The Decree No. 91-362, which stipulates the EIA procedure in Tunisia, defines two categories of projects listed in "Annex I" and "Annex II".

In case of projects listed in "Annex I", EIA is a mandatory process. In case of projects listed in "Annex II", necessity of EIA execution is judged by ANPE. The Rural Water Supply projects fall into a category neither "Annex I" nor "Annex II". Therefore, EIA is judged not required in Tunisian law.

6.3 Screening

6.3.1 Categorization of project

The JBIC guidelines classify projects into categories "A", "B" and "C" primarily based on the degree of potential adverse impact on the environment. Projects that have minimal or no adverse impact on the environment are classified into Category "C".

6.3.2 Results of screening

The information about the sub-projects was collected by the resident consultants entrusted by the Study. All sub-projects are classified as Category "C" based on the following information and considerations:

(1) The implementation cost of all sub-projects 2005/2006 is less than the ceiling amount of SDR 10 millions TD to be classified as Category "C".

(2) There exist no sensitive areas near to the sub-project sites. Besides, the environmental impact to the neighboring cultural heritages can be minimized by

taking appropriate measures.

(3) Exploitation of groundwater by sub-projects complies with the law of Tunisia. Possibility of subsidence of the ground will be out of consideration. Moreover, the impact to the lake Ichkel is also negligible because of the long distance and the volume of water use is quite small.

6.4 Environmental review

The environmental review is not required since all the sub-projects have been classified as Category "C" through the screening process.

6.5 Conclusion and recommendation

It is concluded that all the sub-projects for 2005/2006 will have no significant adverse impact on the environment. It is recommended, however, to take appropriate measures to avoid any potential adverse impact on the environment as need arises.

7 STUDY PROCEDURE

7.1 Eligibility of the projects

A sub-project is judged eligible when it meets the following criteria:

1) The acceptable per capita construction cost for JBIC project was fixed by DGGREE at 729 TD for the sub-projects for 2005 and 766TD for the sub-projects for 2006. (Financial eligibility)
2) At least 80 % of beneficiary household heads have to sign the commitment to the revolving fund. (Social eligibility)
3) The quality of water must meet the acceptable criteria while the quantity has to satisfy the projected water demand. (Technical eligibility)

7.2 Applied methodology

With the aim of durable design and easily manageable WSS, DGGREE set up the methodology of study which consists of the following two phases:

1) Basic study (Feasibility study and socio-economic survey)
2) Detailed design study and preparation of tender documents

The Basic Study consists of ten (10) steps of technical and socio-economic studies.

In principle, the study on sub-projects for 2005/2006 was conducted based on the DGGREE method. However some modifications were made to the design guidelines of DGGREE with respect to the following aspects:

- Design and dimensioning of the distribution network
- Financial analysis.

For application of the modified method of design and dimensioning of the distribution network, 15 pilot projects were selected, whereas the modified method of financial analysis was applied to all sub-projects 2006.

7.3 Identification

Identification of sub-projects is to confirm major items of sub-projects using Identification Card prepared by CRDA such as; (i) present mode and conditions of water supply, (ii) localities concerned and (iii) projected water sources.

This stage is decisive for the implementation of the study.

7.4 Detailed survey and socio-economic study

The detailed survey and socio-economic study are to update and examine the available data and to collect other information about the localities, prospective beneficiaries, present conditions of the existing WSS, water sources, availability of SONEDE and STEG networks, OM/M and the functioning of the GIC, if any, etc.

The collected data are analyzed and become the bases for building the sub-project component.

7.5 First visit of sensitization (consultation with the target population)

The objectives of the first visit of sensitization are to (i) present the results of the socio-economic survey (house-hold survey), (ii) enhance the motivation of the target population to participate in the sub-project, (iii) introduce the advantages and management principles of the WSS, and (iv) discuss and consult with the target population about the sub-project components.

7.6 Selection of the optimum preliminary design

The optimum preliminary design shall be selected among alternatives to be prepared by the resident consultants. The optimum preliminary design shall be examined from technical, financial and socio-economic aspects.

7.7 Second visit of sensitization (Consultation with the target population)

The objective of the second visit of sensitization is to confirm the desires of the population concerning the WSS. Main topics of dialogue include (i) selected preliminary design, (ii) location of service installations, (iii) selection of water charge system, (iv) selection of tap keepers (v) operation hours (vi) different contracts, and (iv) creation of GIC.

7.8 Execution of topographic surveys

The topographic surveys will be executed on the basis of the water distribution plan drawn on the *Ordnance Survey Map*. The reconnaissance of the sites by land surveyors should be done in the presence of a qualified engineer of CRDA.

7.9 Feasibility study

7.9.1 Sub-project period

The life time of the project is 15 years from 2006 to 2020 for the sub-projects for 2005 and from 2007 to 2021 for the sub-projects for 2006.

7.9.2 Water consumption and its growth during the sub-project period

Water consumers of the Project include the population, livestock and public institutions. Water demand depends on the types of the consumer.

7.9.3 Capacity of distribution tank

In principle, capacity of distribution tank is determined to be 50% of the average daily water supply volume according to DGGREE guidelines. The Study Team introduced some new factors to examine the capacity such as operation hours of the service installations, existence of potences and analysis of tank behavior.

7.9.4 Hydraulic simulation according to the DGGREE Guidelines

The following design values are provided for in the DGGREE Guidelines:

1) Flow rate of service installations
2) Minimum dynamic pressure
3) Flow velocity in the pipeline
4) Hydraulic factor related to the friction loss head

7.9.5 Modification of the hydraulic simulation for the pilot sub-projects

The hydraulic analysis of the distribution system by DGGREE guidelines is based on the fixed design flow rate at the taps. The actual flow rate at the taps, however, varies depending on the type of service installations and topography of the service areas.

The Study Team recommended applying the following steps to the hydraulic simulation of the pilot sub-projects:

- To estimate peak hourly demand for all the service installations
- To select diameter of the pipelines which ensures the minimum dynamic pressure of 2 bars in the distribution system
- To calculate the discharge from each tap when it fully opens
- To compare the peak demand for each service installation with the said discharge.

Two cases are considered:

i) demand < 0.5 L/s : to guarantee the demand,

ii) demand > 0.5 L/s : to guarantee the minimum flow rate of 0.5 l/s and the maximum flow rate of 0.9 l/s for communal taps and 2 l/s for potences.

7.10 Financial analysis

Financial analysis is important to justify the sub-projects financially. It is the determinant of the technical solutions.

7.10.1 Financial analysis according to the DGGR guidelines

The financial analysis of the Rural Water Supply projects consists of:

- Estimate of the construction cost of the WSS

- Determination of the cost of one cubic meter of water produced
- Balance of GIC accounts (cash-flow)
- Assumed annual inflation rate at 5% in the financial analysis

(1) Construction cost

The construction cost can be broken down into (i) facilities for water source, (ii) pipe material, (iii) pipeline works, (iv) civil works, and (v) equipment and electrification.

(2) Operation and maintenance costs

The operation and maintenance cost can be divided into fixed and variable costs.

The fixed costs generally include; (i)rated maintenance cost of the facilities, (ii)salary of a pump operator, a system caretaker and/or a technical director, (iii)subscription to STEG and SONEDE and (iv)management cost of GIC.

The variable costs generally include (i)purchase of water from SONEDE or GIC WSS, (ii)energy and (iii)disinfection.

(3) Cost of one (1) m^3 of water supply

The cost of one (1) m^3 of water supply is calculated based on (i)annual volume of production and consumption, (ii)investment cost, (iii)fixed and variable costs for OM/M and (iv)growth rate of beneficiaries.

The cost covers fixed and variable expenses by assuming the annual inflation rate of 5%.

(4) Cash flow and monthly family contribution

1) It is assumed that 62 % of the population becomes the member of the GIC in 2006; this rate will increase to 70 % in 2010 and will reach 90 % in 2020.
2) GIC expenditures include fixed and variable expenses.
3) The GIC revenues essentially come from water charge or flat rate. Two cases are considered for the rate that adherent families pay their contribution, 100% and 80%. Necessary contribution is calculated to make the GIC budget surplus and also balanced.

Based on the amount of the contribution per family, the amount of the revolving fund, which is generally equal to 4 times the monthly contribution, is determined.

7.10.2 Modification of the financial analysis

The revolving fund is introduced in the accounting of GIC. The amount is determined to attain positive balance of the cash flow throughout the project period. However, if the amount is considered to exceed the affordability of the beneficiary population, the amount is decreased while the water charge or flat rate is increased. In general, the amount is determined to be equal to the four (4) months expenses in the first year of water supply service.

7.11 Third visit of sensitization

The objectives of the third visit of sensitization is to ensure the understanding of the

beneficiaries about the water charge of one (1) m^3, the amount of the revolving fund and all other elements that concern the sub-project. The forms of commitment of the beneficiaries to contribute to the revolving fund for the GIC is distributed to the beneficiaries and collected.

7.12 Detailed design study

7.12.1 Geotechnical study

The study consists of the test boring with standard penetration test to have soil profile which is used for estimation of the bearing capacity of the foundation ground of the projected elevated tanks.

7.12.2 Preparation of the design drawings

Following the completion of the feasibility study, design drawings of WSSs to be used as a part of the tender documents are prepared.

The standard design prepared by DGGREE is applied in principle to the design of installations and facilities such as distribution tank, break pressure, pumping station, ancillary facilities of pipeline. However, since the standard design of the relay pumping station is not available, the standard design of distribution tank is applied with minor modification to its design. Furthermore, the standard designs of SONEDE are applied to the facilities to connect the SONEDE WSS and the elevated tank which are out of DGGREE standard design.

7.12.3 Work quantity survey

(1) Supply of pipe materials, construction of pipeline and civil works

The pipeline length is determined based on the topographic survey. Five (5) % is added for allowance. Work quantity of concrete work, mortar coating, etc. for distribution tank, pumping station, etc. have been prepared by DGGREE. As for the fittings and devices used for the ancillary and the hydraulic facilities, list of items is prepared according to the assembly diagram.

(2) Procurement and installation of the hydro-mechanical and electric equipment

The tender documents including the work quantity of hydro-mechanical and electric equipment of all sub-projects are prepared in principle as one (1) package on governorate basis.

7.13 Preparation of the tender documents

The tender document is prepared separately for construction of pipeline/civil work and installation of equipment, based on the standard tender document prepared by DGGREE for implementation of the sub-projects for 2004-2006 financed by JBIC.

Apart from the above, the electrification is included in the exclusive contract with the STEG.

8 PRODUCT OF THE STUDY

8.1 Workshop

8.1.1 Problems confronted in the past

The Study Team considered that it would be effective to organize workshops before commencement of the Study as well as in the course of the Study. The following points were focused before commencement of the Study:

(1) Lack of appropriate guidelines for identification and socio-economic survey to be used in the study of the RWS projects,
(2) Tendency of sociologist to interpret the sensitization arbitrary,
(3) Absence of control and follow-up to guarantee successful sensitization by applying the sensitization manual for introduction of relay persons, presentation of well defined themes, etc.,
(4) Lack of in-depth socio-economic survey, lack of coordination and insufficient interaction between engineers and sociologists

8.1.2 Orientation workshop for CGIC (March 2004)

The workshop was held in March 2004 targeting DGGREE/SGIC, AGR/CGIC and the Study Team. It consisted of 1) problem analysis in the feasibility study, 2) common and better understanding of the Study methodology, 3) gender consideration in the Study.

The problem analysis was made based on PCM method[3]. In the analysis, different problems related to the sensitization including insufficient involvement of CGIC during the feasibility study were identified.

For the second subject, the Study Team gave repeated explanation on the entire work flow followed by Q&A which brought common and better understanding among personnel concerned

Most of the participants justified the relevance of women's participation in the sub-project. Participants did not seem to fully understand the importance of the role of women for efficient and sustainable OM/M of RWSS. This theme was discussed afterwards in other workshops.

8.1.3 Workshop for personnel in charge of study execution

Workshops were organized before the commencement of the Study each year targeting the resident consultants who worked for the Study.

[3] PCM method is a tool for managing the entire cycle of a project from planning and implementation to evaluation. Problem analysis is one of steps in participatory planning of this method, which visualizes a relationship between causes-effects of a given problem in a form of problem tree.

(1) Workshop for the Study of the sub-projects for 2005

The workshop was held on February 9, 10 and 12, 2004 for the subjects of (i) the Study methodology, (ii) Technical knowledge necessary to the sociologists, (iii) Socio-economic survey including household survey and PRA, (iv) gender consideration and (v)water and sanitation.

The discussion and group exercise of the workshop revealed misunderstanding and weak understanding of participants on the above-mentioned. However, according to the evaluation by the participants and daily review by the organizers, the workshop was effective and achieved its initial objectives. Comments obtained show that the methodology, especially the appropriate timing and the objectives of each visit of the sensitization and their relation with technical activities became clear to the participants. Other outcomes of the workshop included better understanding on technical aspects and on gender approach of the Study by sociologists.

(2) Workshop for the Study for the sub-projects for 2006

The workshop was held on February 11 and 12, 2005 for the subjects of (i) Points focused to the Study, (ii) the socio-economic survey and sensitization program, targeting engineers and sociologists of the resident consultants.

The significant contents of the questionnaire for the household survey was clarified to the sociologists.

The exercise on "FAQ", through the exchange of field experiences and points of view allowed the consultants to reconsider their approach and the manner to deal with themes on the sensitization.

8.1.4 Workshop for Chef d'AGR

The workshop was held on March 15 and 16, 2005 targeting Chef d'AGR of concerned CRDAs. However, most of the participants were staff of CGICs. The following subjects were discussed in the workshop:

1) Important points of the Study (accountability, sustainability of GIC, gender consideration)
2) Methodology applied to the Study
3) FAQ (frequently asked questions by the population)
4) Proposed new themes for the sensitization
5) Lessons derived from the Study in 2004

8.1.5 Workshop to modify the design of the RWS projects

The workshop was held on June 23 and 24, 2005 targeting the engineers and Chef d'AGRs concerned with the pilot projects in 15 CRDAs.

The modification of the design method of the RWS projects concerns the following three

(3) themes:

- Distribution system modeling
- Optimization of the distribution tank
- Simplification of financial analysis of the RWS projects

Proposal of the above modification was basically accepted by the participants. The modified method for distribution system modeling was applied to 15 pilot sub-projects study selected from the sub-projects for 2006, while optimization of distribution tank and simplification of financial analysis were applied to all the sub-projects for 2006.

8.2 Sensitization activities

8.2.1 Identification

The sociologists contacted the beneficiaries with the assistance of "Omda" to get the following information and to select relay persons:

- Identification of the sub-project area
- Preparation of the list of beneficiaries by households
- Identification of relay persons

Recognizing the usefulness of the relay persons, the Study Team required the consultant companies to identify competent relay persons for the Study in 2005.

1) Verification of the list of beneficiaries by households

The list of beneficiaries was collected and verified. The verification was completed by the end of 1st visit of sensitization in the Study in 2004 and from the identification to the end of the 2nd visit of the sensitization in the Study in 2005. The identification of the sub-project was made referring the identification card prepared by the CRDA. Comparing the number of prospective beneficiaries identified with that shown in the card, the number of the prospective beneficiaries increased in 41 sub-projects in which 11 sub-projects became more than 2 times while it was decreased in 23 sub-projects[4].

This variation of the number of the beneficiaries can be explained by the fact that some localities were often left unidentified in the preliminary study made by the CRDA and the local authorities tried to include localities of which water supply was considered insufficient.

2) Identification of relay persons

In the majority of the cases, relay persons were selected based on the following criteria:

- Motivation to assist the consultant
- Confidence in the inhabitants or recommendation by others,

[4] The Mzouga-Zeldou 1st phase and 2nd phase sub-projects in Beja and the Ouled Ammar sub-project and Ouled Essaafi sub-project in Mahdia are considered as one project respectively. The total number of sub-projects discussed in this section is accordingly 64.

- Availability of communication means (cellular phones in GSM),
- (Ideally) minimum educational level

The following tendency was observed about relay persons:

- Women relay persons were selected in only one third of all the sub-projects for 2005, while at least one woman relay person was selected in all the sub-projects for 2006.
- The relay persons were effective in the preparation of beneficiary lists and sensitization meetings and the collection of various commitments. However, the number of participants in the sensitization meetings did not increase.

8.2.2 Socio-Economic Survey

(1) Methods applied

1) Household survey based on a questionnaire
2) Appraisal of the sub-project areas through following PRA tools:
   i) Development of the Community mapping
      An exercise was made to know the perception of the population about the configuration of the sub-project areas guided by the sociologists
   ii) Needs identification using a matrix of Pair-wise ranking
      Interview with the participants was made following their way of thinking regarding the needs they expressed according to a set of priorities of them.
   iii) Semi-structured interview with a selected group of men and women
      It was done according to the guide of the directive interview with a group of relay persons.

(2) Observations

The participatory approach was often appreciated by the target population. Pair-wise ranking was especially appreciated. The Community mapping allowed the participants to visually re-examine the sub-project area and to express their various points of view.

(3) Outcome of the socio-economic survey

The outcomes of the socio-economic survey were shared in the warp-up meeting held between the Study Team and the resident consultants. The concerned CRDA joined the meeting in 2005.

(4) Identified specific themes

1) The importance of water quality from projected WSS and its necessary cost were explained for sub-projects where the beneficiaries are accustomed to consume water for free.
2) The roles of the GIC were explained to prospective beneficiaries to realize that the success of the GIC depends on the contribution of users.

8.2.3 First visit of sensitization

The type of the meeting (mixed men and women or separate) depends on the number of households, configuration of the sub-project area and the local customs.

(1) Principal discussions with the beneficiaries

1) Scope of the projected RWSS

Strong demands for private connection were observed in almost all the sub-projects. With the explanation by the sociologists, the participants accepted the scope, which was the collective water supply, of sub-project except one that was excluded from the Study.

2) Mode of supply

Multiplication of the number of the service installations was often claimed. Sociologists explained about the customary rule of DGGREE about it.

Animal watering place was also requested. The difficulty of animal watering was explained mainly from hygiene and environmental points of view.

3) Future management by the GIC

The management of "Extension GR" sub-project was discussed. The advantages and the disadvantages of a sole GIC (integration with the existing GIC) and of two separate GICs were explained. The choice was left to the beneficiaries up to the second visit.

(2) Principal conclusions

1) Participation of the beneficiaries to the sensitization meetings

The participation rate did not increase compared to the rate in the Study in 2005. However, a slight improvement was observed in women's participation.

2) Acceptance of the sub-project

The target population seemed to understand the advantages of the projected Rural WSS: getting drinking water more convenient, stable water supply during the year and the reduction of expenditure brought by safe water.

3) Elimination of one sub-project

One sub-project was eliminated because of the persistent request for private connection in spite of the efforts made by the concerned parties to convince them of the collective water supply.

4) Elimination of some localities following the refusal of the sub-project

The majority of the population of one locality refused the sub-project putting a significant priority to employment rather than chargeable drinking water. (Etramis-Edmain sub-project)

Three localities refused the sub-project because of their persistent intention to use tapped springs. (Kalboussi sub-project)

8.2.4 Second visit of sensitization

This visit consisted of:

1) General meetings
2) Meeting by small groups

The principal topics were discussed in the general meeting, while specific topics such as operation hours, tariff system, type of work of the tap keepers were discussed in the small group meeting. The target population discussed the service installations on the spot. Various commitments were also made.

(1) Discussion and consultation with the beneficiaries

1) Location of the service installations

Location and number of service installations were determined in the following manner:

- The engineer explained technical constraints about the number of service installations.
- Target population consulted each other and proposed its favorable sites.
- After the acceptance of the land owners, the location of the service installation was fixed by marking with big stone on the spot.
- Requests of the target population to increase the number, if any, were taken into account from social and technical points of view. The configuration of the sub-project area was also taken into account

2) Selection of persons in charge of tap keeping

The tasks of tap keepers were explained to the target population so as the tap keeper to accept its role. The target population proposed to recruit the following person as tap keeper:

- The owner of the land where the service installation was located
- Anybody proposed to be a tap keeper and accepted by others, irrespective of the land owner or not,

a) Repartition of tap keepers by gender

The rate of woman tap keepers increased considerably for the sub-projects for 2006. Only three (3) sub-projects out of 33 sub-projects did not designate any woman as the tap keeper for the sub-projects for 2006, whereas no woman tap keepers was selected in 22 sub-projects for the sub-projects for 2005.

b) Commission for the tap keeper

The commission for tap keepers was determined in the meeting for general information to be applied commonly to a WSS in the Study in 2004. The choice between "with commission" or "voluntary" was left to the decision among prospective users sharing same service installations in the Study in 2005. Voluntary tap keeping will be applied in 22 WSS and the rest will apply the commission determined by the financial analysis or that applied by the CRDA..

3) Water charge system

Discussion with the prospective beneficiaries was made about the following tariff systems for their selection of suitable one:

a) Flat rate (monthly, every 2 months, every 3 months or yearly)
b) Commodity charge (according to consumption or cost sharing among members)
c) Mixed method

The commodity charge was opted in the 63 projected WSSs. Flat rate system was selected in two sub-projects in the Governorate of Bizerte. This method is conducted by most of the GICs in this governorate.

4) Land acquisition

The land transfer for the hydraulic installations, etc. was to be concluded by the end of the 2nd visit in order to avoid the risk of modification of the sub-project design in later stages. However, starting from the socio-economic survey, the subject of land transfer did not cause any problems in the Study in 2005 except minor changes of the pipeline routes and the site location of service installations.

5) Operation Hours

This topic was introduced in the Study in 2005. The objectives of this topic are (i) to reflect the peak hour consumption in the analysis of tank behavior, and (ii) to lead the beneficiaries to think about the work load of the tap keeper

At the beginning, many participants in the meetings showed reluctance to discuss this topic. However, having repeated explanation on the above mentioned objectives, the participants consulted each other during the period of time to select the sites for the service installations.

6) Constitution of the GIC provisional committee

45 provisional committees for the creation of the GIC and three (3) provisional committees for the preparation to expand the existing GIC were set up. 17 sub-projects of "Extension GR" decided to be included in the existing GIC and did not organize the committee.

(2) Principal Conclusions

1) Participation of the target population

The participation rate was higher than other two visits of sensitization both in the Study in 2004 and 2005.

2) Integration of the opinions of the target population in the sub-project design

As a result of proper consultation with the target population, their opinions were taken into account to a large extent in the technical design.

3) Preparation of the future management

The beneficiaries started to prepare a structure of management of the projected WSS through participation in the meetings of the second visit.

4) Materialization of commitments

The various commitments were duly signed without any problems.

5) Elimination of four (4) localities in Ouled Massoud-Rizg sub-project (Kasserine)

Thirty six (36) families of Ouled Barka sub-project were excluded due to the refusal of the sub-project after the change of the projected water source. Four (4) localities of the Ouled Massoud-Rizg sub-project were did not participate in the sub-project following the refusal by the majority. This refusal was due to the fact that the majority of them have private shallow wells or could take water gushing from the groundwater table observation well constructed by the CRDA.

8.2.5 Third sensitization visit

The 3rd visit was conducted after the approval by the AGR of the proposed water charge and the amount of the revolving fund. The objectives of this visit were to inform the beneficiaries of the said water charge, etc. and to confirm their intention to become the member of the GIC. Insufficient participation was recorded due to the coincidence with the marriage season, religious festivals, and the beginning of the school year.

(1) Themes dealt with during the third visit of sensitization

1) Proposed water charge

In the majority of the cases, the prospective beneficiaries accepted the proposed water charge. When the proposed water charge was considered high for them, they were consulted if they could accept voluntary tap keeping. Furthermore, if it seemed difficult for the population to accept the proposed water charge, the explanation was concentrated on the composition of the cost of water to make the them understood necessary cost of supplied water.

2) Commitment to the revolving fund

The prospective beneficiaries of most of the sub-projects signed the commitments to the revolving fund. The rate represents 87.5% on average. All the sub-projects satisfied the social eligibility with over 80%.

3) Un-accounted for water

This topic was introduced in the Study in 2005. It was explained to the participants that when the water loss was higher than expected, it induced to raise the water charge in the budget of the following year would be inevitable to recover the loss.

(2) Principal Conclusions

1) Participation of the population in the third visit of sensitization was insufficient both in the Study in 2004 and 2005. The participation of women in the sensitization meetings even decreased. This insufficient participation was caused by the coincidence the 3rd visit with particular events of the year.

2) The target population accepted the proposed water charge and the amount of the revolving fund. Though a little reluctance was observed in some cases, the beneficiaries finally accepted.
3) The beneficiaries were well sensitized about the new topics of sensitization, such as the operation hours, the un-accounted for water and the importance to save water. However, their understanding on these topics need to be consolidated.
4) Various engagements were signed and collected on time with a few exceptions.

8.2.6 Conclusions and recommendations

1) The selected relay persons seemed active and effective on the various tasks of the socio-economic survey and the sensitization, though the time period was limited to select competent relay persons.
2) Around 80% of the surveyed relay persons affirmed that the sensitization meetings were effective to express their opinions and discuss the future OM/M of WSS.
3) The target population manifested their acceptance of the sub-project by the commitment rate to contribute to the revolving fund that reached 87% on average.
4) Request to private connections was repeated during all the meetings with the population. The sociologists made lots of efforts to make the population understood the scope of the Project.

8.3 GENDER APPROACH

The present sub-chapter describes the way in which the gender issue was taken into consideration in the Study. The impacts on women, as a case of relay persons, are shown in the latter part.

8.3.1 Definition

The term “gender” is a sociological concept. The difference relative to the gender designates the men’s and women’s roles defined by a society, determined by the cultural, religious and institutional practices.

8.3.2 Gender approach and its significance to the Study in 2005

Women’s participation is often lower than to that of men on the qualitative as well as quantitative level. Since women will be the major users of projected WSS, it is pertinent to raise women’s awareness on the importance of the community management of WSS and the responsibilities they are expected to assume.

8.3.3 Approaches introduced in the Study for sub-projects for 2006

(1) Objectives

1) Strengthened participation of women in the sensitization meetings
2) Selection of woman tap keepers to make them responsible in the management of service installations
3) Selection of women as members of provisional GIC committee

(2) Means to achieve these objectives

1) Selection of women and men relay persons for each locality
2) Organisation of sensitization meetings for women

8.3.4 Results and observation

(1) Viewpoint of the target population on women's participation

1) Most of the respondents were in favor of women's participation in sensitization meetings.
2) Obstacles declared by women to participate in sensitization meetings are (i)house tasks, (ii)distance and access to the meeting place and (iii)meeting time
3) The majority of women relay persons needed the permission to attend the meeting.
4) Due to poor experience to attend the meetings, women are not active to speak out in the meetings.

(2) Organization of sensitization meetings from the gender perspective

1) Organisation of sensitization meetings

The type of sensitization meeting depends, in addition to the number of households, on the local custom. In the majority of the sub-projects, mixed meetings were generally organized. Separate meetings by gender were held in four (4) sub-projects due to socio-cultural factors.

The sociologists carried out door-to-door visits and/or individual contacts depending on situations. These particular contacts with women were required because of difficult acceptance of men as well as women in attending the meetings.

2) Results of mobilisation

The participation rate of women was lower than that of men during all the three (3) visits of sensitization. However this rate exceeded slightly that of men in the meetings with limited groups of the second visit.

3) Remarks

In some cases, women were not informed in advance about the meetings, since in most cases women share the mobile phone with their husbands.

In spite of lower attendance rate than that of men, women were satisfied with their participation in the meetings. It was their first experience to participate in community meetings.

(3) Selection of tap keepers

1) Around half of the respondents accepted women tap keepers. However, accepted rate varied between 3.3% and 100%, depending on the sub-project.
2) Despite the fact above, 75% of the respondents did not consider women capable for small repairs of the service installations.

3) The number of women tap keepers increased considerably in the Study in 2005. There were only three (3) sub-projects of which women were not selected as tap keepers.

4) Remarks

a) The difficulty of selecting women as tap keepers was relative to men's reluctance as well as that of women.

b) There were women who did not accept to be tap keepers saying that generally men were responsible for activities outside of the house.

c) Some other women did not accept to be tap keepers claiming that acceptance of new extra tasks did not exempt them from the household tasks.

d) In a sub-project, the massive presence of women as tap keepers reflected the absence of men who worked outside of the sub-project area. Their long and frequent absence forced women to take extra family responsibilities.

(4) Provisional committee of the GIC

1) Outcomes of the household survey

About 70% of the respondents showed opposition to women's participation in the provisional committee of the GIC.

2) Results

Women were not appointed as member of GIC committee in 30 sub-projects out of 47 which set up provisional committees. However, it increased comparing with the study for the sub-projects for 2005 in which only one woman was selected.

3) Remarks

a) Men did not seem to appreciate women's participation in the committee, arguing that women were very busy.

b) Women themselves were not very keen on doing so considering it as an additional task. Necessity for the members of going out to attend the committee would become a further burden that prevented women from being the members of the provisional GIC committee.

8.3.5 Impact of the sensitization on women

(1) Interview survey on relay persons

The Study Team conducted an interview with relay persons so as to grasp impacts on women.

(2) Survey results

1) Evaluation

a) Women appreciate less than man respondents the usefulness of the sensitization meeting, probably due to the difference of experience in attending meetings

b) Among different subjects, men appreciated the subject relative to service

installations. Needs ranking have satisfied both men and women.

c) Around a half of women who did not give their opinions in the sensitization meeting expressed their timidity or their fear of speaking in front of men

2) Change in men's attitude

According to woman relay persons interviewed, men's attitude regarding women's participation in the sensitization meeting changed positively during the Study.

3) Impacts on the relay persons

a) Most of men and women relay persons recognized some positive changes in their behavior, viewpoints, and consciousness.

b) Impacts told by women seemed to be concentrated on personal capacity to express themselves. Women seemed to have acquired such capacity through new experience.

c) Meanwhile, impacts at community level were more recognized by men. They appreciated the sensitization meeting as means of consolidating the relation among the target populations.

8.3.6 Conclusions

1) Women's participation is always lower than that of men. The selection of women relay persons did not lead to a drastic improvement in women's participation
2) Difference in qualitative participation of women by sub-projects was noticed.
3) Concerning women relay persons, two groups are distinguished: those so active to mobilize other women and others who are not.
4) It was observed that active and dynamic relay persons could play a leading role in mobilisation of women and discussions in the meetings.
5) The rate of woman tap keepers increased considerably in the Study in 2005. A number of woman tap keepers were selected from relay persons.
6) Women's participation in the direction of the GIC is a long and complex process which calls for more effort of consolidation against regression.
7) The impacts on women given by experience in participating in the sensitization could be considered as first step in their participation in community activities.

8.4 Basic design

8.4.1 Determinants of sub-project design

(1) Natural conditions

- Water sources in terms of quantity and quality
- Topographic condition (flat, mountains, etc.)

(2) Social conditions

- Localities and the public institutions to be served

- Land acquisition for installations and permission to install pipelines
- Design and location of service installations such as BF, BP and Potence
- Consensus of population regarding number and location of service installations
- Existence of social conflicts
- Operation hours of projected water supply system
- Private Connections of neighboring GIC which make the transmission unforeseeable

(3) Economic conditions

- Availability of power supply
- Construction cost and financial eligibility
- Water charge and amount of revolving fund to be applied
- Commitment rate of participation in the GIC

8.4.2 Basic data

(1) Demographics

The present population in the sub-project area was surveyed in the feasibility study. The projected population of sub-projects for 2005 and 2006 is calculated based on the present population and the annual growth rate, to be 28,468 in 2020 for the sub-projects for 2005 and 36,938 in 2021 for the sub-projects for 2006.

(2) Livestock

The number of the livestock is obtained through the socio-economic survey in 2004 for sub-projects 2005 and in 2005 for sub-projects 2006. The number of livestock is assumed to be unchanged during the sub-project period in the Study.

(3) Projected water source

Ten (10) deep wells, one (1) tapped spring and 54 existing water supply system (SONEDE connection, Extension GR and irrigation system) are used as the projected water sources for sub-projects 2005/2006.

(4) Service Installations

Service installations include communal taps, potences and particular connections. The respectively corresponding design discharges of 0.5 l/s, 2 l/s and 0.5 l/s are generally applied based on the DGGREE guideline.

In case of the 15 pilot projects, the necessary flows at communal taps and potences are individually calculated based on the number of population and livestock on locality basis. Design discharge of the particular connection is fixed at 0.5 l/s.

8.4.3 Basic design

(1) Water demand projection

The water demand of sub-projects consists of domestic water demand and livestock water

demand. The domestic water demand was computed based on the projected population and consumption per capita specified by the DGGREE. The water demand of livestock was calculated based on the present number of livestock and the specified consumption. The livestock water demand, however, is limited to 40% of the domestic water demand of the final year of the sub-project period.

The total water demand for the sub-projects for 2005 is projected to be 1,247m^3/day in 2020 and that for sub-projects 2006 is 1,625 m^3/day in 2021.

(2) Unaccounted for Water

The volume of unaccounted for water was estimated to be 15% of the total water demand for the Study based on the guidelines of DGGREE. However, the actual rate is around 27% according to "Synthesis Report on the Situation of the Water Users Groups for Drinking Water Supply for the Year 2002".

(3) Maximum daily and hourly water supply

The maximum daily water supply and the maximum hourly water supply were estimated to determine the capacity of water supply facilities.

The maximum daily water supply was calculated by multiplying the average daily water supply by a peak factor, which is fixed at 1.25 for northern region and 1.5 for southern region by DGGREE. The maximum hourly water supply is calculated by multiplying the average hourly water supply by a peak factor of 1.8. However, modified method was applied to 15 pilot sub-projects in which the hourly peak factor is calculated individually on sub-project basis.

(4) Possible withdrawal from projected water source

The possible withdrawal of the projected water source was verified comparing with the projected maximum water supply.

(5) Outline of water supply system

The Rural WSS generally comprises; (i) Intake for water source, (ii) Transmission system, (iii) Disinfection facilities, (iv) Distribution system and (v) Service installations.

Water is transmitted to the distribution tank by gravity or pressurized flow and distributed in the projected service area by gravity. Relay pumping stations are provided in the transmission pipeline, while break pressures were provided in the distribution pipeline, according to the hydraulic requirement.

Disinfection is made in principle by injecting hypochlorite solution using a dosing pump in the transmission pipeline.

(6) Land acquisition

It is the policy of the Government of Tunisia that the private land necessary for the rural water supply projects should be rendered by the beneficiaries without compensation. In the

third visit for the sensitization in the Study in 2004, the prospective beneficiaries submitted the signed document of commitment for the land transfer while it was made in the second visit in the Study in 2005.

(7) Intake for water source

The new deep wells have already been constructed by concerned CRDAs. An existing tapped spring is utilized for one (1) sub-project. Water intake from the existing water supply system will be made by connecting to the existing transmission pipe, distribution pipe or distribution tank.

(8) Transmission

The sub-projects are classified into three (3) types from the viewpoint of the transmission system. The first is using dynamic pressure of the existing system (16 sub-projects), the second is pump pressurized (37) and the last is no transmission system (12).

1) Pumping Facilities

a) Number of pump

In total 94 pumps including a reserve for each pump are designed to be provided in 37 sub-projects..

b) Pumping station

Pump sets will be installed in 32 relay pumping stations (including two (2) existing ones) and 12 well pumping stations (including two (2) existing ones).

c) Type of pump

An inline pump was generally designed for the relay pumping station considering easy maintenance, however, a submersible pump for horizontal installation was applied to six (6) sub-projects in the relay tank for higher pump efficiency. Besides, ten (10) submersible pumps will be installed in the deep wells.

2) Electrification

No diesel engine generator was planned to install in all the pumping stations. It necessitated electrification for 43 pumping stations in which 14 ones would be operated with single phase current due to uneconomic availability of three phase current. A phase converter was designed for one (1) pumping station. No diesel engine generator was planned to install in all the pumping stations. It necessitated electrification for 43 pumping stations in which 14 ones would be operated with single phase current due to uneconomic availability of three phase current. A phase converter was designed for one (1) pumping station.

3) Transmission Pipeline

High Density Polyethylene pipe (HDPE pipe) is applied to the transmission pipeline

where the maximum operating pressure is less than 16 bar[5]. In case the said pressure is over 16bar, Ductile Cast Iron Pipe was applied.

The standard of HDPE pipe is classified into PN10, PN12.5 and PN16 in terms of maximum allowable operating pressure. Grades of PN10 and PN16 pipes were applied to the Study.

4) Analysis of Transient Phenomena

Analysis of the transient phenomena in the transmission pipeline was conducted applying micro computer software. PN16 pipe and ductile cast-iron pipe were designed to protect against pressure surge and air chamber and air valves are used to protect against pressure drop.

(9) Distribution system

1) Distribution tank

In total, 91 distribution tanks were designed for the sub-projects for 2005 and 2006 including 11 existing tanks and four (4) tanks which were projected to be constructed by other projects.

The storage volume of the distribution tank is, in principle, determined as 50% of the average daily water supply volume. However, there is a possibility of interruption of water distribution in case the water demand far exceeds the transmission flow rate during peak hours. The storage capacity of the tank is examined based on calculation of hourly changes of water volume (tank behavior) and is enlarged according to need judged by the results of the simulation of tank behavior.

2) Service Installation

The communal tap was planned to be installed in each locality as much as possible. In some sub-projects where social conflicts were recognized during the F/S study, the number has been increased, when necessary.

The numbers of the communal taps, potences and particular connections are 1071, 25 and 83, respectively. The grouped population per communal tap of 114.0 in Enjaimia sub-project (GAFSA) is the largest among all the sub-projects in the Study, which is acceptable according to the DGGREE guidelines.

3) Distribution pipeline system

a) Distribution Pipe

The selection of the distribution pipe is made by similar manner to that of the transmission pipe. Regarding the pipe diameter to be applied, CRDAs of Ariana, Nabeul, Sousse, and Sfax applied 90mm as the minimum outside diameter considering the future

[5] 1 bar is around 1.02kg/cm^2

transfer of the projected WSS to SONEDE. Remaining CRDAs set the minimum outside diameter as 75mm.

The grade of pipe strength was selected according to the pipe inner static pressure in the projected WSS. DGGREE officially instructed to apply PN16 pipes when the static pressure exceeds 9 bars to avoid the fatigue failure of the pipe..

b) Optimization of the distribution network

The distribution system was designed, in principle, based on the guidelines of DGGREE. As a result of the simulation, in case the minimum dynamic pressure or the static pressure exceeded the allowable level, break pressures and/or pressure reducing valves were considered.

c) Optimization of the distribution network for pilot sub-projects

Modified design method was applied to optimization of the distribution system of 15 sub-projects. The objectives of the method is to avoid the risk of cavitation and/or water hammer to service installations and to assure the minimum flow rate at all the projected service installations at peak time when all the taps fully open.

(10) Operation and control of the pumping system

The pump operation should be stopped or started according to the water level in the distribution tank. The control system applied to the Study comprises 1) signal transmission by pilot cable with electrodes, 2) pressure gage with electric contacts and 3) radio transmission with electrodes, depending on the distance between the pumping stations and distribution tanks.

(11) Disinfection

It was projected to disinfect the water of new water sources as well as the existing water supply system where the residual chlorine was not detected in the water analysis and/or the projected WSS is relatively large. The disinfection system was designed with a chlorine concentration of 0.8mg/liter in the water. The point of injection of the chlorine solution was selected where the flow rate is stable as much as possible.

(12) Ancillary facilities

1) Washouts were provided at concave points of the pipeline in order to drain water from a pipeline in case of repair or maintenance, and cleaning of a pipeline.
2) Air valves were provided at convex points of pipelines in order to discharge accumulated air inside the pipelines during the operation, discharge air for starting the operation or drawing air at the time of cleaning of the pipe.
3) Sluice valves were installed at the branching or connection points to isolate a part of the WSS from others for repair and maintenance.
4) Break pressures were provided, in general, to reduce the static water pressure to

lower than 9 bars in the downstream section of it. The break pressures were also used to reduce the dynamic pressure up to an appropriate value.

5) A small pressure reducing valve was applied to the service installations in case the pressure at the branching points to them exceeded 5 to 6 bars.
6) The flow control valve was installed in the inflow pipe to the distribution tanks, relay stations and/or break pressures in case appropriate flow can not be assured at service installations in the vicinity of their upstream service area.

(13) Personnel for O/M

Pump operators, system care-takers and tap keepers are generally employed by GIC for the O/M of the Rural WSS. The pump operator is employed for the O/M of the pumping station and maintenance of the distribution pipelines. The system care-taker is employed for the WSS which does not have pumping system and shall maintain the distribution pipelines. Tap keepers are generally assigned to each communal tap and potence for collecting water charge and O/M. Apart from the above, A technical director is considered for relatively large scale WSS for sound management of the WSS.

8.5 Financial analysis of sub-projects

8.5.1 Construction cost

The construction cost consists of; (1) facilities for water sources, (2) pipeline material, (3) pipeline construction, (4) civil work for installations, (5) electrification and (6) equipment. Physical and price contingency equivalent to 15% of the construction cost is added. Total investment cost of 65 sub-projects is around 29,910,000TD. The average investment cost per sub-project is 460,000TD.

The ceiling for per capita investment cost of the sub-projects for 2005 and 2006 is set at 729 TD and 766TD, respectively. All the sub-projects have been judged eligible on the financial basis.

Twenty nine (29) sub-projects out of 65 are located in the Middle west semi-arid region. The scale of sub-projects of this region is the biggest among the three regions. In contrast, the per capita construction cost of sub-projects in the Northwest hilly region covering the lowest average number of beneficiaries is the highest. Relatively hard topographic condition of this region is considered to render to increase the per capita construction cost.

8.5.2 Operation and maintenance cost

O/M costs can be considered as the annual budget of the GIC and comprise; (1) fixed cost (rated maintenance cost, management cost of GIC, salary of personnel, subscription for SONEDE/STEG,, etc.) and (2) variable cost (purchase of water, electricity, disinfection)

The following are observed from the result of analysis of O/M cost:

1) Maintenance cost shares 50% of the O/M cost of all the sub-projects。

2) There is no big difference between the O/M cost "WSS with pumping" and that of "WSS without pumping" because even "without pumping", the purchase cost of water is high.
3) The "Extension GR" is the highest among five (5) types in terms of the water source due to higher fixed cost for maintenance and higher variable cost for purchase of water.
4) There is no big difference between the cost of purchase water of "Extension GR" and that of "SONEDE Connection".
5) The small-scale WSSs can not afford to employ the personnel for O/M.

It can be concluded that the rated maintenance cost is the critical component of the O/M cost.

The rate of the rated maintenance cost to the total construction cost of 65 sub-projects for 2005/2006 and 36 for 2000 varies between 0.15% and 1.26% with the average of 0.63%. It is proposed to take into account the particular conditions of each sub-project relative to O/M (such as employment of O/M personnel) in determination of the maintenance cost.

8.5.3 Financial analysis

The cost of $1m^3$ water was calculated as the amount of the O/M portion of the necessary price of water for having 5% of FIRR.

The revolving funds were considered as the revenue of the GICs in the financial analysis of the Study in 2005 so as to keep the GIC's accounting balance positive during the sub-project period. However, the result showed that the net cash flow became red during the first several years.

On the other hand, there were cases of which the calculated amount of the revolving funds exceeded the affordability of the beneficiaries. In such cases the financial analysis was modified with a reduced amount of the revolving fund within the affordability of the population and with a slight increase of the water charge of $1m^3$ water and the modification finally made the financial situation of the GIC during the project period always positive.

It is noted that the applied water charge of four (4) sub-projects, which will be merged with the existing GIC, is lower than the calculated one. The water charge of these sub-projects will be reviewed in the second year of the operation after the consultation with the beneficiaries of both new and existing WSS referring the F/S report..

8.5.4 Cost of $1m^3$ water and water charge applied

The median, maximum and minimum costs of $1m^3$ of 66 sub-projects for 2005/2006 are 0.621TD, 1.414TD and 0.273TD, respectively. The cost of $1m^3$ water exceeded one (1) TD, which is considered to be the affordability of the rural population, in sub-projects Ezzaguaya and El Ouena (LE KEF), Tirasset (MANOUBA) and Ouled El Faleh (SOUSSE).

There are several dominant factors which generally affect the cost, such as (i) necessity of

pump operation, (ii) type of water sources, (iii) purchase of water, and (iv) scale of the WSS.

Once the cost of $1m^3$ water is fixed, the water charge is determined considering commission for tap keepers. If the water charge exceeds one (1) TD, the rate of commission is decreased and sometimes the tap keepers are requested to work on voluntary basis.

8.5.5 Revolving Fund

When the projected WSS is put in service, the GIC in charge of management of the system has no income for the first several months while the GIC has to pay the cost of water supply. The beneficiary population was requested to contribute certain amount of money to compensate for the debt balance as the revolving fund.

The amount of the revolving fund is normally determined equivalent to four (4) months expenses of the GIC in the first year.

When the calculated amount of the revolving fund was considered to be higher than the affordability of the population, the water charge was increased a little so as to reduce the amount of the revolving fund within the affordable level of beneficiaries. The amount of the revolving fund together with the water charge was thus determined with the approval of AGR.

8.6 Detailed design

8.6.1 Detailed design

(1) Geotechnical survey

The geotechnical survey was carried out in 13 sites of the projected elevated tanks. Test boring was conducted at the construction site and core samples were taken. The geological logs revealed that in general the surface layer up to 10m in thickness consists of sand and clay. As a result of SPT (standard penetration test) the N-value got from the test of the ground almost exceeds 50. The bearing capacity of the foundation ground was estimated using Terzaghi's formula. Stability of the elevated tanks was examined and confirmed against horizontal load of wind.

(2) Preparation of design for installations

The detailed design was carried out applying the standard designs of DGGREE for the installations of sub-projects categorized as follows:

- Intake works
- Transmission and distribution pipelines
- Distribution tanks
- Ancillary works of pipeline
- Service installations
- Other facilities (disinfection station and GIC office)
- Pump facilities including power supply

In the above, the detailed design of the pipelines was completed based on the topographic

survey during the basic study. The standard designs of SONEDE for elevated tanks of which specifications did not meet the DGGREE standard designs and for the intake facilities for the SONEDE WSSs were also applied to the detailed design.

(3) Work quantity survey

Construction work quantity survey for the sub-projects for 2005/2006 consists of pumping stations, pipelines, distribution tanks, relay pumping stations, service installations, electro-mechanical equipment, electric work, disinfection facilities, ets. In the feasibility study, the work quantity was approximately estimated by number of the installations and facilities. By contrast, in the detailed design, the quantity of each work item was calculated based on the detailed design drawings.

The work quantity of (i) earth work, (ii) concrete work, (iii) mortar coating for waterproof, (iv) doors and windows, etc. are fixed corresponding to the standard design of pumping station and distribution tanks by DGGREE.

8.6.2 Tender document

(1) Application of model tender documents prepared by DGGREE

DGGREE had elaborated standardization of the detailed design, tender procedure and technical specifications for pipe and fittings, civil works and electro-mechanical equipment so that each CRDA could develop the Rural WSS under the similar conditions.

DGGREE updated the bidding document to be applied to the implementation of the sub-projects for 2004 to 2006 financed by JBIC. The bidding documents of each sub-project generally consisted of two lots of (i) construction of civil works and (ii) installation of hydro-mechanical-electrical works.

(2) Procurement lots

Because of the small-scale construction works, the simplification of bidding procedure and the execution of works, the number of bidding lot was limited to one (1) or two (2). In all the sub-projects, the construction works (pipeline and its ancillary facilities and civil works) was allotted to the Lot 1 and Lot 2 was prepared for electrical equipment, if necessary. The Lot 2 was, however, considered as one contract for all the sub-projects of CRDA. The equipment of disinfection facilities was in general included in the Lot 2, however, the Lot 1 was applied in case that there was the contract for electro-mechanical equipment and electric works.

8.7 Study on quality control of construction works

8.7.1 Site Investigation

(1) Selection of sub-projects and facility for observation

Twenty (20) sub-projects constructed in JICA Study in 2000, including four (4) projects under construction in the governorates of Jendouba and Mahdia, were selected as the site for observation.

The observation was focused on the following items that might affect the functional durability of AEP facilities:

1) Water leakage (pumping station, pipe, tank)
2) Pipe support (pumping station, appurtenant structure, tank)
3) Finishing of building (pump station, tank)
4) Finishing of wall (tank)
5) Drainage from pit
6) Surface condition of concrete (pillar of elevated tank)
7) Pumping equipment / chlorination facilities

(2) Observed problems and their frequency of observation

The observation identified the following problems (frequency in parentheses):

1) Cracks on mortar coating on the outside wall of the tank, etc. (43%)
2) Cracks on waterproof mortar on the inside wall of the tank (26%)
3) Water leakage from the pipe joint (3%)
4) Unstable pipe support (4%)
5) Breakdown of chlorine facility (8%)
6) Incomplete finishing of the buildings, fittings, etc (3%)
7) Stagnant water in the valve pit (31%)
8) Subsidence and erosion of the earth embankment around semi-buried tanks (58%)

(3) Other findings in the site investigation

1) Honeycomb was observed on the concrete surface of semi-buried tanks and relay pumping stations under construction. Besides, repair work traces were observed on the concrete surface of pillars of an elevated tank.
2) The current standard design of relay pumping station assumes to utilize submergible pumps while in-line pumps are generally applied.
3) The work site record and completion drawings are properly prepared by the contractors, however, trial mix of concrete was not executed in nearly half of the CRDA offices, while record of rinsing and disinfection of pipelines could not be checked in any of the CRDA offices.

8.7.2 Examination on results of the site investigation

(1) Major problems and proposed actions

As a result of the observation, the following are considered major problems and actions to be taken:

1) In order to prevent cracks on waterproof mortar coating, the contractors are required to strictly follow the instruction of SIKA, which is also quoted in the standard quality control manual of DGGREE.

2) It will be necessary to improve the stability of embankment around semi-buried tanks. For this purpose, it is recommended changing the side slope to 1:1.5 and to compact the embankment per layer of 0.3m.
3) To prevent formation of honeycomb in the concrete, it is essential that the contractors execute trial mix test. Moreover, the contractors should establish proper work procedure for placing and compaction of concrete.
4) It is proposed to modify the form of daily work site record for construction of pipelines reflecting the specific nature of the construction activities.
   On the other hand, it is proposed to modify the Standard Technical Specifications specifying the responsibility of the contractor for preparation of execution drawings.

(2) Consideration on lifespan of each facilities

It is recommended maintaining the currently assumed lifespan of AEP facilities for the reasons; (i) above mentioned observed problems are judged not serious considering their influences on the durability and possibility of improvement by taking countermeasures, and (ii) it will be possible to attain the said lifespan, if the facilities are constructed under proper quality control and properly maintained.

8.7.3 Proposal on the standard specification, drawings and quality control manual

(1) Proposal on the standard technical specifications

It is proposed to add the following prescriptions to the existing Standard Technical Specifications:

1) Procedure for preparation/submission by the contractors and approval by the AGR of execution drawings including the joint reconnaissance visit to the site (Pipe Laying Work and Civil Work).
2) Determination of mix design of B5 concrete by trial mix test including the test procedure (Civil Work)
3) Compaction of the embankment around a semi-buried tank per layer of 0.30 m by manual tamping or using plate compactor (Civil Work)

(2) Proposal on the standard design drawings

1) It is proposed to change the side slope of the embankment around semi-buried tanks to 1:1.5 and the top width to 50cm.
2) It is proposed to apply the standard design of semi-buried tank to that of the relay pumping station with modification of the size of valve room.

(3) Proposal on modification of daily work site record

It is proposed to modify the form of daily work site record incorporating the followings:

- Executed work shall be recorded classifying into civil works and pipeline works.

- Material delivered shall be recorded with delivery location.
- Exact portion in the pipeline/structure where the work was executed shall be indicated.
- Execution of quality control test shall be recorded.
- Instruction/order to the contractors shall be classified into quality control, construction schedule and coordination with other works, contract and financial matters, and safety control.

9 LESSONS LEARNED

9.1 Lessons learned from the Study in 2004 and feedback to the Study in 2005

9.1.1 Preparation of the sub-projects

The identification card prepared by CRDA does not give clear idea on the sub-project area. In many cases the number of localities is far bigger than mentioned in the card. According to the model contract for the study of the RWS projects of DGGREE, the contract amount can not be increased except the topographic survey even if the work quantity is increased.

The resident consultants are discouraged to contribute to the sensitization of population due to such increase in the number of localities. It might cause insufficient sensitization. The Study Team requested to the resident consultant companies to submit the offer for the work contract based on the reconnaissance of sub-project areas.

9.1.2 Identification

(1) Accomplishment of beneficiary families list

In the Study in 2004, the prospective beneficiaries list was accomplished by the end of 1st visit. In this case, it was difficult to modify the project component after the 2nd visit. In the Study in 2005, the final determination of beneficiaries was postponed until the end of 2nd visit of the sensitization so as to ensure the access to water for people in need as much as possible.

(2) Reinforcement of identification of relay persons

Mobilization of the target population in the Study in 2004 was not sufficient. This result was related with sociologists' approach, as often observed in their dependence on "Omda". To ensure effective sensitization by mobilizing prospective users as much as possibl, the sociologists were requested to select competent man and woman relay persons in each locality.

9.1.3 Socio-economic survey

For appropriate presentation of the data from the household survey in socio-economic report, modification was made on the content of survey data such as: current water collection, annual income, OM/M of existing GIC.

9.1.4 Detailed survey

It was anticipated that the resident consultant companies collected the information of the basic infrastructure in the detailed survey. However, it was revealed in the 1st visit of the

sensitization that the engineers tended to neglect the survey and made it in the later period of the study. The Study Team discussed the results of the detailed survey and identified the data and information identified necessary for the study with the resident consultants.

9.1.5 Sensitization

(1) Land acquisition

Since there had been the case that delay of collection of contracts for land acquisition on hydraulic facilities affected the finalization of the sub-project design in the Study in 2004, it was requested to the entrusted consultant companies to collect all the necessary contracts by the end of the 2nd visit.

(2) Important themes to be introduced

1) Operation hours

The theme of operation hours of service installations was introduced in the sensitization meetings not only for consideration of the prospective users on workload of tap keepers but also for appropriate calculation of tank capacity.

2) Un-accounted For Water (UFW)

The actual UFW rate was reportedly higher than the design ratio of 15% in the RWS projects. It was supposed to be effective to raise awareness of the target population on this subject and the significance of water economy.

9.1.6 Planning

The Study Team, AGR and the resident consultant company held the meeting on selection of the optimum preliminary design. The Study Team recommended comparing the alternatives from viewpoints of not only construction cost but also O/M cost and easy maintenance.

9.1.7 Design

There were some sub-projects of which communal taps were designed to cover more than 200 users, in these cases, it was necessary to operate the service installations for more than 10 hours per day if the flow rate was fixed at 0.5 L/s. However, there was no information about complaints of inconvenience so far. It was also confirmed by DGGREE that the flow rate of 0.5 L/s for the communal tap described in the design guidelines was to be used for the determination of distribution pipe diameter but it was not controlled in the WSS.

The above information led the Study Team to recommend modification of the design method of the distribution system taking into consideration several factors which so far have not been clarified yet in the Study.

In this connection, the Study Team proposed to study/review: (i) introduction of hourly peak factor, (ii) operation hours, (iii) study on distribution tanks, (iv) necessary flow rate based on the water demand on locality basis, and (v) actual flow rate based on the hydraulic

conditions.

The following subjects were also discussed to achieve appropriate design of the Rural WSS:

1) Waste of energy
2) Necessity of flow control at the free discharge inlet of the tank
3) Selection of electromotor pump

9.1.8 Financial analysis

(1) Revolving fund

The objectives and definition of the revolving fund had not been clear and not considered in the financial analysis before the Stud in 2005, although this form of contribution was required in the management of the GIC. The revolving fund thus defined as the contribution of the beneficiaries and the amount of it is equivalent to four (4) months expenses of the GIC in the first year of the water supply service. Moreover, it should be considered as a part of the GIC revenue in the financial analysis.

(2) Cash flow of GIC accounting

It was observed that the balance of cash flow of GIC was generally negative for several years after commencement of the water supply service in the past. The situation required subsidy from local or central government which, however, was practically difficult. Consequently improvement of the balance of GIC cash flow has been made by including the revolving fund as the revenue of GIC in the financial analysis with necessary adjustment of the water charge.

9.2 Lessons Learned from the Study in 2005

9.2.1 Identification

The following are recommended taking into consideration the results of the Study in 2005:

1) More flexibility is required in selection of the relay persons including replacement of those who are considered ineffective.
2) An early commencement of the tasks of relay person should be planned in order to give them a better sense of responsibility and make them aware of the pivotal role.
3) It is desirable that sociologists establish more positive and human relations with the relay persons

9.2.2 Socio-economic survey and detailed survey

(1) Socio-economic survey

The socio-economic survey based on the household survey and PRA implemented in the Study in 2004 and 2005 can be regarded as one of achievements in the study for the RWS project of Tunsia. However, the survey method needs to be improved from several viewpoints, as follows:

1) The collected data through the household survey was not appropriately processed and analyzed. In some cases the sociologist did not spare enough time for the interview. The way of the household survey should be clearly mentioned in sensitization manuals.
2) The data collection should be consistent over the whole sub-items under the specific theme so that the collected data can be analyzed on the same basis.
3) The data collected by the socio-economic survey was not sufficiently utilized to identify specific needs or specific themes for the sensitization. The sensitization should be made according to the result of the socio-economic survey so as to focus more important themes in the sub-project area.

It is noted that, in general, the socio-economic survey takes risk to be viewed as a mere contractual task to be filled in by the consultant who is not fully aware of its impact on the parameters of the project study.

(2) Detailed survey

The resident consultant companies sometimes had the difficulties to collect necessary data/document concerning the detailed design and need strong support from CRDA concerned. However, such support was not sufficient and sometimes not timely made. Besides, the cost of collection of these materials will be a big burden to the resident consultants.

9.2.3 Sensitization

(1) Water charge method

Advantages and disadvantages of each water charge method were explained in the Study in 2005. However, the sociologists tended to insist the commodity charge as the best payment method. In sub-project Kalboussi, the population accepted reluctantly the proposed flat rate, which is higher than that applied by several neighbor GICs. There exists population who use tapped springs freely and refused the projected WSs.

The water charge method should be more flexible in the future. The target population can be free in selecting among different water charge methods by discussing with CGIC.

(2) Reinforcement of new themes for the sensitization activities

It may be concluded that the new themes for sensitization (operation hours and the UFW) succeeded to raise awareness of the target population. However, there was a difference in the understanding of these themes among the population.

It is recommended introducing these topics into the consolidation stage of the sensitization so that they would be understood until the moment of the start-up. For this purpose, the CGIC can plan small meetings with the relay persons that were selected in this study.

(3) Women's participation

The experience of an exclusive female meeting for women in some sub-projects showed its

effectiveness and its positive impact on the involvement of women in the process of discussion. In this respect an exclusive meeting for women by sub-project is desirable.

It is also recommended that the participation of women in the project should be discussed as a major topic in all the three visits of sensitization.

9.2.4 Planning

The Study Team recommended AGR selecting the preliminary design which offered the low O/M cost and/or easy O/M. However, it seemed still difficult for the engineers of the consultant companies as well as AGR to have the idea to evaluate the project from various viewpoints.

9.2.5 Design

A number of technical subjects have been brought to light, in the course of the study applying the modified design method, to be discussed for the improvement of the Rural WSS as well as the sustainability of the projects.

9.2.6 Financial Analysis

The rated maintenance cost occupies about 50% of the water charge. It is recommended reviewing the rate based on the actual maintenance cost of the existing RWSS.

On the other hand, GIC is required to use the budget in more rational way such as making a maintenance contract with a repair shop at competitive prices. If the maintenance budget can be saved, the GIC could be authorized to reduce the maintenance rate in the coming years.

10 FOR THE SUSTAINABILITY OF THE RURAL WATER SUPPLY PROJECT

The following are recommended for the sustainability of the Project based on the experiences and observations in the Study:

10.1 Review of water charge system

The commodity charge system is recommended by DGGREE/CRDA for the RWSS. However, each water charge system has the advantages and disadvantages. It is recommended considering and comparing the following conditions in the final selection of the water charge system:

1) The commodity charge system necessitates the commission fee of the tap keepers.
2) With the commodity charge system, the local population is not always satisfied with the uniform tariff because the service level is different among beneficiaries.
3) Monthly flat rate system does not require the cost for water charge collection. The system, however, encourages medium and high income groups to use water for productive use. It will be possible by applying different rate according to the consumption estimated.

4) Mixed rate, which consists of the low flat rate for basic service and relatively high commodity charge for extra service, might be one of the solutions.

10.2 Promotion of water consumption

The water charge is determined through the financial analysis over 15 years of the project period. In most of the sub-projects, the majority of the cost of the water supply is occupied by the fixed cost. As a result, water charge can be reduced if the water consumption is larger than the assumed in the analysis.

On the other hand, the WSS is designed to have the capacity meeting the water demand at the end of the 15 years project period. It is possible for the population to consume as much water as possible within the capacity of WSS. It is also preferable to encourage the population to consume more from the viewpoint of improvement of the hygiene condition and enhancement of the living standard.

10.3 Coexistence with conventional water sources

The local populations who collect water from shallow wells, wadis, springs, etc. for free do not always appreciate the convenience of the WSS. It will be difficult to prevent them from utilizing these conventional water sources. Beside, shortage of water resources is predicted in the near future.

In view of the above situation, it is recommended using positively the conventional water sources for the secondary purposes such as animal watering, kitchen gardening, etc. These secondary water consumptions should also be taken into account in the water demand projection of the RWSS.

10.4 Operation hours of the water supply system

The Study Team introduced the theme of operation hours based on the understanding that the WSS has to be managed with limited human and financial resources. The theme, however, was discussed in rather uniform manner and minor opinion was neglected in the Study. It is thus recommended reinforcing the discussion on this theme with the population in more flexible manner depending on the specific conditions that may arise.

10.5 Location and number of Service Installations

It is recommended taking the following procedure to determine the number and location of service installations:

1) to determine the standard flow rate of service installations considering the risk of cavitation, the nominal flow of water meter, pressure loss, etc.,
2) to determine the maximum number of population to be covered by one service installation,
3) to determine the total number of service installations to be installed in the locality,
4) to determine the location of the service installations with the population.

10.6 Practical participation of the beneficiaries

Indifference to the relationship between the population and the GIC is generally observed among the local population. Raising the population's sense of ownership of the WSS is necessary for sustainable operation of it. It is recommended sensitizing the population by introducing specific themes related to WSS (operation hours, UFW, tariff system, etc.) in the study stage by involving the population in the construction activity in the second stage, and organizing training session for maintenance and repair of small works in the operation stage.

11 FOR BETTER DEVELOPMENT OF THE RURAL WATER SUPPLY PROJECT

11.1 Review of the criterion on sub-project financial eligibility

The average per capita construction cost of the sub-projects in the North west hilly region is the highest among three regions while the number of the beneficiary population covered by the sub-projects is the lowest. The water supply coverage in 2001 of the four governorates in this region occupied the lowest four (4) among all the governorates. The topographic conditions of the region and the scarcity of the good water sources may hinder the development of the water supply system.

One of the objectives of the rural water supply project in Tunisia is to prevent rural exodus. It is important to decrease the disparity between the regions or governorates and, for this purpose, to give advantage to the sub-projects which are located in deprived area or unfavorable conditioned areas for water supply projects,

11.2 Preparation of sub-projects

There are a number of sub-projects of which localities to be covered were substantially increased from that of the identification card prepared by CRDA. However, the contract amount for the study was principally fixed based on the data of the identification card and increase of the workload imposed by unexpected number of localities would discourage consultants to conduct good quality work. Besides, a substantial increase in the implementation cost due to augmentation of coverage of the sub-projects may cause budget shortage. Improvement in the precision of identification card is thus essential for efficient development of the Rural WSS.

11.3 Promotion of beneficiaries' participation

11.3.1 Some modification of the sensitization manual

The current manual of sensitization is rather limited to the description of the preliminary sensitization stage closely linked with the feasibility study.

According to the Study in 2004 and 2005, limitations were also noticed in application of the sensitization manual in the field activities due to the lack of the practical guide such as insufficient involvement of relay persons, as explained below.

(1) The time was not enough to select competent relay persons in the identification stage. Besides, the selected persons were not properly guided to conduct as resources and relay persons for the projects.
(2) In spite of certain progress, women were sometimes weakly involved in the sensitization and their presence was sometimes formal. The social objection to women's involvement in community life was not treated by the specific program of sensitization.
(3) The informative approach was not enough considered to the extent of knowledge of the target population.
(4) Importance was given to the general information meetings, whereas the meetings of small groups were insufficiently organized
(5) The data collected through the household survey were not processed sufficiently to define the specific themes of sensitization.
(6) The specific themes in the sensitization of the consolidation stage during the construction were not identified with the prospective beneficiaries during the 3 rd visit.

11.3.2 Better application of the sensitization manual - design of the Practical Guide of the sensitization manual

Design of a practical guide for better application of the sensitization manual is proposed in the Appendix of this report taking into account the lessons mentioned in Section 11.3.1.

11.3.3 Constraints on the sensitization

Constraints on the sensitization include the following:

(1) The quality of the sensitization is affected by the capacity of the parties in charge of the sensitization.
(2) In case the sub-project area is unexpectedly enlarged the consultant company will be discouraged to maintain good quality of work.
(3) The traditions of meeting and dialogue in rural settings are generally not enough developed, therefore, the sociologist finds difficulties in sensitization of the population.
(4) The idea of shared responsibility and assuming the WSS management by community is not clear to the local population.
(5) The gender consideration is recently developed in rural environment. A lot of patience is needed to make effective introduction of the concept to the population.
(6) Most of the population is keen on the private connection.

11.3.4 Promotion of women's participation

The usefulness of women relay persons was recognized in some cases. In this regard, it is important to identify such persons at the first contact. In addition, it will be effective to select several relay persons per locality considering lack of experience to attend meetings and to take responsibilities at community level of the majority of women in rural area.

Women's implication in the provisional GIC committee is a crucial factor for the

sub-project sustainability. It is recommended making follow-up the women appointed as members of the provisional committees so that they can positively work for the committee.

11.4 Review of design methodology

11.4.1 Design consideration on the distribution system by gravity

The service installation consists of connection pipe with fittings, a water meter, stop cocks, a tap are distinguished from the distribution system by design method in urban water supply.

The distribution system is generally designed as looped network to make the fluctuation of dynamic pressure in the system small while the number of houses determine the diameter of service pipe considering the rate of simultaneous use by households and their water demand.

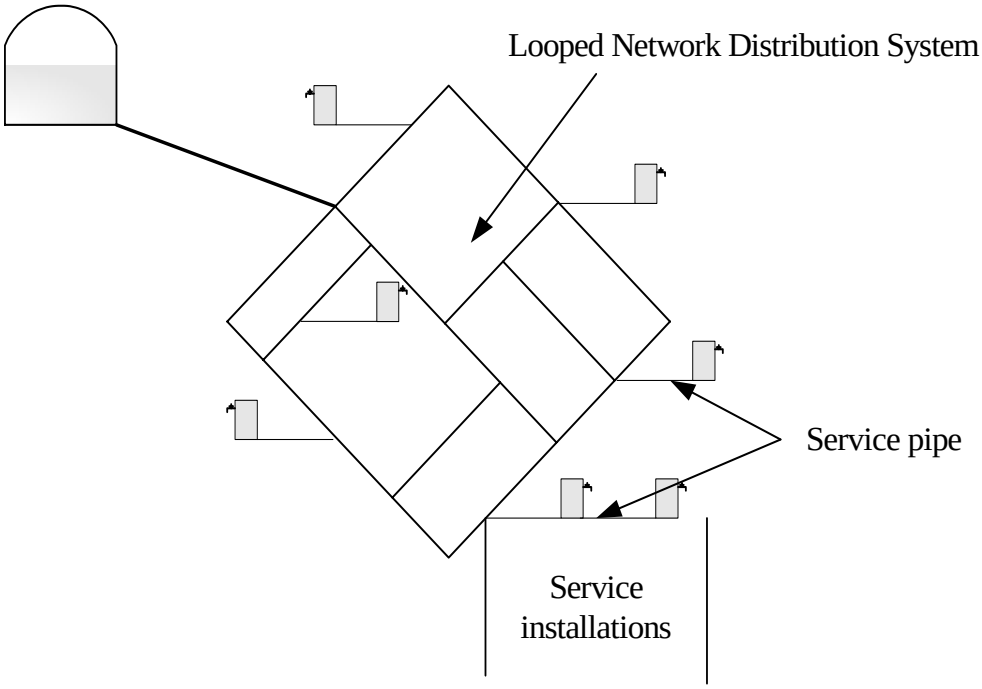
Following mathematical expression presents how to determine the flow rate, i.e. the diameter of the service pipe:

$$Q = (q_1+q_2+\cdots\cdots+q_n) \times p$$

where

Q : Design flow rate of the service pipe at the branching point from the distribution pipe
q_i : water demand of a household
p : simultaneous use rate

Figure 11.4.1 Distribution system and service installations



In case of the design of the sub-projects under the Study except pilot sub-projects, if the distribution system is assumed as the distribution tank, it is similar to the design methodology of the service pipe though the simultaneous use rate was not applied. Namely, the service pipe shown in the above figure corresponds to the distribution pipe in the conventional Rural WSS design.

Taps are connected to the distribution pipe directly and the pressure fluctuation of the

distribution pipe affects to the flow rate of the taps.

It is preferable to introduce the separate consideration on the distribution system and service system in order to the water supply service more stable. For this purpose, how to stabilize the distribution pressure is important.

Preparing several independent sub-service areas in the service area by constructing small distribution tanks seems to be one of the possible solutions.

There might be other solutions, for example, to extend a distribution pipeline to each sub-service area in which service installations are located on similar elevation.

The water supply engineers are requested to find out every possible ways considering site conditions, financial constraints, above-mentioned, experiences in other similar countries, etc. to realize more stable water supply system.

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11.4.2 Review of the presently applied design guidelines

The present design guidelines prepared in 1994 does not meet the present conditions of Rural Water Supply Projects. It is recommended reviewing some of the design factors as explained below.

(1) The specific water consumption, particularly of scattered population should be reviewed based on actual data on site.

(2) It is recommended setting the UFW rate at 15% in the first year and to increase the rate by 1% per year to reach at 29% at the end of the project period.

(3) There is no substantial difference in seasonal peak factors among countries. The socio-economic survey revealed that the factor is between 1.29 and 1.35 in Tunisia. On the other hand, there is no back data for the current applied hourly peak factor of 1.8. It is recommended reviewing the value of factor based on the actual data on site.

(4) It is necessary to maintain the flow velocity in the pipeline within the specified range as much as possible. Besides, it is recommended selecting the diameter of pipeline taking into consideration the following:

- Conveyance and transmission pipeline based on the maximum daily water supply.

- Distribution pipeline based on the maximum hourly water supply.
- Distribution branch pipe based on the number of household
- Maximum/minimum flow rate of service installation depends on the demand by users and type of the service installation.

(5) It is recommended that the capacity of distribution tanks should be at 50% of the maximum daily water supply in the final year of the sub-project period. However, if the transmission flow rate is not sufficient, the capacity should be determined through analysis of tank behavior.

(6) The operation hour of two hours in the morning and two hours in the afternoon is recommended for distribution tank behavior analysis.

11.5 Necessity of the design guidelines for the private connection

Private connection seems to be possible utilizing the existing WSS which is designed with the minimum dynamic pressure of 10 bar, around 50 lpcd consumption including animal watering and the minimum flow rater of 0.5 L/s in the distribution.

However, introduction of private connection may increase domestic water demand thereby increase the required capacity of the distribution system (pipeline, tank, etc). If number of service installations are increased, the flow rate in potentially (topographically) unfavorable service area will be decreased, unless the system is not designed to properly allocate flow by localities.

It is recommended taking into account the concept of private connection in the design of collective water supply system.

12 CONCLUSION

The financial eligibility, which is assessed by the per capita construction cost, as well as the social eligibility, which is judged by the commitment rate to the revolving fund of the beneficiary households, of all the 65 sub-projects to realize the WSSs are confirmed through the Basic Study under the Study on the Rural Water Supply Project (Phase II).

Needless to say, the capacity of WSS is quite small in comparison with that of the urban WSS. In spite of small scale, the WSS always requires OM/M cost similar to those of the large scale ones. This OM/M cost is reflected in the water charge applied to the sub-projects.

One (1) TD/m^3 has been always considered as the affordability of the rural population in the RWS project. Even the sub-projects of which proposed water charge is less than one (1) TD sometimes require tap keepers to work on voluntary basis and tap keepers and pump operators with relatively low salary. Even if they agree with such condition now, it does not necessarily assure long basis contribution.

On the other hand, the strong request for the private connection may bring the population dissatisfaction with the collective water supply. It may affect the motivation of the population

on participation in OM/M of the projected WSS through the GIC.

The parties concerned with the Rural Water Supply Projects in Tunisia are requested to continue the efforts to build the ownership of the projected WSS of the population so as to maintain and reinforce the active participation in the GIC.

THE STUDY ON
THE RURAL WATER SUPPLY PROJECT
(PHASE II)
IN
THE REPUBLIC OF TUNISIA

FINAL REPORT

MARCH 2006

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1 INTRODUCTION

1.1 Background of the Study

Tunisia is situated mostly in an arid region with the annual average rainfall of 230 mm over the country. It is one of the important issues for development of the country to effectively exploit the limited water resources and thereby provide safe drinking water to the population.

The Government of the Republic of Tunisia (hereinafter referred to as “GOT”) planned to increase the coverage of the rural water supply up to 90% in 2006 from 81 % in 2001 by the Tenth 5-Year National Development Plan (2002-2006) by implementing 441 new sub-projects and other rehabilitation sub-projects which will benefit around 220,000 people.

The GOT requested the Government of Japan (hereinafter referred to as “GOJ”) to extend the ODA loan to the 346 sub-projects (191 new and 155 for rehabilitation) in 20 governorates. In response to the official request from GOT, Japan Bank for International Cooperation (hereinafter referred to as “JBIC”) dispatched a Special Assistance for Project Formation Team in June 2002 (hereinafter referred to as “SAPROF 2002”). As a result, 242 sites were selected as proposed sub-projects (157 new and 85 for rehabilitation).

Through consultation with GOT, JBIC finally determined to finance 159 new sub-projects and 85 rehabilitation sub-projects and the loan agreement was concluded between JBIC and GOT in March 2003.

GOT, which appreciated the performance of Japan International Cooperation Agency (hereinafter referred to as “JICA”) in the Study on the Detailed Design on the Rural Water Supply Project in the Republic of Tunisia in 2000 (hereinafter referred to as “JICA Study in 2000”), officially requested JICA to conduct the Study on the Rural Water Supply Project (Phase II) (hereinafter referred to as “the Study”).

JICA examined the request and dispatched a Preparatory Study Team for the implementation of the Study on 94 sub-projects which are scheduled to be implemented in 2005 and 2006 (hereinafter referred to as “Study in 2004” and “Study in 2006”, respectively). The Preparatory Study Team and the GOT concluded on the S/W (Scope of Work) of the Study. It was mutually understood that the sub-project under the S/W might be replaced or cancelled due to problems such as inappropriate source water quality, etc.

1.2 Objectives of the Study

The objectives of the Study are:

(1) To prepare the basic design, operation and management program of the water users

group (hereinafter referred to as “GIC”), detailed design and tender documents of the new sub-projects for 2005 and 2006, and

(2) To pursue the transfer of knowledge to the counterpart personnel in the course of the Study

1.3 The Study Area

The number of sub-projects under the S/W of the Study by the JICA Study Team was revised, through the Inception Meeting between General Department of Agricultural Engineering and Water Management (hereinafter referred to as “DGGREE”) and the JICA Study Team (hereinafter referred to as “the Study Team”) to 46 for the Study in 2004 and 34 for the Study in 2006 for the reasons that the detailed design had already been completed for the rest of the sub-projects by the Regional Directorate General for Agricultural Development (hereinafter referred to as “CRDA”).

The area of Study in 2004 was further examined at the beginning stage of the feasibility study in 2004. Eleven (11) sub-projects were cancelled as the result of water analysis of the projected water sources. Besides, one (1) sub-project was cancelled because the project area had already been covered by SONEDE and another sub-project was also cancelled because the water quantity of the projected water source is not sufficient. The number of sub-projects for 2005 was thus determined to be 33.

The area of Study in 2006 was examined through water analysis of the projected water sources and feasibility study in 2005. Part of the water analysis had been made in 2004. The water sources of six (6) sub-projects were found not appropriate to be utilized as drinking water and, as a result, alternative sub-projects were examined and selected. Besides, one (1) sub-project was replaced, since the sub-project area had already been covered by SONEDE, while another sub-project was finally cancelled due to strong demand for the private connection by prospective beneficiaries. The number of sub-project for 2006 was thus determined to be 33.

The Areas of Study in 2004 and 2005 are shown in the Location Map. Tables 3.3.1a and 3.3.1b show latest situation of the sub-projects.

1.4 Activities of JICA Study Team

The JICA Study Team headed by Mr. Toshihiro Tsuchiya commenced the preparatory work for the Study on November 13, 2003. The Study Team mobilized to Tunisia on December 6, 2003.

The JICA Study Team assisted by JICA Advisory Committee had a series of consultation meeting with DGGREE from December 8 to December 11, 2004. The minutes of meeting on discussion of the Inception Report was signed by the both parties on January 11, 2004.

The JICA Study Team carried out the Study in 2004 from January to November 2004. The Study was divided into five (5) lots and entrusted to the local consultants. The water analysis of the projected water sources of sub-projects was also entrusted to a local laboratory. Two (2) orientation workshops were organized at the beginning stage of the feasibility study targeting the local consultants and personnel of the District Agricultural Engineering Offices (AGR) concerned respectively.

A stage-wise implementation was applied to the feasibility study. The Study Team organized separate consultation meetings for each of the governorates concerned to discuss about the feasibility study reports and socio-economic study reports. After completion of the feasibility study the local consultant prepared detailed design and draft tender document. The results of the Study were summarized in the “Basic Study Main Report” and “Detailed Design and Tender Document Main Report”.

The Study Team carried out the Study in 2006 from January to November 2005, applying, in principle, almost the same method and procedure employed in 2004. The Study was entrusted to the same local consultant companies which carried out the Study in 2004. The water analysis of the water sources of sub-projects was also entrusted to the same local laboratory in 2004. Two (2) orientation workshops were organized in February and March 2005 focusing on the issues observed in the Study in 2004 and new themes proposed to be introduced in 2005.

Part of the water analysis of the projected water sources of sub-projects for 2006 had been carried out in the middle of 2004 to expedite the Study in 2005. Sampling and water analysis of the projected water sources was practically completed by the end of March 2005.

In May 2005, the Study Team proposed modification of the design method of DGGREE. Fifteen (15) pilot projects were selected for application of the modified method in the feasibility study. In June, a workshop was organized focusing on the hydraulic analysis of the distribution pipes, volume of distribution tanks and financial analysis. In addition, the Study Team reviewed the hydraulic condition of the distribution pipelines of sub-projects for 2005.

The expert of the JICA Study Team visited the Ministry of Public Health, SONEDE, CRDA and GIC to collect information about water treatment and monitoring in Tunisia.

During the third visit of the sensitization in August to September, the Study Team conducted an impact survey on relay persons to see whether women relay persons have been positively changed.

1.5 Organization of the Study and Staffing

1.5.1 Organization of the Study

Organization of the Study consists of the JICA Study Team, DGGREE/Department of Rural Potable Water (hereinafter referred to as “DEPER”) and CRDA/ AGR.

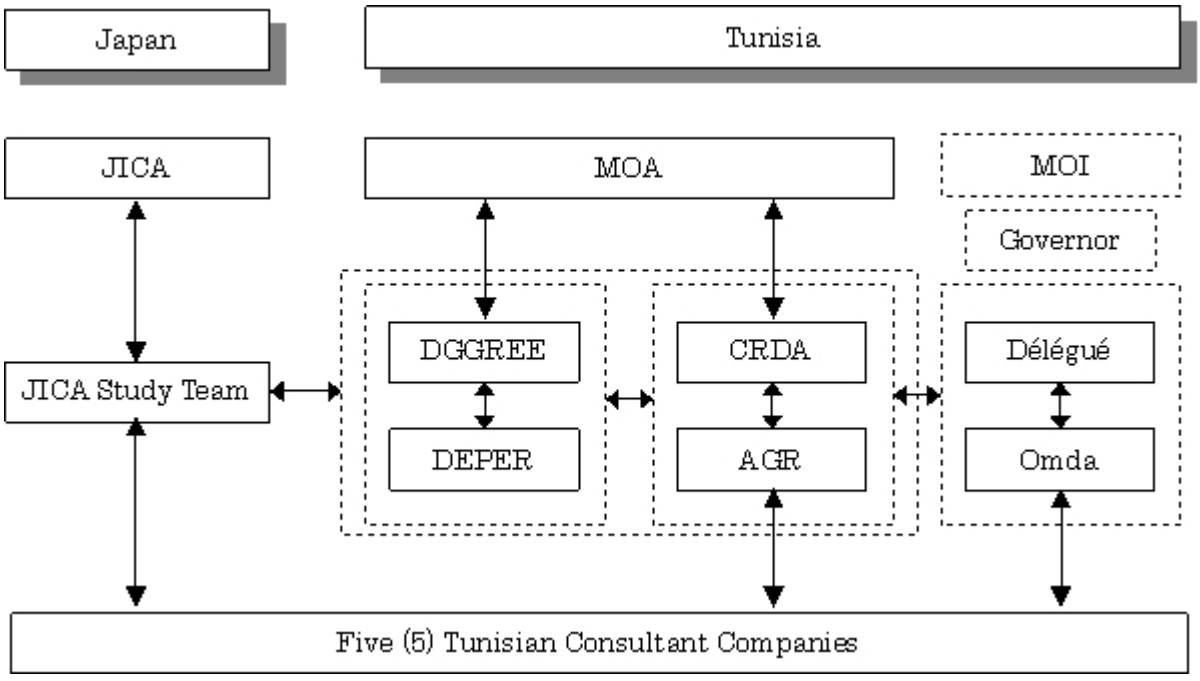
DEPER of DGGREE that is the principal executing agency for the Study was assigned as the counterpart of the JICA Study Team. Major issues relative to the Study were discussed between JICA Study Team and DEPER for mutual understanding. For field activity of the Study, DGGR/DEPER provided necessary arrangement and coordination between CRDA/AGR and the JICA Study Team.

CRDA/AGR, the actual executing agency of sub-project, is the key organization at local level. CRDA/AGR provided all the major information and comment necessary for execution of the Study on sub-project basis. The field activity of the contractors was carried out under the coordination of CRDA/AGR.

The JICA Study Team subcontracted the Study work to five (5) Tunisian consultant firms.

Organization of the Study is illustrated as follows.

Figure 1.5.1 Organization for the Study



1.5.2 Staffing

Experts of the JICA Study Team enjoyed excellent co-operation from the counterpart personnel of DGGREE/DEPER and CRDA/AGR.

Staffing of JICA Study Team, DGGREE/DEPER and CRDA/AGR is shown in Table 1.5.1. in the following page.

As seen in the Table, the same staffing was maintained, in principle, for the Study organization over the past two years, which greatly contributed to efficient and consistent execution of the Study.

Table 1.5.1 Staffing of the Study Organization

JICA Study Team	
Name	**Assignment**
TSUCHIYA Toshihiro	Team Leader/ Water Supply Planning and Design (1)
ABE Takatsugu	Water Supply Planning and Design (2)
TAMURA Hidehisa	Quality Control of Construction Works
TERAMATSU Sayuri / TANIMOTO Shinichiro	Water Analysis/Water Source Assessment/ Environmental Impact Assessment
TAKEMOTO Isaburo / FURUKAWA Kazumitsu	Electrical/ Mechanical Design
HAMAOKA Maki	Socio-economic Survey/ Sensitization Program (1)
Belgaccem KHESSAISSIA	Socio-economic Survey/ Sensitization Program (2)
Magdalena LUKOWSKA	Economic and Financial Analysis
KAMATA Shinnich / NAKANO Kennji	Interpretation
NISHI Mototaka / FURUKAWA Kazumitsu	Project Coordination

Counterpart Personnel of DGGREE/ DEPER	
Name	**Assignment**
GABOUJ Ridha	Study on Water Supply Project (Director of DEPER)
FAKHFAKH Mohamed	Civil engineering (Chief Engineer)
BRAHAM Taoufik	GIC Promotion (Chief of SGIC)
MNAJA Abdelhamid	GIC Promotion

Counterpart Personnel of CRDA/ AGR			
Governorate	**Chief of AGR**	**Chief of Study Section**	**Chief of CGIC**
Ariana	Mohammed Amara		Hamda Bahri
Manouba	Kamel Jlel		Kawther Zaafouri
Nabeul	Jenni Amor	Abderrazzak Fehri	Mondher Ben Abdallah
Beja	Noureddine Ferchichi	Mohammed Chebbi	Sihem Ben Salah
Jendouba	Med Néjib Nasraoui	Abderrahman Wasli	Néji Bousiidi
Bizerte**	Michani Mustapha	Guissouma Monia	Jaiari Hmaid
Le Kef	Mouldi Boussami	Hasnaoui Jalel	Brinsi Jounaidi
Siliana	Sami Ben Romdhane		
Kairouan	El Afli Abdeljalil	El Hedhili Kamel	Jemli Abdeljabbar
Kasserine	Nacib Belhaj Arbi	Mbarki Tahar	Nasraoui
Sidi Bouzid	Nejib Fhal	Choour Leila	Essaied Héni
Sousse	Med Salah Glaied	Mohammed Gaaya	Boghdadi
Mahdia	Hassin Ahmed	Baraket Youssef	Slouma Ali
Sfax*	Baklouti Abdelaziz	Mezghani Mohhamed	Taktak Mohhamed Hechmi
Gafsa	Jaballi Tahar	Sayah Fatma	Ben Ali Brahim
Medenine	Ben Ammar Mohsen		Khnissi Mokhtar

* Study in 2004 ** Study in 2005

2 NATIONAL SOCIO-ECONOMIC BACKGROUND

2.1 General

Tunisia, having lower altitude and least mountains in the Maghreb countries, is situated in the eastern part of the high Maghreb. Morocco and Tunisia, having less rainfall than that in other Maghreb countries, obtain the better position on the agricultural development.

Thanks to the geographical position, spanning the two basins near the Mediterranean Sea, Tunisia is the most largely exposed country to the influences of this Sea which reaches the interior of the land. Such influence its northern part to what geographers call Maghreb "utile", whereas its desert area is a junction between Algerian and Libyan Sahara. Desert area represents one third of the Tunisian area; therefore, Tunisia is more privileged in terms of climatic conditions than the neighbouring countries (84% of Algeria and almost whole Libya have a desert climate) except Morocco.

From the historical and natural viewpoints, the Maghreb countries are situated in the crossroad between Europe and Africa and between Christian west and Arab-Muslim east. Thanks to its central position, Tunisia play a melting pot for civilization.

Tunisia is the least Berber speaking country and has the highest population density in the Maghreb countries. It also shares inhabitants of 13 % and territory of 3.5 %. It is the first country to adopt the family planning, which contributed considerably in reducing the annual population growth rate and to a certain extent in controlling the imbalance between population and employment.

Situated in the center of the Mediterranean Sea, Tunisia obtained benefits from its location which has great strategic and commercial importance throughout history. The country shares 965 km of the west border with Algeria and 459 km of the south-eastern border with Libya, while the northern and eastern coasts stretch over 1,290 km.

The Tunisia can be divided into four geographical areas: the Tell, the ridge, Steppe and the South.

The Tell constitutes the set of relieves situated on the north of a line stretching from Thala (Kasserine) to Tunis. Altitudes are generally low (400 to 800 m), but some places reach 1,014 m in Ain Draham and 1,271 m in Kalaat Senan in Kef (Table of Jughurtha). This region is characterized by a set of hills and mountains that rarely exceed the height of 400 m and that separate huge plains. Madjerda is the principal river in Tunisia; its stem from Algeria stretches over 600 km including 400 km in Tunisia. An average annual discharge is one thousand million m^3, that brings a severe erosion. The Tell is the most fertile region in Tunisia and offers several possibilities of agricultural development.

The mountain chain that passes from south west to north east until Cap Bon peninsula, reaches the highest peak of the Chaambi mountain in Tunisia (1,544 m).

Steppes are in plains and mountains that form central Tunisia. High steppes are in the large high plains (more than 400 m) between which there are secondary mountainous chains. The drain from the high steppes is through the networks of big wadis, whose discharges have characteristics of intermittent considerably large in autumn and spring due to the arid Mediterranean climate. Except the rainy periods, the bed of these wadis is always dry because of insufficient rainfall, weak supply of water, strong evaporation and big infiltration. Low steppes are situated in the eastern part of the high steppes; it expands in the large plains that end in the east, near Mahdia.

The south region stretches from Gafsa in the west to Tataouine in the east. The area of Gafsa includes the Sahara (a region with few discharge and with high and thick dunes in the west getting thinner and finally disappear in the east). It also includes the Dahar (a sloping plateau of 400 m to 600 m height into which wadis occasionally have discharges that finally sank into sand) and the Jeffara (a huge monotonous plain including some hills and scattered small salt lakes).

The Tunisian coast (or Sahel) constitutes the economic core of the country, including important agricultural and industrial activities and harbours offering an access to foreign markets. The north of Tunisia is characterized as a Mediterranean climate (hot and dry in summer, soft and humid in winter), while in the south, climate becomes hotter and arider.

Despite four years of drought (1999-2000), the sector of agriculture remained as the principal income source offering the employment of one fifth of the working force. The fertile agricultural north, olive and dates production in the centre and the south, citrus fruits and vineyards in the Cap Bon are the distinctive traits of the country's economy. The rural sector was supported by the governmental policy which consists in implementing drinking and irrigation water systems in order to assure water supply for domestic and agricultural needs; especially in arid and semi arid areas in the central west and in the south. Tunisia has also important resources of fish. Mining exploitation does not play a significant role in the country's economy, but it is an important element for exploitation. Phosphate and iron are the major products.

2.2 Demography

Tunisia is a young country with almost 27% of population under the age of 15 years old[1]. Population rate has grown rapidly; it rose from 2.6 millions in1936 to 6.9million in 1984, to

[1]Source : Preliminary results of population census –INS- December 2004

8.8 million in 1994 and to 9.9 million in 2004 (data of the last general population census). Tunisia applied an effective policy of family planning which permitted the control of the demographic growth. Currently, population growth rate was reduced from 2.3%, recorded during the last decade, to 1.21%[2] according to the previous census. This policy reduced the pressure on economic growth, similarly the immigration which had permitted in the past to reduce the imbalance between population and employment.

The population has concentrated heavily in urban and coastal regions; actually, two thirds of population is in urban area. Unemployment still represents a considerable challenge that the Tunisian government has to overcome. It is officially estimated at 13.9%, however, judging from the underemployment condition, this figure will undoubtedly increase. Despite the lack of unemployment compensation, the generous system of forma or informal social security helps to decrease the adverse effects of unemployment.

Tunisia is a homogeneous nation: 98% of its population is originally Arab Berber. However, the country was exposed to an enormous cultural diversity. Phoenicians, Arabs, Turkish, Ottomans, Spanish Muslims, French and Italian colonizers have all left their prints/ traits in the country.

The level of human resources is high in Tunisia. Since the independence in 1956, the government has granted the priority to social development, as a result, school attendance rate reached 95% in 2004 and the majority of pupils continue their secondary education.

Although illiteracy rates decreased every year, further improvements need to be achieved; since 14.8% men and 31% women are still illiterate. Moreover, the government still registers a shortage of skilled labour among the 2.7 million domestic labours. It also gave priority to professional training, notably within companies; and a broader policy of upgrading which puts particular emphasis on the management skills was put into practice.

2.3 Rural Administration

The regional administration in Tunisia is based on 24 governorates with governors appointed by the president of the republic. Each governorate includes 5 to 19 delegations, with a total number of 254 delegations in the country. The delegate is appointed by the Ministry of Interior and Local Development. The delegation is made up of several sectors each being managed by an “Omda”, the head of the sector. The “Omda” is appointed by the governor. This system is controlled by the Ministry of Interior and Local Development.

There are also local departments pertaining to the different Ministries in each governorate. The local department undertakes the execution of the mandate of the concerned ministry. For

[2] Source; INS

example, the CRDA, the Regional Committee of Agricultural Development is the regional department of the Ministry of Agriculture and Hydraulic Sources.

2.4 Economy

Tunisia witnessed a considerable economic growth since 1987. Having few oil reserves, Tunisia relied on the capacity of its human resources, its geographical and strategic situation and its bonds with the European, African and Arabic markets.

Under successive plans of development that have been elaborated since 1987, Tunisia managed to reach an average growth of gross domestic product (PIB) of 4.8% between 1991-2001 and an almost equivalent growth between 2001 and 2004. This figure is about four times of that of demographic growth of 1.2%. As a result, the national product per capita increased from 2,837TD in 2001 to 3,380TD in 2004[3].

Employment situation improved noticeably; the coverage rate of employment demand increased from 76.4% in 2002 to 91.3% in 2004. As far as the unemployment rate is concerned, it decreased for the first time from 15% in 2001[4] to 13.9%.

Poverty rate decreased considerably in Tunisia. It shifted from 12.9% in 1980 to 7.7% in 1985, to 6.7% in 1990, to 6.2% in 1995 and to 4.2% in 2003. However, poverty remains relatively high in rural areas, notably in the middle[5] west and southwest where it is still between 10.5% and 12.6%[6]. Measures against poverty become more difficult since poverty proportion went down. In order to assure the effectiveness of these measures, it is necessary to get the concerned people involving more in the design and maintenance of programmes. The middle class represents almost 85% of the total population.

Nevertheless, Tunisia is still challenging to improve its performances and to get higher growth.

The Tunisian economic model is still suffering from certain structural weaknesses reflected in an insufficient investment rate (22.3% of PIB). Indeed, even if it is progressed to 4% in 2004 in comparison to 2003, unemployment rate is still high (13.9%) regardless of this improvement. The high salaries of civil servants which are higher than in similar countries and big amounts of the foreign debt (the coefficient of foreign debt service in % of current receipts is 14.1% in 2004)[7] are also the weakness of the Tunisian economic model. There is a two-pronged model of production, one prong is a totally exporting off shore sector

[3] Annual Report 2004, Central Bank, p.43
[4] Annual Report 2004, Central Bank, p.43
[5] National Households Survey 2000, INS, p.33
[6] National Household Survey 2000, INS, p.33
[7] Annual Report 2004, Cental Bank, p.43

that is adapted to satisfy the demands of the free market and another is a domestic market that still dominated in agriculture and informal economy.

It is worth noting that authorities are aware of these gaps and shortages and that they are keen on reducing them. Some concrete measures were taken to remedy the situation.

Actually, the finance act of 2005 authorizes the off shore companies to run out 30% of their sales turnover to the local market against 20% of the previous years. Concerning unemployment, the same law pertains to the future programme of the president (2005-2009) and brings in concrete responses. This programme plans to create 70 thousand companies, to reduce the fiscal pressure and companies' expenses, to reduce rate of taxation applied for goods with firm imposition and the simplification of procedures of companies setting up.

In addition, Tunisia set up the following major objectives as part of the tenth economic development plan 2002-2006: to improve the income per capita, to reduce actual unemployment rate, to promote investments and to consolidate exports.

Despite the fact that public companies are still dominant, contribution of the private sector in PIB increased from an average of 55% at the end of the ninth development plan to 56% in the present time. Its contribution is planned to reach 60% in the tenth plan. The fostering of privatization of public companies and the creation of private firms, the contribution of public companies will be more reduced. Actually, the private sector is destined to replace more and more the public one and to constitute the essential driving force in the economic growth.

There is a growing awareness of a need for a strong maghrebi economic alliance, composed of Algeria, Libya, Mauritania, Morocco and Tunisia, in order to reinforce market position of this region, to reach objectives of OMC and to facilitate economic integration in the market of the EU. Tunisia has become a member of the international organization of commerce (OMC) since1995. Actually, it signed an agreement of association with the European Union; thereby it attempts to ensure the general balances and the diversification of the economic base. It also supervises its budget deficit which is actually estimated at 3.5% of GDP in 2001while a reasonable level is 2.3%.

In the future, according to Tunisian authorities and the International Monetary Fund (IMF), the growth is expected regarding the promotion of exports, the development of tourism and the recovery of the agricultural production.

2.5 10th Development Plan

Under the 10^{th} development plan (2002-2006), Tunisia aims at promoting reforms and economic liberalization for a better economic growth.

The infrastructures, the basis of economic development, became the first target of investment. Under the 10th development plan (2002-2006), the budget allocated to the infrastructure was 10 billion TD (almost 8 billion USD).

Investment in infrastructure covers several sectors: transport (42% of total investments); preservation of natural sources, fighting against desertification (25%) and protection of the environment (13%). The other target sectors are: the urban and local development (7.66%); electricity and drinking water supply (6.37%); estate and administrative investment, essentially for the construction of administrative buildings (6.35%) and urban development (0.07%).

Water sector has the position in the national priorities. The 10th development plan devoted 1.9 billion TD to the mobilization of water comparing to 1.6 billion TD in the 9th plan. This will be used to finance the creation of irrigation area (1.1 billion TD), construction of dams, installation of pipelines (520.6 billion TD), agricultural management and development (9.5 million TD), drinking water supply for rural people (196.8 MTD) and the studies linked to the water sector (87.2MTD).

2.6 National Finance

2.6.1 Budget

The estimated budget for 2004 was 12,833 MTD within the framework of the complementary finances act and the budget revenues of the state increased to 12,741 MTD with a growth rate of 10.2% in comparison to 2003. It came from a total value of 68% national resources and 32% of different loans, which represents the same proportion as 2003.

Representing 83% of national resources of the state budget in 2004, tax revenues were 7,254 MTD with a growth rate of 623 MTD or 9.4% in comparison to 2003. Hence, tax pressure which was expected to be 20.3% of GDP went up to 20.6% as same level as 2003.

The expenses of the state budget were 12,996 MTD in 2004 with an increase of 17.6% in comparison to 2003. This increase is partly due to state policies to compensate for the rise of international levels of crude oil in addition to the expenses used in the refunding of national debt, notably the foreign debt.

The budget deficit in 2004 was 800 MTD that was 2.3% of GDP, against 1,015 MTD and 3.2% in the previous year. The financing of the deficit was ensured up to a limit of 73% by resources of net interior loans and 27% by resources of net foreign loan[8].

[8] Annual Report 2004, Central Bank, p.168, 171 and 174

2.6.2 Fiscal Policy

Tunisia maintained a cautious tax policy. During the last years, the tax policy was directed toward consolidation which helped to reduce the budget deficit in 4.6 % of GDP in 1997 and with an average of 3.7% between 1998 and 2000. In 2002, budget deficit was 3.2% of GDP and in 2004, 2.3%[9]

2.6.3 Monetary policy

The objectives of the Tunisian monetary policy are to preserve currency value while maintaining inflation rate as low as possible, similarly to its associates and its economic competitors.

In 2002, a policy of inflation control based on securing the adequate financing of economy was carried out to control the current deficit. The latter continued to reduce from 1,209 MTD in 2001 to 941 MTD in 2004, from 4.2% in 2001 to 2.0 % in 2004. This was achieved thanks to the consolidation of tourist revenues which increased from 1,903 MTD in2003 to 2,290 MTD in 2004[10] and to the improvement of an agricultural value after four years of drought.

2.6.4 Inflation

After reaching a low record of 1.9% in 2001, price inflation in consumption increased to 2.8%; it remained close to the average annual rate fixed in the 9th economic development plan and at - 0.1% in comparison to the objective fixed to be 2.9%. In 2003, inflation rate was 2.7%, yet, it rose in 2004 to 3.6%[11]. This level is due to the sharp increase of foodstuff prices (5% in average) whose consumption price index (base 100 in 2000) rose from 102.0 in 2001 to 115.0 in 2004[12] because of the effect of the insufficient production of certain food products, effects of years of drought and the increase of prices of services and manufacture products. Tunisian planners and responsible staff of IMF have estimated an inflation rate at 3% in coming years.

2.6.5 Debt

Tunisian foreign debt rise to 13,197.4 MTD in 2004 with a growth rate of 5.3% in comparison to 2003. However, Tunisia deserves credit because it has never rescheduled its debts. Foreign debts were maintained around 60% of GDP during the last five years and the

[9] Annual Report 2004, Central Bank, p.43
[10] Annual Report 2004, Central Bank, p.43
[11] Annual Report 2004, Central Bank, p.41
[12] Annual Report 2004, Central Bank, p.43<

proportion of debt service regarding the percentage of products and export services decreased slowly from 19.2% in 1997 to 14.1% in 2004 after being 13.3% in 2001.

2.6.6 Investment Rankings

Tunisia continue to benefit under certain conditions from a privileged and important support of financial bankers who foresee in the president's future programmes a serious commitment to give Tunisia a long term strategy of development as well as to resolve shortages and accelerate the development of the country on safer basis. The World Bank exposes orientations to solve main problems that impede the acceleration of Tunisian economic rhythm of development. Concerning the improvement of the contribution of private sector in investment, it recommends "the repeal of uncertain regulations" applying transparency rules of companies financial situation that obtain significant amounts of banking financing. It also recommends the improvement of the framework of economic competition, infrastructure development and autonomy of the administrative services. Finally, it suggests a bigger selectivity in granting bank credits.

In addition, according to the notice of June 2004, released by IMF, Tunisia shows an economic performance that ranks among the best in the Middle East and in North Africa. Actually, the economy improved due to the renewal of activity in the majority of sectors with agricultural sector in the first rank.

3 PRESENT CONDITIONS OF THE RURAL WATER SUPPLY PROJECT

3.1 Background

3.1.1 Rural Water Supply Project

In Tunisia, several issues on rural development could be identified such as low agricultural productivity, over-exploitation of the natural resources and rural poverty. There are strong linkages with each other.

The MOA, one of the main actors for the rural development, has been constructing the Rural WSSs, as one of the important rural infrastructures since 1980'.

Thanks to the efforts of DGGREE and assistance from donors such as JBIC, IBRD, KfW, etc., Rural WSSs have expanded remarkably. The number of GIC/AEP is 1581 and the coverage of RWS reached 83.5% at the end of 2003.

However, there are several issues in the RWS.

- There still exist areas not yet covered by Rural WSS
- Aging of the water supply systems constructed earlier necessitates rehabilitation, renewal and/or expansion.
- It is predicted that limitation of water resource availability will take place in the near future.
- Strong demand for private connection persists while the RWS service is made through communal taps.

These issues require strengthening of GIC capability in the OM/M, particularly of autonomous management. Moreover, efficiency and effectiveness of supporting organization for GIC such as CRDA/AGR, etc. are urgently required under the budget constraint and the decentralization policy.

In order to meet above requirements for RWS sustainability, DGGREE takes measures such as private sector participation, the assignment of 'Technical Director" by GICs, preparation of a design guideline for private connection introduction, etc.

3.1.2 Tenth Rural Water Supply Program

The main target of the Tenth Program is to supply safe water to 220,000 people in rural areas by implementing over 400 projects during five years from 2002 to 2006 of which total investment cost is 130million TD. Apart from the above, it is considered to implement over 75 rehabilitation projects.

The following table shows the detail of the 10th Rural Water Supply Program:

Table 3.1.1 Detail of 10th Rural Water Supply Program

(Unit: number of sub-project)

		2002	2003	2004	2005	2006	Total
JBIC	RWS Project (Phase 2)			67 (19)	66 (17)	55 (16)	188 (52)
IBRD	Water Sector Investment Project	70 (20)	76 (25)	20 (5)			160 (50)
KfW	Scattered Villages Water Supply Program	10 (4.5)					10 (4.5)
TUNISIA					40 (7)	37 (6.5)	77 (13.5)
	Rehabilitation			25 (2.5)	25 (2.5)	25 (2.5)	75 (7.5)
Total		90	76	112	131	117	516
		(24.5)	(25)	(26.5)	(26.5)	(25)	(127.5)

Note: Figure in parentheses show budget in MTD

Source: Report on SAPROF 2002

Followings are objectives of the RWS in the 10th Development Plan:

i) The coverage of the water supply service in the rural area at national level should be increased to 90% from 81% at the end of the ninth program and the minimum coverage at the governorate level should be 80%.

ii) Rehabilitation of the existing RWS facilities should be intensified to enable the optimum operation by GICs. The investment cost of the rehabilitation is 18% in the tenth program while 6% was allocated in the ninth program.

iii) Aiming at the improvement of the water supply system management by beneficiaries, the organization of GICs is to be reinforced by efficient sensitization and training of the beneficiaries. In this context, it is planned to facilitate a gradual introduction of private sectors to the RWS sector by developing a method to issue the bill for water used; the improvement of the GIC financial management and the O/M capability; and the dissemination of the water bill issuance and the water charge collection. CRDAs will intervene in the implementation of the above.

iv) The strategy for private connection of the beneficiaries to the Rural WSS is to be developed in response to the increasing water demand in line with the Demand Management Principle.

v) Pilot sub-projects will be implemented in order to introduce the private sectors for the operation, maintenance and management of the water supply systems; and water transmission and distribution in the rural area.

3.1.3 The Rural Water Supply Project financed by JBIC

3.1.3.1 PISA

In response to the requirement of the Government of Tunisia (GOT) which put the top priority to development of the agricultural sector and improvement of the living standards in the rural areas in the Eighth National Development Plan (1992-1996), the Overseas

Economic Cooperation Fund “OECF” (former organization of “JBIC”) implemented the Agricultural Sector Investment Loan Program (PISA: Agricultural Sector Investment Loan), which consisted of i) small scale dam, ii) groundwater exploration and development, iii) irrigation and iv) RWS. The implementation of PISA was completed in 1997.

3.1.3.2 The Rural Water Supply Project (Phase 1)

In the Ninth National Development Plan (1997-2001) GOT projected to develop the service rate of RWS up to 80% in 2001 by implementing 541 water supply systems for the target population of 347,000. International and/or bilateral cooperation was implemented to realize the 5-year development plan.

In 2000, the GOJ decided to extend a loan for implementation of the RWS Project, which consisted of “Project 2000” and “Project 2001”, through JBIC. JICA carried out the detailed design for the Project 2001 (JICA Study in 2000) and CRDAs for the Project 2000. As of October 2005, implementation was completed for 76 sub-projects out of 80 in total.

A technical assistance consultant assisted CRDA/AGR in supervision of the implementation of the Rural Water Supply Project with the following objectives:

i) Improvement of participatory approach
- Evaluation of sensitization activities conducted by local consultants for the detailed design of sub-projects
- Demonstration of MARP (Accelerated Method of Participatory Approach) in six pilot sites

ii) Assistance in supervision of the construction work of Projects 2000 and 2001
- Assistance in supervision of civil works of 80 sub-projects
- Work control of electro-mechanical work of pump stations in 60 sub-projects

iii) Improvement of water supply system management
- Improvement of organization of GIC
- Improvement of O/M of hydraulic equipment
- Improvement of accounting

3.1.3.3 The Rural Water Supply Project (Phase 2)

The RWS Project (Phase 2) covers 161 new sub-projects, of which 65, 57 and 37 sub-projects were scheduled to be implemented in 2004, 2005 and 2006, respectively.

The study of sub-projects for 2004 was carried out by CRDA. As of October 2005, implementation was completed or in progress for 48 sub-projects for 2004 covered by the JBIC finance.

The study of the sub-projects for 2005 was completed by JICA in 2004 and that of the

sub-projects for 2006 is in progress, though the study of the several sub-projects for 2005 and 2006 had been completed by CRDA concerned.

3.2 Organization for Rural Water Supply Project

Organization for the RWS projects consists of those of state, governorate and local levels. Their functions are closely linked with each other.

3.2.1 Organization at national level

The MOA is the core agency responsible for implementation of the RWS project at state level. The Ministry of Finance is concerned in the scope of finance and budget, and investment planning in line with the national development plan. The MOI is related with the creation of GIC which is administratively supervised by the governor. The MOPS is responsible for sanitation and hygiene related to drinking water. The Ministry of Environment plays an important role in protection of water resources.

Other agencies such as SONEDE and STEG are also related to the RWS in their respective field. SONEDE plays as an important supplier of water to GICs.

In the MOA, the DGGREE is directly responsible at the central level for water supply in the rural areas. DGGREE comprises i) Department of irrigation and agricultural water exploitation, ii) Department of water economies and iii) Department of drinking water and agricultural equipment (DEPER). The DEPER takes charge of planning, study and construction of the RWS systems. The SGIC of the Sub-department of Promotion of Water Users Organization supports the CGIC of CRDAs.

3.2.2 Organization at the governorate level (CRDA)

The CRDA is the regional organization of the MOA in each governorate, which is administratively supervised by the governor. The CRDA covers almost all the administrative functions of the Ministry of Agriculture at the governorate level. The GIH is an advisory committee to the governor with regard to establishment and management of GICs.

In CRDA, the DHER is responsible for the rural water supply and comprises four (4) sub-divisions including (i) agricultural engineering (AGR), (ii) irrigation (API), (iii) water resources (ARE) and (iv) maintenance of equipment (AME).

The AGR, the core organization for implementation of the RWS projects, comprises (i) unit for study (UE), (ii) unit for construction (UT) and (iii) unit for supports of GICs (CGIC).

3.2.3 Organization at local level (GIC)

In the local level, the RWS projects are supervised administratively by the "*délégué*", who is the head of the delegation appointed by the MOI. The delegation consists of several sectors. "*Omda*", the chief of sector appointed by the governor, administers the RWS projects in each sector.

The GIC is established for the purpose of operation and maintenance of the facilities related to irrigation, drinking water and drainage by the beneficiary group. The GIC has the legal personality and should be created either by government initiative or by the request of the concerned parties. Currently, there exist 2,717 GICs all over the country, consisting of 1,581 for drinking water (AEP), 1,022 for irrigation and 114 of combined GICs (2003).

The organization of GIC is set forth by the Decree together with its role and function.

3.2.3.1 General assembly (GA)

The GA, consisting of all beneficiary members, is the supreme organ of GIC. The first general assembly should be held within one month after official approval of the establishment. In the GA, members of Board of Directors are elected among the GIC members.

3.2.3.2 Board of directors (BD)

The BD is the management organ of the GIC. The members of BD are elected among the GIC members in the GA. The number of BD members should be 3, 6 or 9. The term of BD member is 3 years, though reelection is allowed.

The President (Chairman) of BD is elected by and among the BD members. The Treasurer is designated on recommendation of the BD and approval of the governor.

The BD usually hires the pump operator and/or the system caretaker, mechanic as required. For the effective GIC management, Technical Directors are being hired by some GICs with the cost shared by the GICs and the National Employment Fund (Projet 21-21)

Besides, the following contract systems have been introduced:

i) Contract between the CRDA and GIC on operation and maintenance
ii) Contract between the GIC and beneficiaries on the water charge

Contract system of operation and maintenance to be entrusted to the private sector is being introduced.

3.3 Current Situation of Sub-projects for 2005 and 2006

In the Inception Meeting of the Study, it was confirmed by the DGGREE and JICA that the JICA Study Team would undertake the detailed design of 46 and 34 sub-projects for the Study in 2004 and 2005, respectively. The study area of sub-projects was further examined at the beginning of each of the feasibility study. The number of sub-projects for the study has been finally reduced to 33 for the Study in 2004 and the same for the Study in 2005, for the following reasons:

- The quality of projected/backup water sources are not suitable to be used as drinking water (11 sub-projects),
- The sub-project area is covered by SONEDE (one sub-project),
- The capacity of backup water source is not enough (one sub-project),
- The population preferred the private connection and refused the sub-project (one sub-project).

In the identification stage of sub-projects, many localities were found not covered by the WSS, and accordingly the service areas of a number of sub-projects have been increased from those described in the identification card prepared by the CRDAs. The service area has been increased by 62% from that of the identification card (in terms of the pipeline length) of the sub-projects for 2005 and 2006.

Besides, in the identification stage, private connections were observed in a number of the Rural WSSs. In case that the GR extension sub-project will connect to the distribution pipeline of such a WSS, particular consideration was taken to secure sufficient flow rate to meet its design.

The Study in 2004 was completed in November 2004. The Study in 2005 is in progress as of November 2005. Currently, implementation was completed and/or in progress for five (5) sub-projects for 2005.

Tables 3.3.1a and 3.3.1b show sub-projects for 2005 and 2006, respectively (Rquiat sub-project in Mahdia is included in Table 3.3.1a, though implementation is scheduled for 2006).

Table 3.3.2 shows the progress of the sub-projects for 2005 of which study is completed in 2004 by the JICA Study Team. Around half of the sub-projects has started the construction works and remains are now under the tender procedure. It should be noted that the Kef Darougui-Sfaya sub-project in Beja has been scheduled to execute in 2006.

4 INTRODUCTION TO THE PROJECT AREA

A household survey was carried out in all the sub-projects in order to understand the socio-economic conditions of the sub-project areas. This survey was based on a household survey that included a total number of 2349 households, in 66 sub-projects, that is to say a sample which represented around 22% of the total number of households identified in all the sub-projects which is 10,837.

Other tools for the study were also used, such as semi-structured interviews conducted with men and women of each sub-project, the population needs ranking task, the drawing of the community mapping by the beneficiaries themselves. This set of information allowed the access to a complete knowledge concerning the demographic, social and economic conditions of the sub-projects' areas.

This chapter constitutes an introduction to the sub-projects' areas; the analyses included in this chapter are based on the results of the detailed socio-economic survey and notably the household survey.

4.1 Geography

The governorates in which the RWS projects will be implemented are classified into three regions, depending on the geographic, climatic and economic conditions that characterises the region. The classification of these regions is shown in the Figure 4.1.1.

1) Seacoast region: Governorates of Ariana, Manouba, Bizerte, Nabeul, Sousse, Mahdia. Sfax
2) Northwest hilly region: Governorates of Béja, Jendouba, Kef and Siliana
3) Middle west semi-arid region: Governorates of Kairouan, Kasserine, Sidi Bouzid and Gafsa.

The Seacoast region is located in the part of Tunisia which is opposite to the Mediterranean Sea and is affected by the Mediterranean climatic characteristics. Altitudes in this region are relatively low, the ground is generally flat, except for Bizerte, Manouba and Ariana, which presents some small hills, and the ground is slightly uneven. Beneficiating from the coastal climate, this region constitutes the nucleus of the Tunisian economy.

Nevertheless, rural areas of this region present the essential traits of the Tunisian rural setting: illiteracy rate higher than the average, population exodus in order to find a job, income level is quite low, activities based mainly on the dry, irrigated agriculture and livestock farming.

The Northwest hilly region is situated at the west of the metropolitan Tunis. Jendouba and Béja, which are located in the Northern part of the region, are in front of the Mediterranean Sea. The region relief presents altitudes that can reach 500m.

This region has a heavy and a relatively more regular rainfall than in the other regions. It is possible to conclude that it receives almost the 1/3 of the rainfall of the whole country. The annual rainfall in this region is generally more than 400mm. In the area of Nefza where two sub-projects will be implemented, the rainfall can reach 800mm per year, this offers to the region a relatively rich vegetation and to Tunisia one of the most fertile agricultural lands.

The Middle west semi-arid region is located in the easternmost part of the Atlas Mountains range. It includes steppes, which constitute a set of plains and hills. The high steppes constitute an area of large and high Plaines between which there are hilly links. It comprises the Tunisian Highest point, Jbel Chaambi, which has an altitude of 1,544m. The low steppes stretch over vast plains, which end at the west side of the country. This region includes also the south, notably the area of Gafsa.

The annual rainfall varies from 200mm to 300mm. The major agricultural products are, olives, almonds, dates, and some of the season fruits. The main vegetation developed in this region is alfalfa, which is a wild steppe plant used in the production of paper. This activity represents a seasonal source of income for the population of the region, notably Kasserine and Sidi Bouzid.

4.2 Demography

4.2.1 Annual Population Growth Rate

The Population annual growth rate, at the governorate level, is provided by the population general census of 2004. The census also provides the rates evolution between the decades (1984-1994 and 1994-2004). The rates are presented in the table 4.2.1.

The growth rate in the seacoast areas registered in 1994-2004 varies between 0.82% and 3.81%; whereas all the other governorates have a growth rate less than 1.0%. The Northern region presents rates comprised between – 0.51% and 0.02%, which are a little less than the rates recorded in the middle west semi-arid region, which are comprised between 0.25% and 0.64%. This is the most influenced region by the phenomenon of the rural migration towards the coastal region. Indeed, the migratory balance of this region decreased more and more; it shifted from less than 35,895 in1989-1994 to less than 45,224 in 1999-2004.

The population growth rate of the governorate of Ariana, which belongs to the Tunis metropolitan area, is the highest among the 15 concerned governorates, followed by Sousse, Manouba. The lowest growth rate is recorded in Kef.

Table 4.2.1, shows that comparing to the last decade (1984-1994), all the governorates have witnessed a substantial demographic growth of the population. The general demographic rate in Tunisia moved from 2.30% to 1.21%.

Table 4.2.1: The population growth rate of the concerned governorates (1984-1994 and 1994-2004)

1984-1994	1994-2004	Population growth rate	
		1984-1994	1994-2004
Seacoast Region	Ariana	4.70	3.81
	Manouba	3.80	1.89
	Nabeul	2.30	1.83
	Bizerte	2.00	0.82
	Sousse	3.00	2.30
	Mahdia	2.20	1.19
	Sfax	2.40	1.54
Northwest Hilly Region	Béja	1.00	0.02
	Jendouba	1.20	0.29
	Siliana	1.00	-0.45
	Le Kef	1.00	-0.51
Middle west Semi-arid Region	Kairouan	2.30	0.25
	Kasserine	2.60	0.64
	Sidi Bouzid	2.70	0.48
	Gafsa	2.70	0.51
	Tunisie	**2.30**	**1.21**

4.2.2 Population

Total beneficiary population of the 66 sub-projects is 55,082 inhabitants. The household number is however, 10,837. Table 4.2.2 displays the beneficiary population and the household number in each governorate.

Eighteen of the sub-projects have a population number higher than 1,000 inhabitants. Guergour-Brahmia-Fkayhia, located in the governorate of SFAX, is the sub-project which includes the highest number of beneficiaries, be 3,622 inhabitants followed by the sub-project of Gard Hadid in SIDI BOUZID, with 2,802 inhabitants. The minimum population number in the 66 sub-projects is 77 in Cebalet Ben Ammar in the governorate of Ariana, followed by Rmadhnia in MAHDIA, with 110 inhabitants.

The average size of the households in the total of the 66 sub-projects is 5.1. This average is higher than the Tunisian average which is 4.5 in 2004. As far as the average size of the households per region is concerned, in seacoast region the average size is 4.8, yet the average size in Sousse is rather high. Whereas the Northwest hilly region holds the least averages, varying between 4.2 and 4.9; the Middle west region has an average size of 5.5 inhabitants, holding thus the highest averages in GAFSA, 6.4 is the maximum average number of inhabitants per household in the 66 sub-projects; it was recorded in the sub-projects of Enjaimia in the governorate of Gafsa.

Table 4.2.2: Actual beneficiary population in each governorate

No.	Governorate	No. of Sub-projects	Population	Households	Average Size
1	ARIANA	2	367	78	4.7
	BIZERTE	3	2,284	501	4.6
	MANOUBA	3	711	152	4.7
	NABEUL	3	1,634	378	4.3
	SOUSSE	2	521	97	5.4
	MAHDIA	7	5,108	1,061	4.8
	SFAX	1	3,622	705	5.1
Sub-total		21	14,247	2,972	4.8
2	BEJA	3	4,888	1,154	4.2
	JENDOUBA	2	840	200	4.2
	LE KEF	4	2,529	553	4.6
	SILIANA	6	3,580	729	4.9
Sub-total		17	11,837	2,636	4.5
3	KAIROUAN	8	4,921	875	5.6
	KASSERINE	9	12,742	2,313	5.5
	SIDI BOUZID	7	9,395	1,736	5.4
	GAFSA	4	1,940	305	6.4
Sub-total		28	28,998	5,229	5.5
Total		66	55,082	10,837	5.1

Note: 1 ; Seacoast region, 2 ; Northwest hilly region, 3 ; Middle west semi-arid region

4.3 Socio-economic Conditions

4.3.1 Social Characteristics

The three regions present common features, related to their belonging to the Tunisian rural world. These features are characterized by:

- An illiteracy rate higher that the Tunisian national average, mainly among women.
- Weak participation of women in the social life in spite of her dominating role in the economic field and particularly the agricultural activity.
- Sharing the same beliefs and commitments to the same religious or Para religious practices, such as the veneration of marabouts and the presentation of offerings during the same period of the year (autumn).
- The survival of the rural populations is related to the urban center's contributions, where young and adult men generally go for a period of four or six months in order to find income sources as substitution to the modest sources provided by agriculture, which mainly based on dry agriculture and sheep farming.
- Wishful for the lifestyle in city
- Scarce organisations for dialogue and community life, likely to educate the population to civic behaviors. This major deficiency is doubled by a spirit of assistantship.

Apart from these similarities, each region has specific characteristics which will be described below:

4.3.1.1 Seacoast region

This region is located next to the most important industrial and costal towns of the country: Tunis, Ariana, Nabeul, Sousse, Sfax, and Mahdia. This region is inhabited partly by the old pastoral tribes, which lived in transhumance towards the north of the country and which become gradually stable. This region is characterized by a continued discord between an ancestral farming community, which constitutes the fundamental element of this region, and an increasing flow of people coming from far rural areas, seeking to approximate the cities where they hope to find interesting opportunities of employment. The reconciliation is taken place very slowly, but not totally; it is for such reasons that in this region the population is heterogeneous and having diverse demands.

The major feature of the people is the strong desire for the urban lifestyle to which they are close and which rejects them, condemning them to marginal life at the periphery of the large cities.

The behavior of this population is neither rural at 100% nor urban; it is a kind of mixture of the different degrees of rural and urban styles. This population accepts the offered services notably that of drinking water, nonetheless, it longs for a service of better quality, that is introducing comfort to their households through private connections. This population is more unsteady than the populations of the other regions. It is important to point out that the sensitization programs should account for such factors to promote the sustainability of water systems they will beneficiate of.

4.3.1.2 Northwest hilly region

This region is the part of the country which was more affected by the destruction of its farming community, due to shifting the best lands into buildings. This resulted in pushing the small farmer to the hilly and the forest areas where resources are meagre. Therefore, these farmers depended on migration to the costal areas seeking to substitute their agricultural work which became insufficient to supply survival needs. Hence rich and fertile lands of the region were given up to foreign investors.

This situation has created within the population of this region a feeling of frustration, mistrust and suspicion toward foreigners as well as a kind of aggressiveness and lack of hospitability. In order to decrease their expenses this population has recourse to free of charge water and forest products. The absence of men in this region and their lack of motivation imposed on women heavy charges, which she is forced to assume to ensure the survival of her family.

Family habits have been weakened in this region more quickly than in the other regions and the mechanisms of traditional solidarity was broken too; thus the collective social

structures suggested to this population require an intense sensitization in order to evoke the community spirit.

4.3.1.3 Middle-west semi-arid region

This region is the former territory of pastoral tribes who lived centuries of transhumance toward the Tunisian fertile north in order to ensure pasture to their livestock. During a long period, the inhabitants of this region relied on only one resource: livestock breeding. 50 years ago, and after the Tunisian independence, these tribes started to settle. Actually, road construction, social housing, collective social equipments, and the spread of electricity and drinking water encouraged this population to settle down and to diversify their sources of revenue through arboriculture namely olive tree and almond tree; known for their resistance to dryness. The inhabitants lost their custom of transhumance and adopted another migratory habit, that is exodus to the costal urban centers seeking thus supplementary income to the meager local incomes. They attempted to seek other revenue sources but they remained attached to their lands.

Contrary to the Northwest hilly region, the inhabitants of this region have preserved stronger family customs and solidarity that is more enduring. The hospitability of this population is vivid since they did not go through aggression, as it is the case of the northwest hilly region. The lands of this region are not so fertile to attract foreign investors.

Despite their contribution in the agricultural activities, women in this region are less solicited than in the northwest where the long absence of their husbands and sometimes his resignation attributes heavy tasks to women.

Rather homogeneous the population of this region is made up of lineage that seeks to be perpetual; hence, a high fertility is noticed in region. Contrary to the northwest region where the demographic fertile started much earlier, the fertility rate in the Middle west started decreasing rather belatedly.

Conversely, to the northwest farming community, which was uprooted from their ancestral lands, the Middle west farming community was encouraged to settle down in its lands and to improve them thanks to governmental programs of irrigation.

The social collective structures proposed to this population, notably GIC of drinking water projects, are likely to by successful considering the social links which are more homogeneous and stable and the population that is more willing to preserve their achievements.

Nevertheless, the habit of dialogue and consultations remain low in the three regions, and community and spiritual life is rather poor. Mobilization of this population for social collective activities such as the drinking water project, requires much effort so that to

develop a feeling of responsibility and to raise women's awareness, in particular in order to play a more essential role in community life instead of the usual secondary role.

Effort made in the Study showed that there are achievements that need to be consolidated; notably women participation in sensitization meetings, assigning them the tasks of relay persons and appointing them tap keepers or members of the provisional GIC committee. Women's participation in social life is still insufficient due to socio-cultural resistance which puts back the essential role that women can play in the development of rural communities. In this regard, it is necessary to prepare specific consolidation programs.

4.3.2 Hygiene

4.3.2.1 Medical facilities

(1) Medical care in the sub-project areas

Table 4.3.2 displays the available medical care in the sub-project areas. Most of the sub-projects do not have health facilities in their area, except for 11 sub-projects.

(2) Access to medical care

Medical care is not available in the majority of the sub-project areas, the average distance to is relatively long. In three sub-project areas, the average distance separating the sub-project areas from the health facilities is 6.5 km. Distances of the Northwest hilly and Middle west regions are relatively longer, respectively 6.2 km and 7.5 km.

Table 4.3.1: Access to medical care

Region	N° of projects	N°of projects having mediacal care system	Disatnce to medical facilities (Ave. Km)
Seacoast region	21	4	5.6
Northwest hilly region	17	0	6.2
Middle west semi-arid region	28	7	7.5
Total	**66**	**11**	**6.5**

Table 4.3.3 and the Figure 4.3.1 show the target population perception of accessibility to health care.

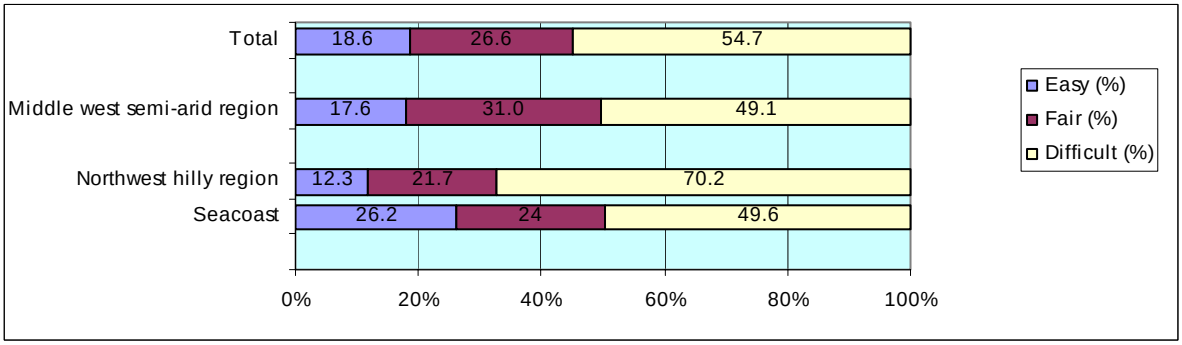
- The target population of the northwest hilly considers the access to medical care more difficult than in the other regions, because of the insufficient infrastructure and the long distance, as mentioned above. Additionally, the mountainous and non-paved pistes and secondary roads make the access to the majority of the sub-project areas difficult.
- The access to medical care in the coastal region is relatively easy, comparing to the two other regions, probably because of the shorter distances and the easily accessible roads

to medical facilities.

Table 4.3.2: Perception of the access to the medical facilities

region	N° of Sample	N° of reponses	Response rate	Easy (N°)	Easy (%)	Fair(N°)	Fair (%)	Difficult (N°)	Difficult (%)
Seacoast	670	653	97.5	171	26.2	158	24	324	49.6
Northwest hilly region	620	604	97.4193548	74	12.3	131	21.7	424	70.2
Middle west semi-arid region	1059	1059	100.0	186	17.6	328	31.0	520	49.1
Total	**2349**	**2316**	**98.6**	**431**	**18.6**	**617**	**26.6**	**1268**	**54.7**

Figure 4.3.1: Perception of the access to medical care

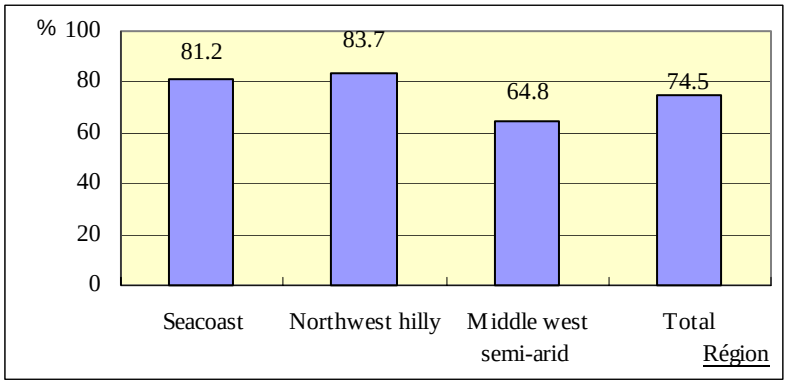


4.3.2.2 Sanitary Equipment (Latrines)

(1) Coverage of latrine equipped in the house

The average existence of latrine in the localities of sub-project areas is 74.5%. Latrines exist in the Middle west semi-arid region shows lower than that of other two regions.

Figure 4.3.2: Coverage of latrine equipped in the house



(2) Latrines location

The figure 4.3.3.1 and 4.3.3.1 show the latrines location, respectively of the sub-projects of 2004 and those of 2005: that is to say, whether they are placed inside or outside the house or inside the house fence. In 2004, the rate corresponding to “inside” is least low except in the seacoast region where it reaches 59.5%; the rate corresponding to “outside” is very high

in the middle west semi-arid region. In 2005, another category was added to the questionnaire to determine whether the latrines are placed inside the house fence or completely outside the house.

The latrine is generally installed outside the house itself; they are outside the house and this category represents a total rate of 38%, or inside the house fence and they represent a total rate of 45%. This condition is mainly due to the lack of reliable sewage system. It may cause bad smell that might affect the amenity.

Figure. 4.3.3.1: Latrine placement (Study in 2004)

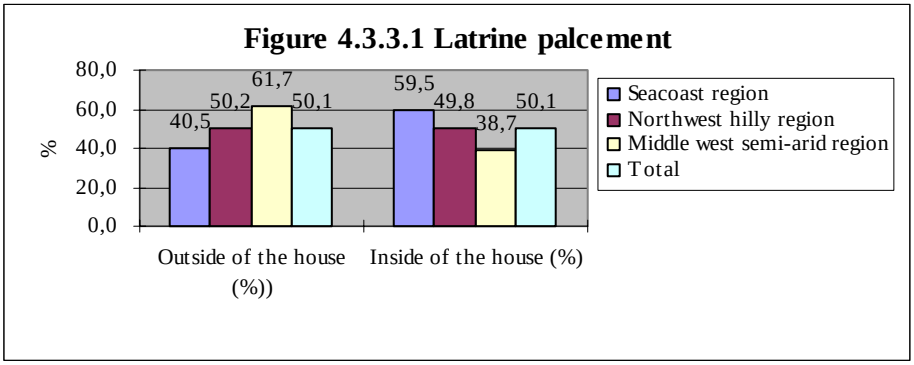
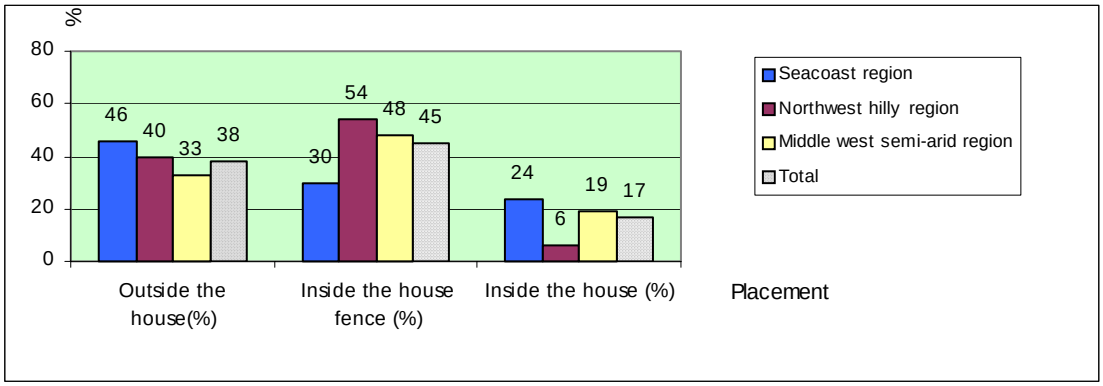


Figure. 4.3.3.2: Latrine placement (Study in 2005)



(3) Water availability in latrines and sewage system

The figures 4.3.4.1 and 4.3.4.2 respective to the Study in 2004 and 2005 show firstly that there is no water in most of latrines (81.4%), especially in the hilly region. The second, they show that most of type is a pit ratline regardless of the region. Though it represents only 7%, these households have no latrine evacuating raw sewage outside the house. It may threat the vicinity environment.

Figure. 4.3.4.1: Water availability in latrines (Study in 2004)

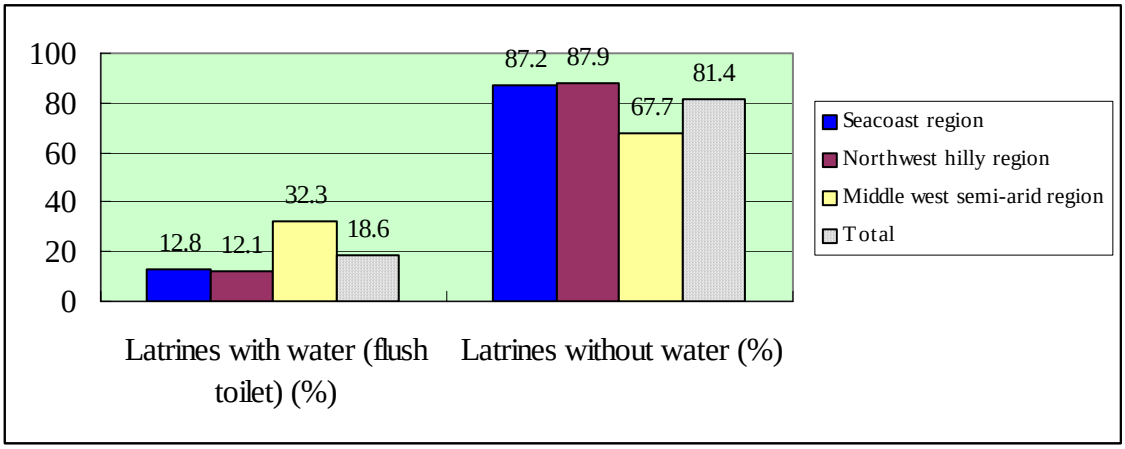
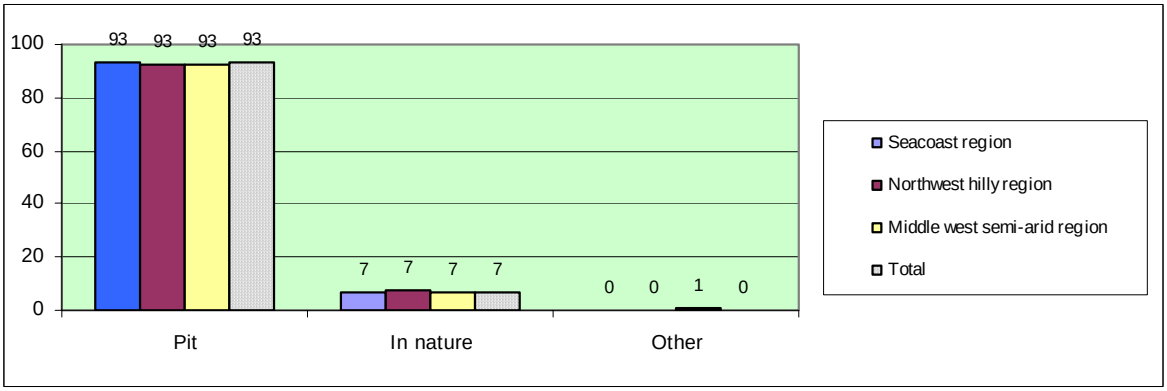


Figure. 4.3.4.2: Sewage system (Study in 2005)



4.3.2.3 Diseases associated with water

(1) Perception of the population

Table 4.3.4.1 and 4.3.4.2 present the perception of the future beneficiaries as far as the negative effects of water on health is concerned. The population awareness of the danger caused by bad quality water on health is not strong enough. Actually, 2/3 of the surveyed population (67.6 %) does not perceive the link between water and health. Comparing to 2004, in 2005 there is a considerable amelioration since the percentage of people who do not make the link between water and diseases was only 33.8% comparing to 67.7% in 2004. The rate of unconsciousness of danger in the Seacoast region is relatively high, probably because the majority of the population can get water either from existing water systems or from water vendor. Conversely, the western north mountainous region people are mainly supplied in water from natural springs and wadi.

Table 4.3.4.1: Perception of diseases associated with water (Study in 2004)

Region	No.of Sampling	No.of replies obtained	No deseases associated with water (No.)	No deseases associated with water (%)	Some diseases associated with water	Some diseases associated with water (%)
Seacoast region	404	404	335	82.9	69	17.1
Northwest hilly region	310	310	243	78.4	67	21.6
Middle west semi-arid region	409	409	181	44.3	228	55.7
Total	1123	1123	759	67.6	364	32.4

Table 4.3.4.2: Perception of diseases associated with water (Study in 2005)

Region	N° Sample	N° of obtained responses	No diseases associated to water (Number)	No disease associated to water (%)	Diseases associated to water (Number)	Diseases associated to water
Seacoast	266	262	146	55.7	116	44.3
Northwest hilly	310	310	86	27.7	224	72.3
Middle west semi-arid	650	603	165	27.4	438	72.6
Total	1226	1175	397	33.8	778	66.2

(2) Diseases perceived

The diseases perceived by the population in the sub-project areas are:

- Among the diseases indicated by the respondents, diarrhoea is in the first place with 32.2% mainly in Seacoast region.
- Kidney diseases occupy the 2nd position in the Northwest hilly region and in the middle west semi-arid region.
- Hepatitis is underestimated in all the regions; stomach illnesses are mainly considered in the northwest hilly region. As for the dermatitis, they are rather observed in the coastal region as well as the northwest region, even if the rates are not very elevated.

Table 4.3.4.3 : Diseases associated with water

Region	N°od sample	N° of obtained responses *1	Nber of effective responses *2	Reponses	Diarrhoea	Hépatitis	Polio	Itch	Trachoma	ey dise	Stomach	Dermatitis	Tension	Total
Seacoast	670	307	247	Nombre	105	14	2	14	17	47	22	28	0	249
				%	42.2	5.6	0.8	5.6	6.8	18.9	8.8	11.2	0	99.9
Northwest hilly	620	415	487	Nombre	141	10	0	24	27	160	76	49	0	487
				%	29.0	2.1	0.0	4.9	5.5	32.9	15.6	10.1	0	100.0
Middle west semi-arid	1059	818	723	Nombre	223	44	7	34	39	253	63	43	13	719
				%	31.0	6.1	1.0	4.7	5.4	35.2	8.8	6.0	1.8	100.0
Total	**2349**	**1540**	**1457**	Nombre	**469**	**68**	**9**	**72**	**83**	**460**	**161**	**120**	**13**	1455
				%	32.2	4.7	0.6	4.9	5.7	31.6	11.1	8.2	0.9	100.0

4.3.3 Economy

4.3.3.1 Economic activities

The economy of each region included in the RWS projects can be featured as follows:

(1) Seacoast region

As mentioned above (section 4.1), this region is the nucleus of the economy of the country. Nonetheless, the principal economic activities in rural areas of the region are the agriculture (dry and irrigated agriculture), as well as the livestock farming, the day labour in the construction, tourist, and the agricultural sector of the big neighbouring towns.

(2) Northwest hilly region

The principal economic activities are agriculture and the livestock. Among the sub-project areas, Jendouba and Béja are endowed with rich and fertile lands. Agricultural products of these governorates are mainly wheat and barely. Most of the population in the sub-project areas of said two governorates, which are located in forest areas, engaged in the agro-forestry.

(3) Middle west semi-arid region

Agriculture and the sheep breeding are main industries in the region. Agriculture is based on dry as well as irrigated agriculture. Olives are much produced in the whole region and the governorates of Kairouan and Sidi Bouzid are fmous for almonds and figs, and the governorate of Gafsa is famous for its production of dates. The cereal culture is also practiced in the region, yet it is a minor activity because of the low potential of the ground and the aridity of the climate.

The migration towards the urban areas to search for income sources is rather frequent, and the principal destinations are the coastal cities, in particular Sfax, Gabès, Sousse and Tunis.

4.3.3.2 Occupation of household heads

The table 4.3.6 displays the principal economic activities practiced by the surveyed household heads. Day labour and agriculture, which represent 80% of household heads in all the regions, are the principal occupations. Day labour comprises construction work, seasonal agricultural work, and work in construction site of water and soil conservation, etc. Agricultural activities are carried out in parallel with the daily work. Actually, diversified agriculture is insufficient to ensure an appropriate income to the households. Owing to the proximity to the metropolis, such as Tunis, Ben Arous, Bizerte or Sousse, the day work is more developed in seacoast region than the other regions.

Table 4.3.6: Main activities of household heads

Region	Sample	Reponses	Worker	Agriculture/ breeder	Governement Official	Commerce	Services	Other	None	Total
Seacoast	632	Effectif	302	149	31	31	23	22	16	574
		%	52.6	26.0	5.4	5.4	4.0	3.8	2.8	100.0
Northwest hilly	583	Effectif	251	163	15	21	4	11	27	492
		%	51.0	33.1	3.0	4.3	0.8	2.2	5.5	100.0
Middle west semi-arid	1134	Effectif	387	457	72	51	13	40	37	1057
		%	36.6	43.2	6.8	4.8	1.2	3.8	3.5	100.0
Total	**2349**	Effectif	**940**	**769**	118	103	40	73	80	2123
		%	44.3	36.2	5.6	4.9	1.9	3.4	3.8	100.0

4.3.3.3 Revenue and water expenses

The below table 4.3.6.1 shows the average monthly income, and water expenses. The general monthly average income for all the regions is about 257.5 TD per household. It varies from 196 TD in the northwest hilly to 307 TD in the seacoast region, and it is 269 TD in the middle west semi-arid region. The minimal values vary from 145 TD to 224TD; as for the maximum values, they vary from 396 TD to 610 TD.

Water expenses occupy an average of 6.6 % of the households' average income, with a value rather high in the middle west semi-arid and rather low in northwest hilly region. In this latter, people tend to resort to free consumption through the natural sources and the wadis, regardless of the risk that water might have on health.

Table 4.3.6.1: Income and Water expenses

Region	N° of projects	Nber of data	Monthly income (DT)			Monthly water expenses (DT)			Ratio of water expenses/income (%)		
			Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum
Seacoast	20	12	224.6	306.9	609.8	4.2	8.7	18.1	0.9	2.5	4.8
Northwest hilly	17	14	163.7	196.3	229.4	1.5	3.8	9.9	0.5	1.6	5.1
Middle west semi-arid	29	27	144.8	269.3	396	3.3	14.8	37.3	1.2	5.4	10.0
Total	66	53	177.7	257.5	411.7	3	9.1	21.8	0.9	3.2	6.6

Table 4.3.6.2 shows the income brackets; 50% of the income is included in a price range of 1,000 to 2,000 TD. Incomes which are higher than 3,000TD account fro about 25%. This income bracket is high mainly in the Middle west region and it is low in Northwest region.

Table 4.3.6.2: Households income according to income brackets

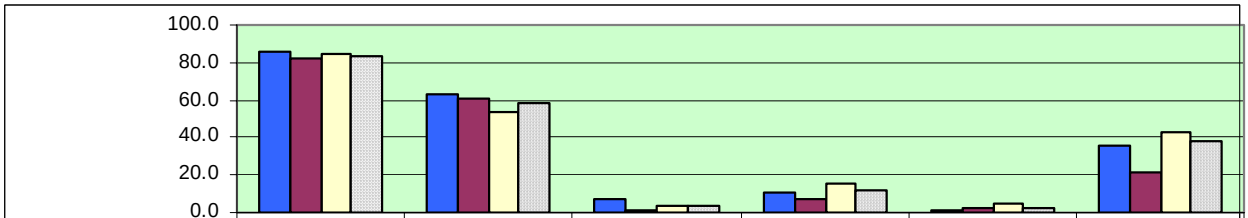
Region	N°of projects	< 1000 DT	1000 to 1499 DT	1500 to 1999 DT	2000 to 2499 DT	2500 to 3000 DT	> 3000 DT	Total
Seacoast	8	13.9	17.3	17.7	17.3	13.5	20.3	100
Northwest hilly Region	9	1.9	8.4	17.7	27.1	36.8	8.1	100
Middle west semi-arid	16	6.2	11.6	17.3	18.5	10.2	36.2	100
Total	33	6.8	12.1	17.5	20.6	18.2	24.8	100

4.3.3.4 Standard of living

The rapid growth of economy has led to a considerable progress in the living standard of all the population. This progress also involved the standard living of the sub-project areas; this is indicated by the possession of the certain commodities. The following present the possession of main commodities in the sub-project beneficiaries' households.

- Television is the most diffused commodity. Its coverage is almost the same as the national level, yet it is mainly popular in the seacoast region. The northwest hilly region presents the lowest rate.
- The households which have a fridge represent 58%. The national level is 81.7%. It is worth noting that the seacoast region is the closest to this rate with 63.6%.
- The GSM possession rate reaches an average of 37.7%, which is equivalent to the national rate. This phenomenon indicates the spreading of the commodity even in rural areas thanks to the expansion of the GSM network in the country. However, the possession rate of fixed phone remains very low reaching 2%.

Figure 4.3.5 : Possession of commodities



	TV (%)	Fridge (%)	Washing machine (%)	car (%)	Fixed phone (%)	GSM (%)
Seacoast region	85.7	63.6	6.9	10.6	1.0	36.3
Northwest hilly region	81.7	61.1	1.7	6.7	2.3	21.7
Middle west semi-arid arid	84	53.8	3.4	15.1	5.1	43.4
Average	83.9	58.4	4.1	11.4	1.8	37.7

4.3.4 Education

In order to achieve the development of human resources the Tunisian government bet on education. The rate of school enrolment at primary schools in Tunisia is rather high. In 2004, The Tunisian rate of elder children schooling aged between 6 and 14 years reached 95%. In all the sub-project areas, the registration rate for primary schools is similar to the national average. The educational conditions are summarized as follows:

There is a primary school each in 33 sub-project areas out of 66 as indicated in the table 4.3.7 below. Average distance to the primary school is 3.3 km. The longest distance of around 15 km gives a big burden for some localities of the sub-projects in the middle west semi-arid region. Some sub-projects prioritized the established of primary school is their needs due to the difficulty of access and long distance.

Table 4.3.7: Number of primary schools in the sub-projects' areas

Region	N° of projects	Nber of projects that have a primary school in the project region	Average Distance (km)	Maximum Distance (km)
Seacoast	21	8	2.5	5.6
Northwest hilly	17	10	2.9	5
Middle west semi-arid	28	14	4.5	15.3
Total	**66**	**32**	**3.3**	**9.6**

4.3.5 Basic infrastructure

4.3.5.1 Roads

Road network in the urban center and in the other localities of the region are rather equipped, but most of the roads in the sub-project areas are not paved. Around 80% of the population accordingly considers that the rural road network is not suitable for motor vehicles, particularly in rainy season.

During the socio-economic survey, it was noticed that strong claims were made for the improvement of the pistes and roads. It occupies the 2nd rank following the drinking water supply in the needs ranking.

4.3.5.2 Electrification

Electricity is widespread all over the country. In 2004, the households' electrification rate in Tunisia was 98.9%. In 43 sub-projects, the electrification rate is of 100% in 16 sub-projects it varies from 75% to 90%; whereas, the Enjaimia sub-project in Gafsa is

completely deprived from electricity. In addition, the M'kimen sub-project in Kasserine is electrified only to 13% and the sub-project Ben Thameur in Nebeul is electrified 58%.

As far as electric energy is concerned, the power line of three phase current is generally far from the sub-project areas. In 18 sub-projects, this distance varies from 1km to 6km, and in six (6) sub-projects, the three phase current is available next to the water source deep well. There are 14 sub-projects in three regions which is able to get only single phase current.

4.3.5.3 Mail and post office

The post office exists in only four (4) sub-project areas; one is located in the governorate of Bizerte and remaining three are in the governorate of Kasserine. The telephone line is not common in the rural area of Tunisia and only 1.8% of households have fixed telephone. On the other hand, 37.7 % of the households in the 66 sub-projects' areas have mobile phones. In 2005, the possession rate of it in Tunisia is 46.6%, it has increased considerably comparing to 27.9% in 2004.

4.3.5.4 Public Institutions

There are public institutions, which are 31 mosques, 33 schools and 9 dispensaries and others such as dams department, that will be supplied under the Project.

4.4 Water Collection

The data concerning the current conditions on water collection for the domestic use in the sub-project areas are presented in Table 4.4.1 which is summarized in the Table 4.4.2 below.

4.4.1 Present conditions

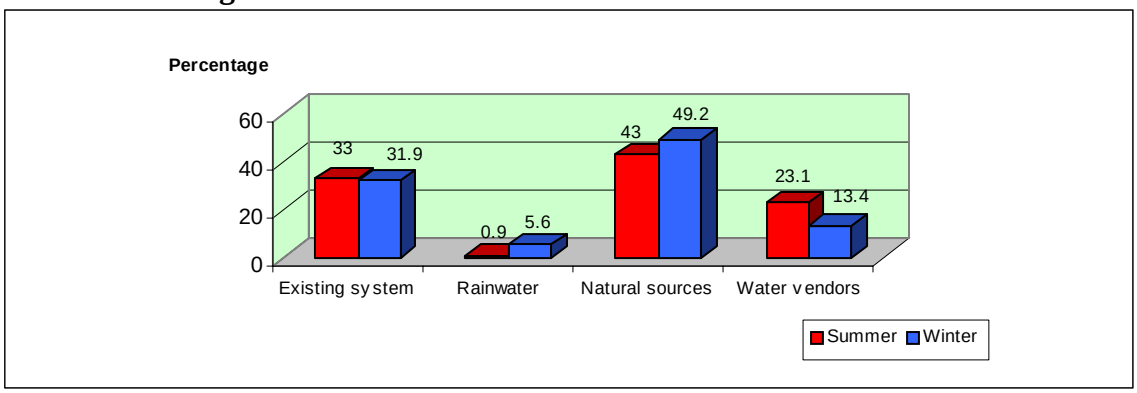
4.4.1.1 Water sources presently used

In the sub-project areas, the population fetches water for domestic use from several water sources. These sources are shown in Table 4.4.2 and classified into four categories. Table 4.4.2 shows the water sources according to the region. The "existing system" in the table means the communal taps, potences, and the connections of the neighbouring GIC or the SONEDE WSS. The "natural source" includes the shallow wells, natural sources such as wadis, springs, and dams which can be accessed freely. Rainwater is collected in winter for a supplementary use, while water vendors offer their services primarily in summer as shown in the below Figure 4.4.1.

Table 4.4.2 Type of actual water sources in the sub-project areas

REGIONS		Existing system		Rain water		Natural water		Water vendors		Total	
		Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Saecoast	Number	116	127	0	15	99	137	66	53	281	332
	%	41.3	38.3	0.0	4.5	35.2	41.3	23.5	16.0	100	100.0
Northwest hilly	Number	104	68	0	23	224	309	34	0	362	400
	%	28.7	17.0	0.0	5.8	61.9	77.3	9.4	0.0	100	100.0
Middle west semi-arid	Number	304	285	8	41	274	292	165	138	751	756
	%	40.5	37.7	1.1	5.4	36.5	38.6	22.0	18.3	100	100.0
Total	Number	524	480	8	79	597	738	265	191	1394	1488
	%	37.6	32.3	0.6	5.3	42.8	49.6	19.0	12.8	100.0	100.0

Figure 4.4.1 Water sources used in winter and summer



Concerning the types of water source per region, it was noticed that the communal taps and potences exist in all the regions. The potence is mainly used in Middle west semi-arid region. Private taps are mainly observed in the governorate of Nabeul, Ariana and Manouba. Rainwater is collected in winter in all the regions and particularly in the Middle west semi-arid region and the south where the annual rainfall is relatively low. Shallow wells and springs, which are sources relative to precipitation, represent 77.7% of water sources in the Northwest hilly region. The population mainly uses two water sources or more for domestic use, however, it is obliged to walk several kilometres to other water sources which locate farther than said water sources due to weak flow rate and the deterioration of water quality of the main water sources in summer.

4.4.1.2 Period of time to fetch water

The following two tables represent the distance and time necessary for fetching water, however, the water vendors, the shallow wells etc. to which distance can be negligible are not included.

The Table 4.4.3 below shows that the average distance to water sources presently used is 1.9 km in the 66 sub-projects. This distance is longer in the middle west semi-arid region of which average one is 3.2 km than that of other two (2) regions.

Table 4.4.3: Distance to the water sources presently used (km)

Region	Available data	Average	The farthest	The nearest
Seacoast	34	2.2	5.6	0.3
Northwest hilly	33	2.6	6.9	0.9
Middle west semi-arid	50	3.2	7.6	0.4
Total	117	1.9	6.7	0.3

Table 4.4.4: Period of time to fetch water (go and return)

(minutes)

Region	Available data	Average	The longest	The shortest
Seacoast	34	72.8	127.8	24.9
Northwest hilly	30	84.9	132.7	43.7
Middle west semi-arid	46	89.3	161.3	31.7
Total	110	81.3	158.2	27.0

One hour and a half is the average period of time for the people to fetch water, regardless of the season. The longest time on average is 2h40. In the Middle west semi-arid region shows the worst conditions to fetch water among three regions.

4.4.1.3 Means of water transportation

Means of water transport are classified as follows:

1) Domestic animals which can carry several small containers (20 L Tank).
2) A water tank (of 500 litters) mainly drawn by a domestic animal
3) A water tank (from 3,000 to 5,000 litters) hauled by a tractor
4) Two or three small tanks carried by a woman or a child

Table 4.4.5: Means of water transport by region

Region	Domestic animals (Horses)	Water tank (TA+TM)	Man power	Total
Seacoast	105	140	72	**317**
	33	44	23	**100**
Northwest hilly	153	91	116	**360**
	43	25	32	**100**
Middle west semi-arid	76	129	92	**297**
	26	43	31	**100**
Total	**334**	**360**	**280**	**974**
	34	**37**	**29**	**100**

Note: AT; Animal Traction, MT; Mechanical Traction

In the Middle west semi-arid region, big water tanks are used for transporting water. Domestic animals are mainly used in the Northwest hilly region due to topographic conditions.

4.4.1.4 Price of water

Table 4.4.6 shows the water prices according to regions. The data in the Table does not account for free water from shallow wells, natural springs, etc. and the water rare for

neighbouring houses. The table also indicates that the population in the sub-project areas pays 2.2 TD per one cubic meter on average, which is more than the double of the prevailing affordable water rate for the population in the rural area in Tunisia. The highest price among all the sub-project areas is 4.3 TD and that in the Northwest hilly region marks 5.1 TD.

Table 4.4.6: Water price in the sub-project areas (TD/m^3)

Region	Available data	Average	The highest	The lowest
Seacoast	25	1.8	4.0	0.4
Northwest hilly	9	2.7	5.1	1.1
Middle west semi-arid	28	2.4	3.8	0.8
Total	62	2.2	4.3	0.6

Table 4.4.7 shows water prices of 20 L tanks, big water tanks (3000 litres to 5000 litters),and finally that applied by water vendors. The price of big water tanks is lower than that of 20 L tanks and the price applied by water vendors is the highest among said three (3) categories. This difference in applied water prices might be explained not only by the time used for water fetching but also by the business-oriented mind of the water vendors.

Table 4.4.7 Water price according to purchase conditions (TD/m^3)

Region	20L tank	Water tank	Water vendor
Seacoast	1.7	1.7	3.0
Northwest hilly	2.6	2	5.4
Middle west semi-arid	1.9	1.7	4.4
Total	2.1	1.8	3.7

4.4.1.5 Appreciation of water quality

Almost all the population who collects water from the existing systems such as communal taps or potences is satisfied with the water quality, however, the third of the population used conventional water sources such as shallow wells or wadis considers it salty, bitter, heavy and impure. Even those who tend to appreciate the natural water sources for its clearness, freshness, etc., clear, have to bear the disadvantages of these sources. They have to go and return long distances to the sources, make a row for water, be prepared for drying up the sources in summer and undergo the risks of health by using non-protected water.

4.4.1.6 Present water consumption

Table 4.4.8 represents the actual conditions on water consumption per capita and per region. It is noteworthy that the population in the Middle west semi-arid region consumes double the quantity of that of the other regions. Besides, this quantity exceeds the projected water demand at the end of sub-project period, which is around 50 litters including the livestock consumption of 40%. It might be explained partially this phenomenon for the use of water in the irrigation of arboriculture to preserve it form drought.

The actual maximum water demand exceeds the projected demands in all the regions.

The ratio of the average consumption in summer to the annual average consumption is around 1.5 which is almost the same among three regions.

Table 4.4.8 Water consumption per capita and per region

Region	Available data	During the year			Summer			Winter		
		Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.
Seacoast region	21	36.3	60.2	18.9	49.1	85.0	24.2	23.4	36.9	13.5
Northwest hilly	15	29.5	49.1	13.0	38.4	63.8	16.1	20.6	34.3	9.8
Middle west semi-arid	30	61.7	141.2	19.1	79.6	183.5	22.8	43.8	98.8	15.5
Average	66	40.1	64.1	13.8	60.4	155.1	16.6	31.7	52.0	11.0

4.4.2 Inconvenience in drinking water collection

The most significant disadvantage of the actual WSS for the population is the distance to the water sources followed by the low availability of water (quantity) as well as the high costs. These three reasons represent 83% of the disadvantages declared by the population. Further details are shown in the Table 4.4.9 and in the below table 4.4.10 below.

Table 4.4.9: Disadvantages of present water collection

Region	Quality	Distance	Price	Quantity	Storage	Total
Seacoast region	68	156	73	65	9	**371**
	18	42	20	18	2	**100**
Northwest hilly	112	208	57	198	4	**579**
	19	36	10	34	1	**100**
Middle west semi-arid	203	397	365	423	5	**1393**
	15	28	26	30	0	**100**
Total	**383**	**761**	**495**	**686**	**18**	**2343**
	16	**32**	**21**	**29**	**1**	**100**

The table shows that the population in the sub-project areas considers that having insufficient water quantities is more serious matter than having a water of bad quality. Nevertheless, several households in the Middle west and in the Northwest hilly regions face problems of storing water in hygienic conditions. It is necessary to set a goal to be achieved by the rural water supply project.

4.5 Viewpoints of Target Population on Participation in the OM/M of the Projected WSS

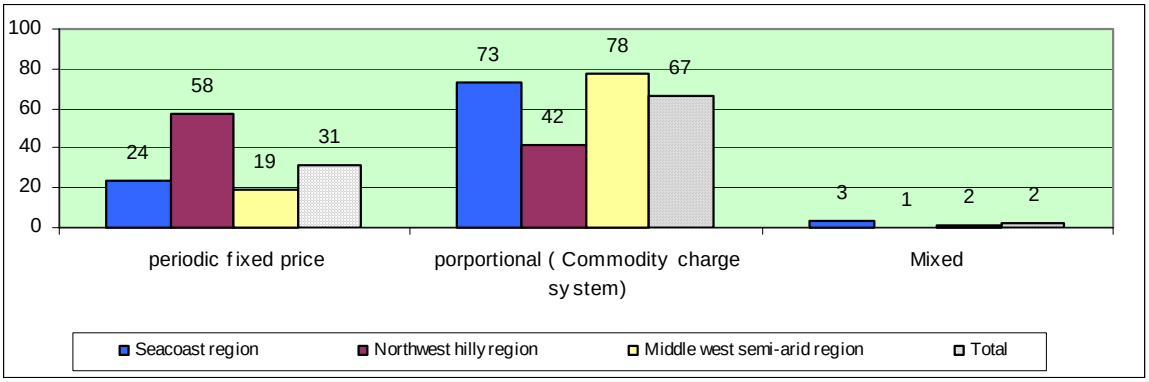
4.5.1 Water charge system

The replies to questions about the preferred water charge method had been analysed before starting the sensitisation activities in order to gather the target population view about

the recovery method. The following step was carried out in order to determine the approach to be adopted in the beneficiaries' choice of the water charge method during the sensitisation.

Generally, the majority of the population opted for the commodity charge (67%) in all the sub-projects areas. This tendency is strong in the Middle west semi-arid region (78%), since this mode is made familiar for the population by the CRDAs. 58% of the population in Northwest hilly region advocated the flat rate (periodical shared cost). This might be explained by the fact that money is not necessarily available everyday in this region due to the migration of men to big cities for cash income. Mixed mode of above-mentioned two water charge methods is rarely requested by the population, it seems to be complicated and early to introduce into the Rural WSS.

Figure 4.5.1 : Preferred water charge method



4.5.2 Type of participation motivated

Questions relative to the population participation in the Project had been modified a little in the Study in 2005 from that implemented in 2004.

In 2004, around 30% to 50% of the surveyed people showed their commitment to the revolving fund, before starting the sensitization. 15% to 34% of them showed their readiness to become the member of GIC. 25% to 34% of them showed their readiness to contribute parts of their lands for the construction of the projected facilities. A few people showed its interest in participating in the GIC board of directors.

In 2005, around 65% to 75% of the surveyed people accepted the participated in the GIC. Similar number of the people accepted to sign the documents to commit the GIC. It will be expressed more clearly in the Seacoast and Northwest hilly regions rather than the Middle west semi-arid region. About the half of the surveyed people are ready to be the members of the board of directors of GIC.

Figure 4.5.2.1: Type of motivation toward the participation (Study in 2004)

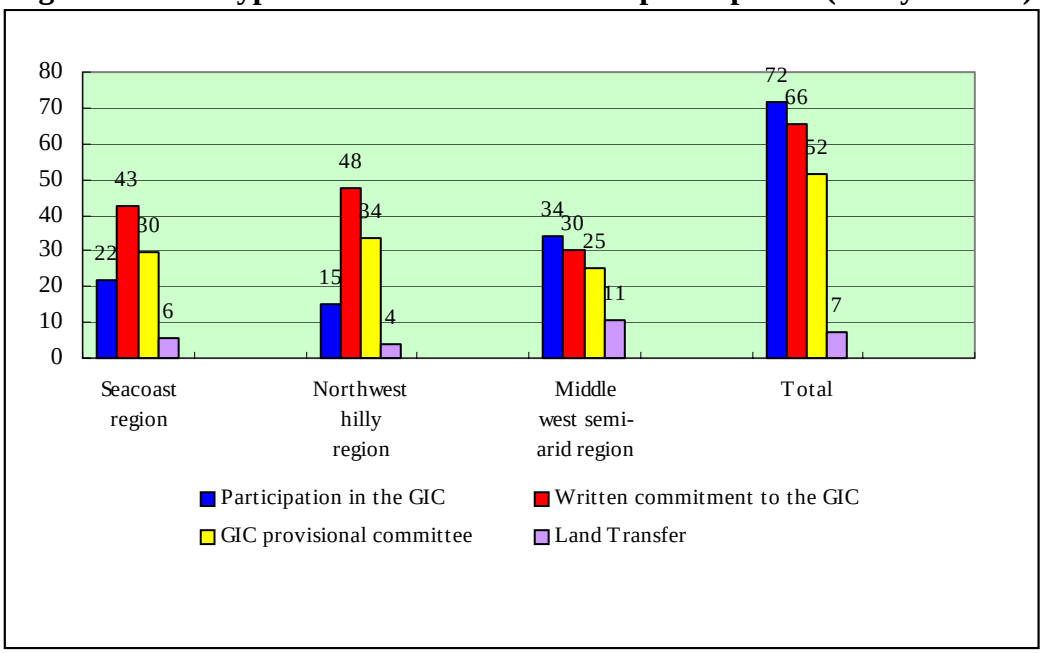
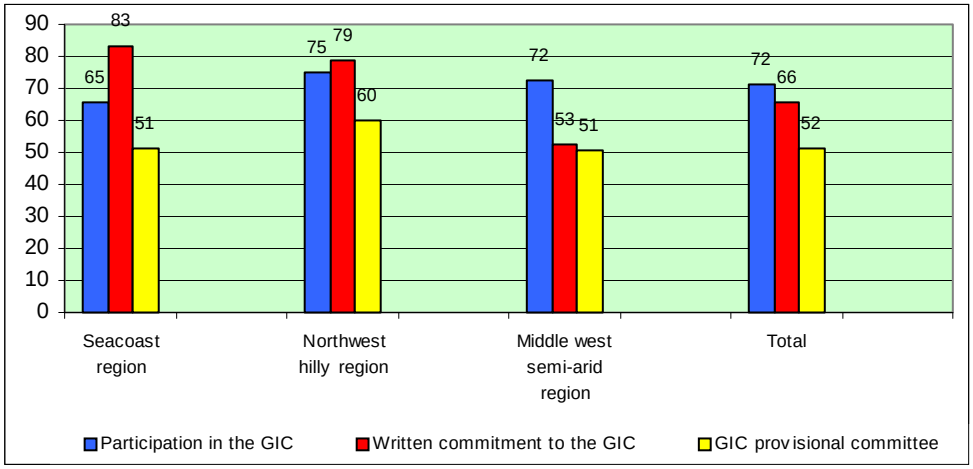


Figure.4.5.2.2: Type of motivation toward the participation (Study in 2005)



4.6 Needs of Target Population for Improvement of Living Conditions

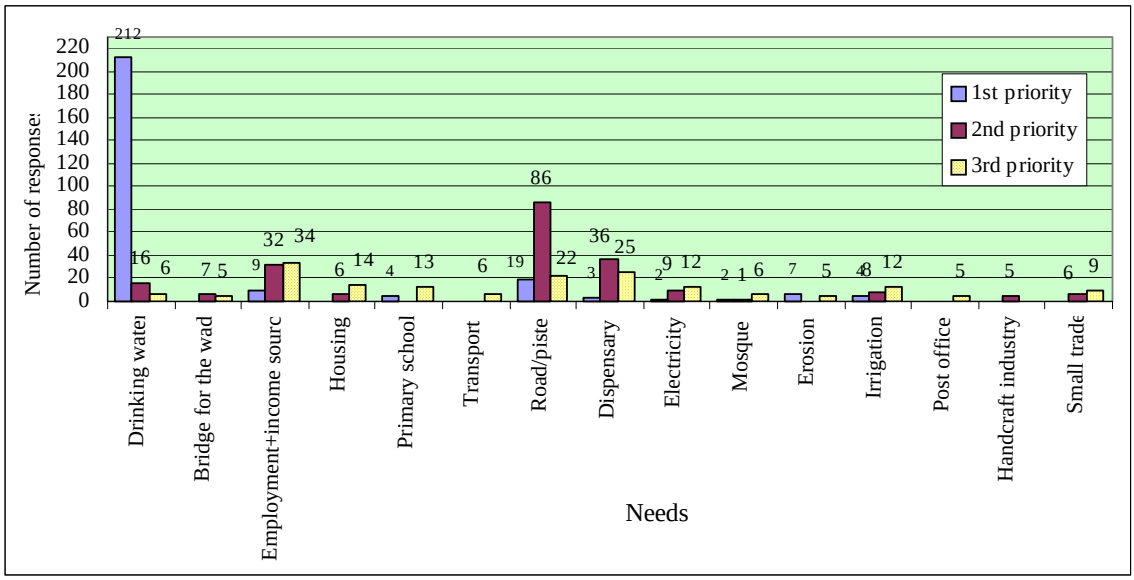
The examination of the needs of target population was carried out through the Study and farther made more precisely through one of the tools of the PRA approach called “needs ranking”. The main objective was to understand the priorities in the needs of the population regarding the living conditions as well as the rank of the drinking water supply in the priorities. Figure 4.6.1 shows the needs of population of all the sub-projects. Figures 4.6.2, 4.6.3 and 4.6.4 represent the needs of population per region.

Drinking water supply is ranked as the first position in the priorities and is considered not only necessity but also urgency. Some sub-projects put drinking water supply in the second position. This result implies the actual critical conditions on water supply collection and therefore the population may focus on the water supply project.

Roads are also important that the bad conditions of the roads and the transport network in target rural areas cause not only a lot of difficulties in usual life also deprive them from transporting their agricultural products.

Development of employment and income sources occupied the third rank in the priorities. It was revealed by the Study that this need had a direct effect on the affordability of the population, in relation to water rate and stable living conditions in the area. It will influence on the success as well as the sustainability of the Project.

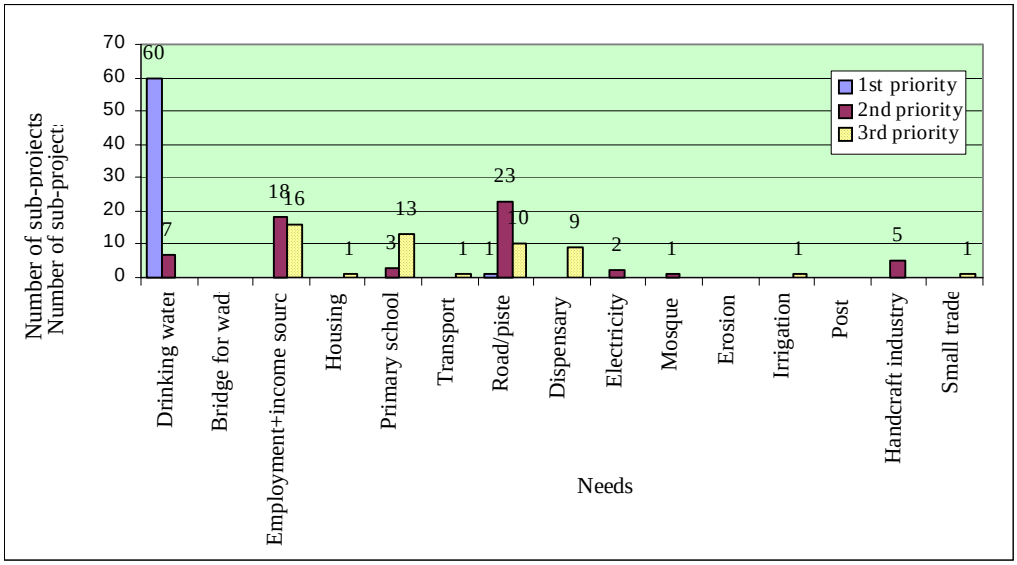
Figure 4.6.1: Needs ranking (Overall results)



4.6.1 Seacoast region

The water, roads and employment are priority needs. The need for roads is brought by the usual conditions of the unpaved tracks. They give the inhabitants the difficulties in many activities of everyday life such as water, access to the medical care, etc.

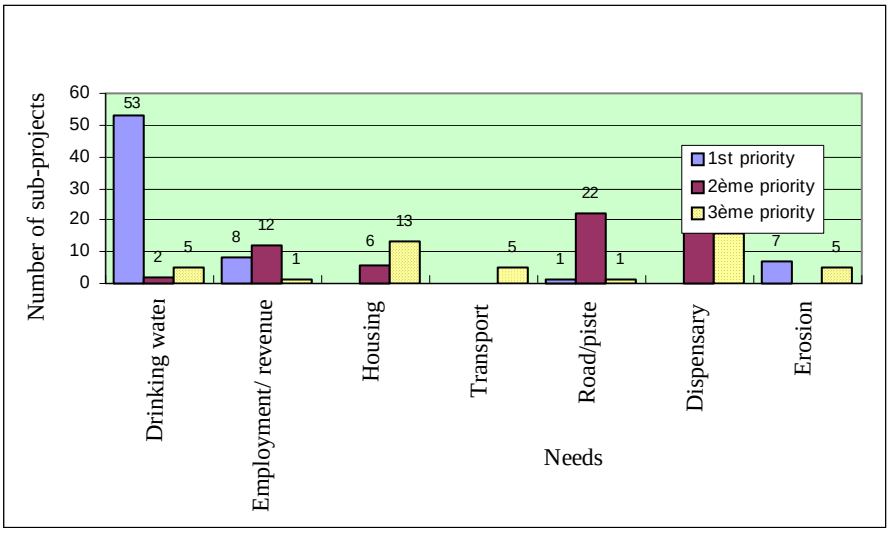
Figure 4.6.2: Needs ranking (Seacoast Region)



4.6.2 Northwest hilly region

In this region, the roads and pistes are placed in second position following the water. The dispensary comes at the 3rd position, followed by the employment. The population in the sub-project areas in this region seems to face a lot of troubles to move due to the bad condition of pistes mainly during winter. They also face difficulties to benefit from medical care because neither hospital nor dispensary exists in the sub-project areas and the population has to go far big cities to have medical cares.

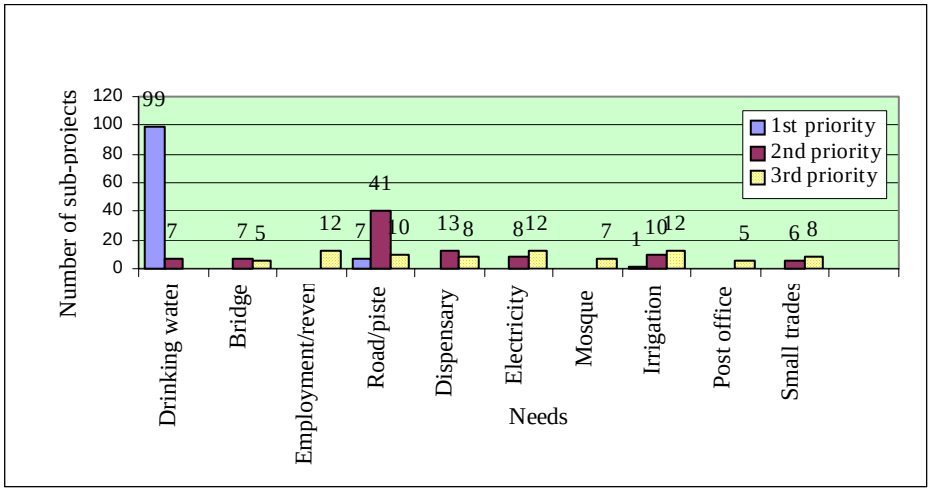
Figure 4.6.3: Needs ranking (Northwest hilly region)



4.6.3 Middle west semi-arid region

Similar to other two regions, the first priority was given to the water. The second priority was to improve roads and unpaved tracks. The irrigation, dispensary and electricity are ranked same as the third priority. The irrigation seems to be important in the needs ranking for the extension of an irrigation system which is valuable for the agricultural development in the region.

Figure 4.6.4: Needs ranking (Middle west semi-arid region)



5 WATER ANALYSIS AND WATER SOURCE ASSESSMENT

The water analysis of the projected water source of all the sub-projects under the Study executed referring the Drinking Water Quality Standard of Tunisia (NT09.14-1983) and the WHO drinking water guideline (3rd edition). The result of the analysis and the projected water source assessment are presented in the volume of “Water Analysis and Water Source Assessment”

6 ENVIRONMENTAL STUDY

6.1 General

The objective of the environmental study is to assess potential impacts on the environment due to implementation of the sub-projects and to take into consideration the necessary measures in the design of sub-projects.

The JBIC Guidelines for Confirmation of Environmental and Social Considerations (hereinafter referred to as "the JBIC Guidelines") was applied to this study. It is stipulated in the JBIC Guidelines that the environmental study should be conducted in the following three steps:

- Screening: to classify sub-projects into category A, B and C. For projects of category C, the environmental review will not be required. (see Paragraph 6.3.1 and Table 6.1.1);
- Environmental review: to examine the potential negative and positive environmental impact of the sub-projects of category A and B.
- Monitoring: to observe, over a certain period of time, the environment relative to the specified items that have been assessed to have significant environmental impacts. This is to confirm the project proponents' undertaking of environmental and social considerations for category A and B projects.

On the other hand, judging from the environmental law of Tunisia, there will be no requirement to carry out the environmental impact assessment (EIA) for the Rural Water Supply projects in Tunisia (see Section 6.2).

The environmental study was conducted for 33 sub-projects for 2005 and 33 sub-projects for 2006 during the feasibility study of the sub-projects.

6.2 Environmental Law in Tunisia

The Decree No. 91-362, which stipulates the EIA procedure in Tunisia, was issued in 1991. ANPE was designated as the national agency responsible for protection of the environment. The Decree defines two categories of projects listed in "Annex I" and "Annex II" according to the relevant sectors and significance of the potential environmental impacts.

In case of projects listed in "Annex I", EIA is a mandatory process, and the project entity is required to execute the EIA based on the terms of reference prescribed by the ANPE, and submit the EIA report to ANPE.

In case of projects listed in "Annex II", on the other hands, necessity of EIA execution is

judged by ANPE. If the project is recognized by ANPE as to have no environmental impact, no more procedure will be necessary and approval will be issued. For judgment, the project proponent must submit a document that contains the full description of the project.

The Rural Water Supply Project falls into neither "Annex I" nor "Annex II". Therefore, EIA is judged not required according to the Decree[1].

6.3 Screening

6.3.1 Categorization of project

The JBIC guideline classifies projects into three categories (Table 6.1.1) primarily based on the degree of potential adverse impact on the environment, as follows:

(i)Category A: Projects that have significant potential adverse impact on the environment.

(ii)Category B: Projects that have less potential adverse impact on the environment than Category A projects

(iii)Category C: Projects that have minimal or no adverse impact on the environment; (Projects with implementation cost less than SDR[2] 10 million (almost equivalent to TD 10 million) can be classified as Category C with the exception of projects located in sensitive areas or of sensitive sectors or with sensitive characteristics[3])

6.3.2 Information about sub-projects

According to the JBIC guideline, information about the sub-projects was collected on the basis of the questionnaire of the "Screening Form", which is summarized as follows:

<u>Information relative to environmental law in Tunisia</u>

- Confirmation about the necessity of permits and approvals for EIA, etc. in Tunisia

<u>Information relative to the Project</u>

- Location of project site
- Project description
- Sector of project
- Scale, etc. of project

<u>Information relative to potential adverse impact on the environment</u>

- Degree of environmental impact
- Existence of sensitive areas

[1] A construction project "*Aqueducs* (pipeline)", which is far bigger than the rural water supply project in scale, is listed in Annex I.

[2] Special Drawing Rights: a kind of international money created by the International Monetary Fund to supplement the use of gold and hard currencies in settling international payment imbalances.

[3] The RWS sub-projects are neither in the sensitive sectors nor have sensitive characteristics.

- Existence of sensitive characteristics, etc,

The information about the sub-projects for 2005 and 2006 is shown in Table 6.3.1a and Table 6.3.1b, respectively. As seen in these tables, the situation of sub-projects can be summarized, from the environmental aspect, as follows:

(1) The implementation cost of each of the sub-projects is less than the threshold amount to be classified as Category C.
(2) Several cultural heritages exist near to the sub-project areas.
(3) Ground water is used as the water source of the sub-projects.

6.3.3 Screening of sub-projects

All the sub-projects for 2005 and 2006 are classified as Category C and judged to have no significant adverse impact on the environment, based on the following information and considerations:

(1) The estimated implementation cost of TD 1.74 million of Gargour-Brahma-Fkayhia sub-project is the maximum of any sub-projects for 2005 and TD 1.72 million of Ain Jaffel sub-project of sub-projects for 2006. These amounts are less than the threshold investment amount of SDR10 millions to be classified as Category C.

(2) Existence of cultural heritages (roman relics) is confirmed in the vicinity of the following sub-project sites:

Sub-project for 2005

Governorate	**Sub-project**
Siliana	Ksar-ouled bouhani
Siliana	Fej-assekra
Le kef	Ezzagaya
Sidi bouzid	Ouled naoui

Sub-project for 2006

Governorate	**Sub-project**
Kairouan	Ghanzour
Kairouan	Gouaad
Kairouan	Khoualdia
Mahdia	Ammar
Mahdia	Essaafi

In Tunisia, the area of 200m from the cultural heritage is stipulated as the protected area by the law No. 94-35 of 1994. Most of the sub-project sites are located farther than several hundred meters from the roman relics, so that implementation of the sub-projects are considered to have no substantial negative impact on the environment of the cultural

heritage.

In case of Ksar-Ouled Bouhani sub-project (sub-project for 2005), the pipeline is projected to pass by small roman relics at a distance about dozens of meters. However, in consideration of the small-scale construction work of the underground system, the environmental impact on the cultural heritages can be minimized or avoided by taking appropriate measures during the construction.

It is therefore concluded that no sensitive area that will be affected by the sub-projects exist in the vicinity of the sub-project area.

(3) Many of the sub-projects use groundwater as the water source. Exploitation of groundwater by sub-projects complies with the law of Tunisia. In addition, possibility of subsidence of the ground can be neglected because no soft ground layers exist in the proximity of projected water source deep wells. In this regard, the sub-projects are judged to have no negative impact on the environment.

The impact of Kalboussi sub-project (sub-project for 2006) in the governorate of BIZERE on Lake Ichkeul was also assessed. The lake is registered as the Ramsar site but at the same time listed as a World Heritage in Danger. The natural environment of the lake is endangered due to shortage of fresh water in the lake. The Kalboussi sub-project is located at about 5 km in the upstream from the lake.

The impact of the sub-project was judged to be neglected based on the following considerations:

i) The groundwater to be used as the water source of sub-project Kalboussi does not feed the Sejnane River because the river is normally dry and only flows into Lake Ichkeul in wet condition, and accordingly can not be considered as the source of fresh water of the lake.

ii) The annual yield of groundwater in the watershed area of Lake Ichkeul is estimated at about 37 Million Cubic Meters (MCM) based on the watershed area, annual rainfall and a coefficient relative to the climatic condition, whereas the projected annual withdrawal volume of the groundwater for the sub-project is 0.03 MCM, which is as small as 0.1 % that of the annual yield of groundwater.

6.4 Environmental Review

The environmental review is not required since all the sub-projects have been classified as Category C through the screening process described in Section 6.3.

6.5 Conclusion and Recommendation

It is concluded that the implementation of sub-projects for 2005 and 2006 will have no significant adverse impact on the environment. However, there exist some small roman relics in the vicinity of the Ksar-Ouled Bouhani sub-project in the governorate of SILIANA, where the pipeline is designed to pass at a distance of dozens of meters from the roman relics. It is recommended taking appropriate measures to minimize the potential negative impact on the environment as need arises.

7 STUDY PROCEDURE

7.1 Eligibility of the Projects

A sub-project is considered eligible when the eligibility criteria defined as follows:

7.1.1 Financial eligibility

The construction cost and the beneficiaries number of the future project are principal factors in confirming the financial eligibility of the project. The unit construction cost is determined through the existing relationship between the total construction cost and the planned beneficiary population in due date.

The acceptable unit construction cost, which defines the financial eligibility of the JBIC lending sub-projects was determined by the DGGREE to 600 TD in 2001, considering subsequently 5% of an annual increase. Resting on this, the acceptable unit construction cost is fixed at 729 TD for the sub-projects of 2005 and at 766 TD for the projects of 2006.

7.1.2 Social eligibility

The social eligibility is defined through the beneficiaries' acceptance rate of the sub-project. This rate is materialised through the signed commitments to contribute a certain amount of money to the revolving fund. In order to guarantee the social eligibility of a sub-project, it is necessary that at least 80% of the beneficiary household heads sign the commitments to the revolving fund so as to confirm the participation of the population in the sub-project.

7.1.3 Technical eligibility

The technical eligibility might be determined through the quality and the quantity of water availability. For a sub-project to be technically eligible, it is necessary that water quality conforms to the acceptable criteria. As for water quantity, it has to satisfy the population water demands in the critical day, usually in summer, in the final year of the sub-project period[1].

7.2 Applied Methodology

7.2.1 Methodology based on the DGGREE Guidelines

Aiming at making the drinking water supply projects uniform, the DGGREE sets up a methodology corresponding to the study of drinking water supply projects in rural areas[2]. The

[1] The projected WSS can assumedly supply water sufficiently with the population by the end of this period.
[2] RAPPORT DE L'ATELIER D'ETUDE DE PROJET ALIMENTATION EN EAU POTABLE, June 1994

aim of this methodology is to conceive durable and viable systems. The present study includes the two following phases:

(1) Basic Study consists of feasibility study and socio-economic study
(2) Detailed Design Study including preparation of tender documents

The present report is relative to the studies mentioned above and it revolves around the technical and the social aspects; it also includes exchanges of results and observations of the different phases of the study. (See Figure 7.2.1)

The Basic Study includes the following sections:

- Identification;
- Detailed survey / Socio-economic survey;
- Examination and analysis of collected data;
- Definition of the sub-project components;
- First visit of the sensitization (consultation with the target population);
- Selection of the optimum preliminary design of the projected WSS;
- Second visit of the sensitisation (consultation with the target population);
- Topographic survey;
- Technical and socio-economic study;
- Third visit of the sensitization

Apart from the above, the environmental impact survey was executed in the early stage of the Study. Detailed Design Study is explained later.

7.2.2 Modification of the methodology

Some modifications of the design guidelines of DGGREE were made by the JICA Study Team. These modifications related essentially to two aspects:

- Design of the distribution system
- Financial analysis.

Detail is described in the relevant clauses.

7.2.3 Pilot sub-projects

Despite the fact that the improvement of the financial analysis included all the sub-projects for 2006, the modification of the design method of the distribution system involved only fifteen projects, which were selected as pilot sub-projects. The selection of the pilot sub-projects was primarily carried out based on the topographic conditions which gave the sites for service installations different height. The list of the pilot projects is presented in the following table:

Table 7.2.3.1: Pilot sub-projects for the modification of the design method and the distribution system modeling

N°	GOVERNORATE	SUB-PROJECT	N°	GOVERNORATE	SUB-PROJECT
1	MANOUBA	SIDI ACHOUR	9	KASSERINE	BNANA/OULED BENAJEH
2	BIZERTE	EL KALBOUSSI	10	KASSERINE	CHAABIA
3	KAIROUAN	MAAMRIA	11	SIDI BOUZID	AIN JAFFEL
4	KAIROUAN	GHANZOUR	12	SIDI BOUZID	GARD HADID
5	BEJA	GMARA	13	SIDI BOUZID	OULED MOUSSA
6	SILIANA	SIDI DAHER	14	SIDI BOUZID	SLATNIA
7	SOUSSE	CHRARFIA	15	GAFSA	ENJAIMIA
8	EL KEF	EL OUENA			

7.3 Identification

The sub-project identification is one of the most important phases in the elaboration and design of the Water Supply projects since it allows a conception on the components, the project cost and accordingly the judge of its feasibility.

This stage is to identify the sub-project area as well as collecting the following data and information:

(1) Current mode and conditions of water collection: water quality and quantity, access to water sources, hygienic condition, diseases associated with water.
(2) Concerned localities[3] (designation, population, type of housing …)
(3) Projected water sources: location, quality (physicochemical and bacteriological analysis)

This stage is decisive in continuing the study; indeed the sub-project can remain unrealized in the following cases:

(1) Unconformity of the quality or insufficient quantity of water source
(2) Exceeding the criterion value to judge the eligibility
(3) Sub-project which will be covered by the SONEDE
(4) Rejection of the sub-project by target population.

7.4 Detailed Survey and Socio-economic Study

After the sub-project identification, the consultant carries out the detailed technical survey. These surveys aim primarily at updating and verifying the available data as well as collecting other information concerned:

(1) Size and characteristics of the localities to be supplied (rate of scattered population[4])
(2) Technical characteristics and data concerning the projected water source

[3] Group of several households considered like the minimum administrative unit
[4] The population who lives outside the community forming a locality of at least 10 houses is defined as a grouped population. The population who lives outside the community, but who is not classified as the grouped population, is considered as the scattered population. The rate of scattering is the ratio of the scattered population and the total population of the locality.

(3) Existence and type of STEG network
(4) Technical and financial data about the existing WSSs (in case that a sub-project is planned to connect an existing GIC WSS)
(5) Technical data concerning the branching point from SONEDE distribution system (static pressure, dynamic pressure and authorized flow rate)
(6) Localization of the necessary data for the sub-project implementation on the CEM; projected water source, STEG network, SONEDE WSS, localities to be supplied etc.

The data which are regarded as basic elements are presented in Appendix 7.4.1.

The detailed survey allows:

- to indicate and provide details about the prospective beneficiaries (population, type of housing, social life, socio-economic standard of living);
- to complete and check the list of families including the number of domestic animals;
- to confirm and complete the data on the projected water source;
- to delimit the project area and the localities to be supplied;
- to draw up location of the localities on the CEM

In order to have useful data and information to focus themes on the sensitization, and to ensure the appropriate OM/M for durable WSS, the consultant company also carries out the socio-economic survey including the households survey and participatory survey applying the tools of PRA method. Appendix 7.4.2 presents the summary of the socio-economic survey.

Following the collection of technical and socio-economic data and information, the consultant company analyzes them then define the sub-project components:

- the water demand based on the number of population and domestic animals
- the number, type and location of service installations
- the type of system; by gravity or with pump
- the number of pumping stations and the characteristics of pumps (discharge and pumping head)
- the type of energy source
- the number, type and capacity of distribution tanks
- the projected service area and localities to be supplied.

In order to determine the sub-project components, it is necessary to discuss the appropriate design and to evaluate the feasibility of the sub-project.

The Study Team held a meeting on the socio-economic survey, and the sub-project components by the examination of the community map, the basic data collected, etc. The meeting also deals with technical matters such as availability of electricity, preliminary

agreement on SONEDE or existing GIC to purchase water, the specificity of land as well as social points such as existence of conventional water sources, the management situation of the existing CIC, etc.

Concerning the Study in 2005, the persons in charge of the sub-project of the AGR attended the meeting. It permitted the participants to understand the focal points relative to the realization of each sub-project from the early stage of the study.

7.5 First Visit of the Sensitization (Consultation with the Target Population)

The first visit of sensitization for the target population is carried out just after the examination of the basic data and the project components. This first visit targets the following:

- to present the results of the socio-economic survey
- to raise the motivation of target population to take part in the OM/M of the projected WSS
- to present the advantages of the new WSS in terms of durability, water quantity and quality, etc.
- to present the disadvantages of the conventional water sources
- to present the management principles of the WSS, the role of GIC and the beneficiaries' responsibilities (membership for GIC, payment for water consumed and contribution to the revolving fund defined in clause 7.10.2.2)
- to discuss and consult with the population about the sub-project components to introduce the type and/or location of the facilities and installations of the target population into sub-project design.

The result of the discussion will be taken into account the optimum design.

The topics of the first visit of sensitization are described in Appendix 7.5.1. and the model of the first visit of sensitization is explained to the consultant company before starting. Appendix 7.5.1.1. presents it.

7.6 Selection of the Optimum Preliminary Design

After the presentation of the project components and the discussion with the population, the consultant company prepares two (2) or three (3) preliminary designs of the projected WSS.

Once the alternatives are ready, a meeting is held with the persons of the AGR, the JICA Study Team, and the consultant company. During this meeting, the alternative designs are presented by the consultant company. It followed a discussion and exchanges of opinions

how to select the optimum preliminary design from technical, financial and socio-economic viewpoints.

7.7 Second Visit of the Sensitization (Consultation with the Target Population)

Once the optimum preliminary design is selected, the consultant company starts the second visit of sensitization. It aims at confirming the desires of the population concerning the water supply project so as to reflect them to the design of the WSS. The sensitization also aims to make the prospective beneficiaries understand the constraints to realize the desirable WSS. It also seeks the requests of the population which is not taken into account the design.

Topics of the second visit are presented in Appendix 7.5.1. Appendix 7.5.1.2. shows the presentation model for the second visit of sensitization including those of the cost recovery mode, the operation hours and the tap keeper tasks.

7.8 Execution of Topographic Surveys

After reaching the accord on the optimum preliminary design for projected WSS with the population, the consultant company immediately starts to identify the pipeline route in the presence of the persons concerned followed by the topographic survey in compliance with the specification prepared by the Study Team.

The scale to be applied to the drawings as the survey result was determined after consultation with the CRDA.

The topographic surveys will be used in:

(1) Carrying out the hydraulic simulation for the distribution system optimization
(2) Determination of the pipe laying level and the location of hydraulic works
(3) Quantity survey of the pipeline works

The Study Team requested the CRDAs the official acceptance of the products of the topographic survey in order to let it know the site conditions to implement the sub-projects.

7.9 Feasibility Study

All the necessary data collected and the completion of the topographic surveys allow to carry out the feasibility study.

7.9.1 Sub-project period

The projected WSS can assumedly supply the population with sufficient water by the end of the project period.

7.9.2 Water consumption and its growth during the sub-project period

The basic water supply unit and its evolution during the project period applied to the grouped and scattered population and domestic animals determine the water demand for the sub-project.

The details on the computation method of water demands and their evolution are given in Appendix 7.9.1.

7.9.3 Capacity of distribution tank

The capacity of the distribution tank is determined according to the DGGREE guidelines, which designates 50% of the average daily water supply in the final year of the sub-project period.

The JICA Study Team introduced following factors to verify the capacity in the Study in 2005 as the feedback from the Study in 2004:

(1) Operation hours: the hourly water consumption varies according to the operation hours in a day. If the hourly consumption is far bigger than the capacity of the transmission system, the storage volume of the distribution tank can not compensate the difference between the inflow and outflow.
(2) Existence of potences: A potence is able to supply over 3.6 m^3 of water in half an hour, it may affect immediately on the stored water in the tank. It is consequently considers in the analysis of distribution tank behaviour described below.
(3) Tank Behavior: The storage volume of the tank is verified by analyzing tank behaviour considering above mentioned factors and the capacity is increased, if necessary. The analysis of tank behaviour also makes possible to determine an appropriate transmission flow rate. However, it necessitate further information and data to make the analysis appropriate.

7.9.4 Hydraulic simulation according to the DGGREE Guidelines

(1) Flow rate of the service installations:

The flow rates to be applied to the service installations which governs the distribution system design are specified as follows in the guidelines of the DGGREE.

- Communal tap and particular connection to public institutions: 0.5 L/s
- Potence: 2.0 L/s

(2) Minimum dynamic pressure

The DGGREE guidelines recommend that the minimum dynamic pressure in the distribution system should be 1 bar (10m of water head). In addition, the distribution flow by gravity is applied to the rural WSSs in order to reduce the operation cost.

(3) Flow velocity in the pipeline

It is specified as from 0.4 m/s to 1.2 m/s. The acceptable flow velocity should not be lower than 0.4 m/s with expectation to avoid the deposit of the particles suspended and to ensure cleaning. Besides, the velocity should not exceed 1.2 m/s in order to avoid the risks of the pipe corrosion according to DGGREE.

(4) Hydraulic factor related to the friction loss head

It has to be estimated according to the formula of Hazen William or Colebrook. The application of the formula of Hazen William is however recommended. The value C (hydraulic factor related to the roughness of the pipe inner surface) used in the formula of Hazen has to be 120 considering the long term use.

7.9.5 Modification of the hydraulic simulation for the pilot sub-projects

The hydraulic simulation of the distribution system is essentially based on the flow rate delivered to each service installations. The specified flow rate by DGGREE to the service installations mentioned above is not necessarily fixed by a device such as a orifice, a flow regulating valve, a pressure reducing valve, etc. or by arranging the service pipe length between the distribution pipe and the service installation. The flow rate of each service installations is consequently governed by the characteristics of distribution system such as a diameter, scale of the system, ups and downs of the service area relative to the location of the service installations and distribution tanks, etc.

The JICA Study Team proposed to modify the design method of distribution system as follows:

1) the distribution system is to be designed based on the hourly peak water supply
2) the water demand is to be reflected the number of population who uses a service installation
3) since the peak factor which can be practically applied to the design is not available, specified flow of 0.5L/s for the communal tap is to be the basis of the simulation, i.e. the total flow rate (the maximum hourly water supply) of communal taps should be equal to the calculated value of 0.5 L/s multiplying the number of the communal taps.

Further details are mentioned in Appendix 7.9.2

The JICA Study Team recommends the following steps for the distribution system design:

- to calculate the peak hourly flow rate of each service installations
- to design the system based on the flow rates and to apply appropriate diameter of the distribution pipelines in order to keep the minimum dynamic pressure 2 bars.
- to compute the flow rates when all the service installations open
- to compare the flow rate to be allotted to each service installations and those got by above mentioned computation
- to modify the assumed distribution system according to the following conditiions:

  i) the necessary flow rate of communal tap < 0.5L/s; the necessary flow rate should be maintained

  ii) the necessary flow rate of communal tap > 0.5L/s; since the period of time that all the communal taps open does not last long, it can be assumed that the flow rate of them increases within a few minutes. Consequently, 0.5L/s should be kept but it should not exceed 0.9L/s so as not to affect the precision of water meter

  iii) 2 L/s should be maintained for the potence.

7.10 Financial Analysis

The financial analysis leads to the justification of the sub-project realisation.

7.10.1 Financial analysis according to the DGGR guidelines

The guidelines of DGGR requires following:

- estimation of the construction cost of the WSS
- determination of the cost price of water produced by one cubic meter
- cash flow balance of the GIC
- annual inflation rate of 5% is assumed in the financial analysis

7.10.1.1 Construction cost

The construction cost includes the following:

(1) Facilities for water source
(2) Pipe and fittings
(3) Pipeline works
(4) Civil works
(5) Electrification and equipment

It is noted that the exploitation cost of the water source such as a deep well is prepared by another budget of the government.

7.10.1.2 Operation and maintenance costs

Operation costs can be divided into the fixed costs and variable costs.

(1) The fixed costs; not related to the quantity of water produced:

- Maintenance costs of the distribution and transmission pipelines, equipment, etc.
- Salary of the pump operator and/or system caretaker, and the technical director.
- Subscription charge to STEG and/or SONEDE
- Management cost of the GIC

Appendix 7.10.1 presents details.

(2) The variable costs; vary in proportion to the volume of water produced:

- Purchase cost of water from SONEDE or neighboring GIC
- Energy cost
- Disinfection cost

7.10.1.3 Cost of one (1) m^3 of water supply

The calculation of cost price for the sub-projects for 2006 was established over the period of observation 2007-2021. The year 2006 is the year of the construction and the year 2021 corresponds to the final year of the project period, i.e. the WSS will not be able to supply water sufficiently with population for a number of days in a year. So did the sub-projects for 2005.

Following are factors to determine the cost price of one cubic meter water:

(1) the annual estimation of the production and consumption;
(2) the construction cost
(3) fixed costs and variable costs.
(4) the annual increase of water production

Details of the computation are described in Appendix 7.10.2.

Since the construction cost and related administrative cost are prepared by the central government, the cost price of one cubic meter water does not necessitate cover the depreciation of the WSS facilities and therefore it covers the fixed and the variable costs.

7.10.1.4 Cash flow and monthly family contribution[5]

The cash flow computation takes into account the revenue based on the flat rate and on the expenses; fixed and variable costs. The construction and the renewal cost are not included in the computation.

[5] It can assumedly cover the monthly expenses based on the projected water production. However the actual consumption is not reflected to the rate.

(1) Consumption growth

The water consumption depends on the participation rate of the population. The financial analysis assumes that the said rate is 62% in the first year of the water supply service and it increases by 5% per year up to 90% in the final year of the sub-project period.

(2) GIC expenses

The fixed and the variable costs explained in the clause 7.10.1.2

(3) GIC revenue

The GIC revenue is essentially depends on the monthly family flat rate. Following two cases are considered:

1) Case 1

All the families participated in the GIC pay their contribution. The contribution has to be determined so that the GIC is able to have surplus in its accounting. However, it is not necessary to have surplus at the end of the sub-project period.

It necessitates to determine the required monthly family flat rate for the OM/M of WSS so that the GIC cash flow can be balanced during the project period. In this case, the subsidy to the GIC from central and/or local government is necessary during the first several years to compensate for the cash shortage in order the GIC to continue its water supply service.

2) Case 2

The participant rate is assumed as 80%. The determination of the family contribution is made similar to above.

Once the flat rate is determined, it is compared with the result of the first case and the more unfavourable one, then the suitable case ensures the autonomous management of the GIC.

The amount of family flat rate allows to calculate the amount of the revolving fund, which is supposed to be equal to 4 times of the monthly contribution in case of the participation rate of 80%.

7.10.1.5 Cash flow and the commodity charge

The cash flow computation determines the commodity charge per cubic meter that should be applied in order to make the cumulative accounting balance at the end of the project period. The computation takes into account the inflation rate of 5%. It is applied to the O/M

costs and the assumed commodity charge in the first year of the project period. Construction and renewal costs are not included because they are the subsidy from the government.

7.10.2 Modification of the financial analysis

As mentioned above, the estimated cash flow of the GIC during the project period requires the subsidy to continue the water supply.

In reality, it is difficult for the GICs to have any subsidy from both central and local government in spite of carrying out rather complicated financial analysis. The JICA Study Team proposed to simplify the financial analysis by introducing minor modifications concerning the family flat rate and the calculation of the revolving fund.

First of all, the proposal defines the amount of the revolving fund shall be equivalent to four months O/M costs for 100% of the projected consumption in the first year of the sub-project period.

The amount of the revolving fund is included in the financial analysis in order to make the cash flow balance of the GIC always positive during the sub-project period. Then, the result is evaluated by AGR concerned from the viewpoint of the affordability of the population. If the population can not afford it, it is reduced by increasing the water charge or flat rate slightly.

Details on the computation of the revolving fund as well as the cash flow of the GIC is explained in Appendix 7.10.3.

7.11 Third Visit of the Sensitization

After the approval of the feasibility study report, the consultant company informs the beneficiaries of the water charge system to be applied and the price of water per cubic meter and the family contribution amount to the revolving fund and all the other components relative to the sub-project in collaboration with the concerned services of the CRDA and the local authorities.

During the third visit, the population is sensitized about the objectives of sub-projects, the service level and the new hygiene conditions regarding the WSS as well as the necessity of a regular payment of the water charge in order to assure the viability of the sub-project.

The form of commitment to contribute to the revolving fund of the GIC according to the model recommended by the DGGREE, is distributed to the target population and then collected during the feasibility study.

It should be noted that 80% of the prospective family heads should sign the form of commitment so as to judge the sub-project eligible.

The activities during the third visit of sensitization are presented in Appendix 7.5.1. The presentation model for the third visit of the sensitization is presented in Appendix 7.5.1.3.

The third visit mainly treated with the explanation on the following themes:

1) composition of the water charge to be applied
2) the result of the discussion in the second visit meeting on the operation hours (new themes of the sensitization introduced in the Study in 2005)
3) unaccounted for water (ditto)

7.12 Detailed Design Study

7.12.1 Geotechnical study

The study consists of the test boring with standard penetration test to have soil profile of the foundation ground of the projected elevated tanks. The task should conform with the specifications prepared by the JICA Study Team.

7.12.2 Preparation of the design drawings

Following the approval of the feasibility study, the consultant companies start the preparation of the design drawings that will be used for the preparation of the tender document. There are two types of drawings.

1) Drawings of the hydraulic works: distribution tanks, a break pressure, pumping stations etc.
2) Drawings of the ancillary facilities: washouts, air valves, sluice valves, etc.

The consultant company can apply the standard drawing of hydraulic installations prepared by DGGREE. There are standard drawings of distribution tanks, a break pressure, and pumping stations for a deep well, whereas drawings corresponding to the relay pumping stations are not available.

As for the standard drawings of the DGGRE, the consultant companies has to input the design elevations of the works as well as to present details about fittings such as tees, elbows, short pipe, etc., a pressure reducing valve, sluice valves, a water meter, etc. Regarding the relay pumping stations, the standard drawing of the distribution tanks is applied by making minor modifications.

The ancillary works such as installing air valves, washouts and sluice valves are determined on the basis of the layout of the pipelines in terms of elevation and branched points. These works are examined one by one determining the dimension and the necessary devices. The consultant companies make an assembly diagram of all the parts and the formwork plan of them. These drawings and diagrams are used for the construction works.

7.12.3 Work quantity survey

Based on the feasibility study, two detail estimates are prepared for the tender documents.

7.12.2.1 Supply of pipe materials, construction of pipeline and civil works

The pipeline length is determined from the longitudinal profile, however, 5% of it is considered for reserve considering the loss due to arrange the pipeline length between installations.

For the soil and the civil works, a ground surface survey is carried out by the consultant companies in order to determine the quantities of soil works for the execution.

As for the fittings and devices used for the ancillary and the hydraulic facilities, the consultant companies make the quantity survey to prepare the list of items according to the assembly diagram. This list is used for the detailed estimate and also the construction works.

7.12.2.2 Procurement and installation of the hydro-mechanical and electric equipment

Though the detail estimate of mentioned above has to be prepared for each project separately, the detail estimate related to hydro-mechanical and electric equipment is generally prepared for one package equipment of all the concerned sub-projects by CRDAs.

7.13 Preparation of the Tender Documents

As specified above, the consultant companies prepare at least two tender documents, one is for the pipeline related works and civil works and another is for the equipment. Respective tender documents should have the following documents:

- particular administrative clause (CCAP),
- particular technical specifications (CPTP),
- tender model
- detailed estimate and price schedule
- documents for execution (working drawings, assembly diagram, parts list, etc.)

These documents have to be consulted with the sub-project owner indicated in the tender notice.

The price schedule provides specific details concerning to each item listed in the detailed estimate. The tender form should require the necessary information of the tenderer as well as the price.

7.13.1 Application of the model tender documents

The DGGREE prepared the model of tender documents for the sub-projects financed by the JBIC and it was approved by the competent personnel of the Bank. The tender

documents are also submitted to the procurement committee of each governorate. Generally this committee adds modifications to the administrative clause of the tender documents, therefore the consultant companies have to adopt the model of specifications provided by the concerned CRDA. This model is prepared in compliance with that of DGGREE.

7.13.2 Contract lots

Two contract lots are generally considered according to above mentioned. One is for the pipeline related works and civil works and another is for the equipment installation.

The former is prepared for one or a few sub-projects according to the size or the location of them. The latter includes all the sub-projects by CRDAs.

Apart from above, the electrification including installation of transformer is usually made exclusive contract with the STEG.

Socio-Economic Survey and Sensitization Activities Photos

No.1: Selection of Relay Persons (Identification)
The sociologists discussed with the target population to select relay persons. The woman in red jacket was cooperative in mobilizing other women (February 24, 2005, El Achich sub-project (ARIANA))

No.2: Household survey (Socio-economic survey)
The sociologist implemented the household survey by using questionnaire (March 8 2004, Slaimia sub-project (MAHDIA))

No.3: Community Mapping (Socio-economic survey)
Target localities and living conditions including water collection were identified based on a community map drawn by the target population (March 30, 2005, Maamria sub-project (Kairouan))

No.4: Pair-wise ranking (Socio-economic Survey)
Needs for improvement of living conditions and the rank of need for water were discussed (March 6, 2005, Khoualdia sub-project (KAIROUAN))

No.5: Examination on the result of detailed and socio-economic surveys
The result were shared among the members of the Study Team, the CRDA and the resident consultant company before the 1st visit of sensitization (March 23, 2005, meeting for the sub-projects of BEJA)

No.6: Use of Community Map (1st visit)
The community map allowed target population to identify the inconvenience regarding present water collection together with the sociologist (April 2, 2004, Sfina sub-project (SILIANA) (suspended sub-project))

No.7: Preliminary concept (1st visit)
An engineer from the resident consultant company explained the preliminary concept: water source, pipeline route, service points, etc. (March 26, 2005, Gard Hadid sub-project (SIDI BOUZID))

No.8: Effective Intervention by the CRDA (1st visit)
Chief of the CGIC/AGR explained the service areas covered by the sub-project and the SONEDE in response to the request of people who lived in the latter to be involved in the sub-project. (March 26 2005, Gard Hadid sub-project (SIDI BOUZID))

No.9: Verification of localities to be covered (1st visit)
The Community map was effectively utilized. Participants explained that their locality was geographically divided into two sub-localities (March 27, 2005, Ouled Moussa sub-project (SIDI BOUZID))

No.10: Optimum design of WSS (2nd visit)
An engineer gave an explanation on the optimum concept determined (June 3, 2004, Ouled Barka sub-project (KASSERINE))

No.11: Location of service point (2nd visit)
Target population showed a sociologist their preferred location of service installation by placing a stone with a painted mark. (April 15 2004, Mzouga-Zeldou sub-project (BEJA))

No.12: Tariff System (2nd Visit)
Water charge systems with merits and demerits were explained before the target population gave their preference (April 23, 2005, Sidi Daher sub-project (SILIANA))

No.13: Operation at Service points(1) (2nd Visit)
Topics regarding the operation of service point such as operation hours, tap keeper, water charge method were discussed with most prospective users who would share the same service installation. (April 23, 2005, Sidi Daher sub-project (SILIANA))

No.14: Operation at service points(2)
The result of the discussion regarding tap keepers, operation hours, tariff system was filled in large-size paper (April 19, 2005, Agba sub-project (SILIANA))

No.15: Explanation on the GIC(2nd visit)
The role of GIC was explained with visual aid so as to make the participants understood easily.
(June 3 2004, Ouled Barka sub-project (KASSERINE))

No.16: Investment Cost (3rd visit)
An engineer of a resident consultant company explained to population the construction cost of the projected WSS according to its component.
(September 21, 2005, Kalboussi sub-project (BIZERTE))

No.17: Component of Water Charge (3rd Visit)
Components of water production such as electricity, maintenance, etc., were explained to population in oder to give an idea on the necessity of payment for water (August 26, 2005, Hsainia sub-project (KAIROUAN))

No.18: Un-Accounted for Water (3rd Visit)
A sociologist explained water leakage at the joint to the tap (one of the causes of UFW) when it is not carefully maintained (September 17, 2005, Ain Jaffel sub-project (SIDI BOUZID))

No.19: Signing the commitment (3rd visit)
After the sensitization meeting, the form of the commitment for the revolving funds was distributed and signed by beneficiary household heads (August 16, 2004, Ezzaguaya sub-project (LE KEF))

No.20: Contact avec les femmes
Door-to-door visits for women. A woman sociologist explained to them the role of the tap keeper and the measures to be taken by users in case of a water leakage (29/04/05 05, Kalboussi sub-project (BIZERTE))

No.21: Relay Persons (1)
A young woman relay person helped a sociologist making an attendance list (April 5, 2005, Etramis-Edmain sub-project (BIZERTE))

No.22: Relay person (2)
Relay persons were preparing the form of commitment for the contribution to the revolving funds for their distribution (August 5, 2004, Ben Thameur et Bkir sub-project (NABEUL))

No.23: Interview with relay persons (1)
The relay person told that she wanted everybody to participated in the meeting and to be satisfied with her task. She was selected as the tap keeper as well as the member of the provisional GIC committee (September 12, 2005, Etramis-Edmain sub-project (BIZERTE))

No.24: Interview with relay persons (2)
The relay persons interviewed told that he was satisfied with having the discussion on different subjects in the sensitization meeting (September 17, 205, Ain Jaffel sub-project (SIDI BOUZID))

8 PRODUCT OF THE STUDY

8.1 Workshop

8.1.1 Problems confronted in the past

According to the experience in the JICA Study in 2000, some problems, especially those related to the sensitization, exist. Therefore, the Study Team considered that it would be effective to organize workshops to discuss these problems and look for solutions before the commencement of the Study as well as in the course of the Study. The points focused before starting the Study are summarized as follows.

(1) Lack of a guideline regarding the identification and socio-economic survey:

The sociologists often have to refer to the manuals of socio-economic survey, not used in the studies of drinking water. So, no feedback of socio-economic survey to the target population was taken into account.

(2) Insufficient presentation of the educational and didactic tools:

It was noticed that the sociologists tended to focus the fieldwork on general guidance interpreting in more or less flexible way. In practice, the involvement of population in the project period was not focused on, but on the commitments to the revolving fund.

(3) Absence of control and follow-up:

The absence of control and follow-up to guarantee a successful application of the sensitization manual was also noticed. So, the relay persons were never selected, and the specific themes for the sensitization were not defined, or in the majority of cases, defined in an obscure and rough way.

(4) Lack of in-depth socioeconomic survey and interaction between social and technical aspects

The lack of in-depth socioeconomic survey leads to lack of definition of specific themes for the sensitization. The coordination between the sociologist and the engineer was not given importance. The contents of the sensitization were of a general character without any specificity of each project. Neither preliminary design, nor optimal design was presented to the population. The feedback of information and the interaction between the social and technical aspects were insufficiently assured.

8.1.2 Orientation workshop for CGIC (March 2004)

A two-days workshop was organized in March 2004 in the presence of DGGREE/SGIC, AGR/CGIC and JICA Study Team. The workshop targeted relatively important persons in

line with its objectives.

8.1.2.1 Objectives

(1) Identification of problems observed in past feasibility studies

Though the study methodology was said to be understood gradually, different deficiencies seemed to remain as mentioned above. For successful implementation of the Study, it was considered effective to identify problems which had not be able to be found in the past and their solutions to be taken for the present Study at the beginning of the Study.

(2) Common and better understanding on the Study methodology

It was often noted that the methodology was not equally understood differently. Thus, it seemed to be necessary to start the Study on the same basis of understanding on the methodology to be applied.

(3) Grasping gender consideration in the Study

The effective participation of women is an essential factor to ensure the sustainability of RWSS. In this respect, the understanding of those in charge of the sensitization such as CGIC is indispensable.

8.1.2.2 Contents of the Workshop

1) Analysis of problems observed in the feasibility study, based on PCM method[1]
2) Methodology of the feasibility study
3) Gender approach

8.1.2.3 Outcome of the Workshop

(1) Problems identified

The problem analysis, started from a core problem "The feasibility study in the RWS projects has not been implemented appropriately", identified different problems: methodological, technical ones, those related to the sensitization and also the insufficient involvement of CGIC during the feasibility study[2]. The result is attached in Appendix 8.1.1

(2) Improvement of the understanding of the study methodology

i) Appropriate steps of the study methodology

[1] PCM method is a tool for managing the entire project cycle of a project from planning and implementation to evaluation. Problem analysis is one of steps in participatory planning of this method, which visualizes a relationship of causes-effects of a given problem in a form of problem tree.

[2] This problem is not directly related with the core problem given, but it is worth mentioning here as one of important learning for the Study Team to collaborate with them in the course of the study.

It was found that objectives of different visits for the preliminary sensitization and appropriate timing of different steps were poorly understood.[3] The explanation followed by Q & A improved their ambiguous understanding to some extent.

ii) Common understanding of the improvement attempted by the Study Team

The method and tools for the PRA to be applied to the Study were explained[4]. Participants seemed to understand the significance of socio-economic survey gradually in the course of the Study according to their appreciation on the improved socio-economic survey verified during and at the end of the Study[5].

(3) Basic understanding of gender consideration

Gender consideration of the Study was explained[6]. Most of participants justified the relevance of women's participation because of the fact that only women's daily task closely related to water[7]. The Study Team emphasized the importance with the concept of efficiency and sustainability of OM/M of RWSS through wider participation of the community. According to the questions raised during the workshop, participants did not seem to understand fully. This theme was continually explained in other workshops afterwards.

8.1.3 Workshop for personnel in charge of study execution

Workshops of two days were organized before the commencement of the Study each year for the personnel in charge of study execution (resident consultants).

8.1.3.1 Workshop for the Study of the sub-projects 2005

(1) Objectives

i) Better and common understanding of the methodology of the Study
ii) Clear understanding on the socio-economic survey

(2) Contents of the workshop

1) Methodology of the Study (principal steps, subjects to be dealt at each step)
2) Technical knowledge necessary to the sociologists (RWSS and different facilities and installations, calculation of the water charge, components of the O/M costs)
3) Socio-economic survey

[3] For example, the reason why the topographic survey takes place after the second visit of the sensitization visit was not clear for most of participants at the beginning, which was clarified at the same time.
[4] PRA tools are explained in the Appendix 7.4.1
[5] Such an appreciation was observed in various occasions such as the socio-economic survey, meetings of the selection of optimum design and the discussion of socio-economic report.
[6] Gender consideration in the Study is presented in Chapter 8.3.
[7] The discussion concentrated on the question "Why is gender consideration relevant?" in the workshop showed their perception.

i) Household survey (explanation on the questionnaire and practice of interview)
ii) PRA (community mapping, pair-wise ranking, semi-structured interview)[8]

4) Gender consideration
5) Water and Sanitation

(3) Outcome of the Workshop

At the end of the workshop, understanding of the resident consultants was supposedly improved regarding following subjects.

1) Methodology of the Study

Similar to the workshop for the CGIC, it was found that most of participants, even experienced consultants, could not at first comprehended the methodology properly. The confusion was found in the definition of different steps of the feasibility study and their orders[9].

Practical exercise followed by Q & A and exchange of field experience allowed participants to improve their understanding on the methodology[10].

2) Technical knowledge of sociologists

The session enhanced basic understanding on technical aspects required to the sociologist for better communication with the target population.

3) Socio-Economic Survey

In the past, the socio-economic survey was not given importance and socio-economic conditions were not often taken into account in the sensitization activities. Detailed explanation and the pre-test of the questionnaire regarding the household survey allowed the participants to understand the procedure of the survey.

As for the PRA, it took much time for the sociologists to understand its usefulness due to insufficient practical experience. The method and the application of PRA tools were understood finally to a certain extent in the course of the Study.

4) Gender Consideration

Referring to the insufficient participation of women observed during the JICA Study in 2000, the session dealt with difficulties related to women's participation and the identification of their causes and the solutions to be taken for the Study.

8 Regarding the PRA tools introduced in the Study, please refer to the Appendix 7.4.1.
9 Several participants needed much time to answer the question about the step to take after the first sensitization visit and the suitable moment for the topographic surveys. The socio-economic survey and the first sensitization visit were considered as only one stage. The difference between the first and the second sensitization visit was not clear.
10 The exercise on "Who does what and when" in each stage was followed by Q & A.

5) Water and hygiene

Based on the manual of hygiene education prepared by DGGREE for the training GIC, the use of illustrations was discussed among the sociologists based on their experiences.

8.1.3.2 Workshop for the Study for the sub-projects 2006

(1) Objectives

1) Feedback to improve the quality of the Study from the result of the Study in 2004
2) Explanation of new themes of sensitization newly introduced in the Study in 2005

(2) Content of the workshop

1) Points focused to the Study in 2005
   - i) Accountability
   - ii) Sustainability of the GICs
   - iii) Gender Consideration
2) Socio-economic survey and sensitization program
   - iv) Identification
     - (A) Accomplishment of beneficiaries families lists at the end of the second visit of sensitization (the final determination of the beneficiary families)
     - (B) Reinforcement of the selection of relay persons (selection of men and women relay persons for each locality)
   - v) Socio-economic survey
     - (A) Improving the presentation of the household survey result
     - (B) Detailed explanation of the questionnaire for the household survey
   - vi) New themes for the sensitization activities
     - (A) Operation hours
     - (B) Un-accounted for water (UFW)
   - vii) Gender considerations
     - (A) Result of the Study for the sub-projects 2005
     - (B) Specific objectives for the Study of the sub-projects 2006 and the means to achieve them
   - viii) FAQ (Frequently Asked Questions by the target population)

(3) Outcome of the workshop

The significance of contents of the questionnaire for the household survey was clarified to the sociologists so as not to misinterpret them, as observed in the Study in 2004. Nevertheless, the household survey did not provide reliable data in some cases due to careless and inappropriate manner of conducting interview and data processing.

The exercise on "FAQ", based on the exchange of field experiences and points of view allowed the consultants to reconsider their approach and the manner of dealing with themes

on the sensitization. Outcome of such exercise, distributed to the consultant companies as a reference of the field work, is attached in Appendix 8.1.2.

8.1.4 Workshop for Chefs d'AGR

A workshop of two days was held in March 2005. It initially targeted Chef AGR of the concerned CRDAs in collaboration with the DGGREE. However, among the 13 concerned CRDA, the Chef d'AGRs of only two CRDAs: Manouba and Bizerte participated in the workshop. Other participants were mostly staff of CGICs.

Objective of the workshop was to share a common understanding on the methodology applied to the Study and lessons learned from the study for sub-projects for 2005 executed in 2004. However, due to the low participant rate of Chef AGR, the themes presented in the workshop seemed to be too much for the most of participants. The session of the workshop consisted of five (5) major items explained hereinafter:

(1) Important points of the Study

The three points mentioned in Clause 8.1.2.2. (2) 1) were emphasized.

(2) Methodology applied to the Study

The 10 major steps were presented and discussed. Videotape records of the socio-economic survey were also presented in order to give the participants a clear idea about the participation of the population.

(3) FAQ (Frequently Asked Questions by the population)

Discussion was made on the possible replies to the FAQ which were prepared for the workshop held on February 11-12 targeting the resident consultants. The team observed that discussion was not made in depth comparing at the workshop for the resident consultants.

(4) Proposed new themes for the sensitization

Three (3) new themes: (i) operation hours of AEP system to give beneficiaries clear idea on the workload of the tap-keepers, pump operators, etc. (ii) different water charge between GIC member and non-member in order to give the privilege to the GIC members[11] and (iii) UFW (unaccounted for water) in order to decrease it for the sustainability of GIC, were presented by the Study Team as the feedback of the Study for the sub-projects for 2005 executed in the last year.

(5) Lessons derived from the Study in 2004

11 "Privilege of the GIC member?" is one of the most difficult questions to reply for the Study Team as well as the resident consultants. The Study Team has not understood the privilege of the GIC member well.

Propositions were made based on the lessons derived from the Study of 2004 with regard to; (i) setting of the residual pressure at communal taps (BF), (ii) control of pipe internal flow between two tanks, (iii) examination of the distribution tank capacity, (iv) calculation method of motor output, (v) installation of electrical dosing pump of chlorine for gravity distribution systems and (vii) number of beneficiaries covered by one BF.

Apart from above, the Team prepared the theme of "Simplification of the Financial Analysis", but it could not be presented due to the time constraint.

8.1.5 Workshop to modify the design of the RWS projects

This workshop was held on June 23 and 24, 2005 targeting wotj engineers and Chef d'AGRs concerned with pilot projects situated in eleven governorates presented in chapter 7. During this workshop, modified design method was presented as well as practical examples were handled.

The modification of the design method of RWS projects concerns three (3) themes:

- Distribution system modeling
- Optimization of distribution tank
- Simplification of financial analysis of the RWS projects

8.1.5.1 Distribution system modeling

(1) Reminding of the present method

At the beginning, the principal steps of the currently applied method to design the distribution system were reminded to the participants:

- Selection of the optimum preliminary design
- Location of service installations
- Topographic survey
- Distribution system modeling

The distribution system modeling is done through the application of a fixed flow at service installations (0.5L/s at the BF and particular connection for public institution and 2L/s at the potence). Diameter of the distribution pipes is selected in order to guarantee the minimum dynamic pressure of 1 bar.

(2) Constraints of the presently applied method

Participants were explained that the actual method is subject to certain constraints:

1) Flow rate at service installations

Service installations are not equipped with devices to control the flow rate and

consequently it varies from one to another according to the location of the service installations and the distribution system design in terms of pipeline length, pipe diameter and the planned elevation of installations.

2) Minimum dynamic pressure

It is the designated pressure to be kept in the distribution system in order to supply water in stable and sufficiently. It is obvious that water pressure at the outlet of service installation is almost null (equal to $V^2/2g$: where V: velocity of flow, g: gravity acceleration) so with a minimum dynamic pressure of 1 bar, the flow rate of a service installation depends on the characteristics of the service system.

(3) Modification of the method of distribution system modeling

1) Presentation

Before discussing the modeling and the examples, the Study Team presented the various factors which are used in the computation:

i) Flow rate at full opening of a tap under the condition of the minimum dynamic pressure of 1bar
ii) Steps to reach an appropriate distribution system model for a WSS
iii) Determination of hourly peak factor and the necessary flow of the service installations with respect to the presently applied design guideline of DGGREE

All these elements were explained and discussed with the participants. Details of these elements are presented in chapter 7.

2) Discussion using examples

After presenting the modified design method of the distribution system, the Study Team gave the participants examples which were borrowed from the sub-projects for 2005. The exercise for the modeling using the examples made the participants understood the limitiatio of the hydraulic modeling software.

8.1.5.2 Capacity of distribution tank

The Study Team introduced following factors which may make the distribution tank empty though it is a limited period. The influence of these factors was illustrated by several practical examples.

i) Operation hours
ii) Impact of the existence of potence
iii) Relation between the transmission flow , the water consumption fluctuation and the storage volume of distribution tank

8.1.5.3 Simplification of financial analysis

At the beginning the present method of the financial analysis of the RWS project was reminded and then following two points were explained:

(1) Revolving funds and membership fee:

The amount of money collected for the revolving fund as well as the annual membership fee have not been included in the financial analysis of the present method.

(2) Cash flow

The cash flow analysis had been made in the past shows the negative balance in the first several years of the project period.

JICA study team proposed to introduce the amount of the revolving fund as well as membership fee in the cash flow analysis. The modified methodology for the cash flow analysis, which is presented in Appendix 7.10.2.2, was presented to the participants and illustrated with examples.

8.2 Sensitization Activities

Sensitization activities consist of five (5) major stages during the Feasibility Study: Identification, Socio-economic survey, and three visits of sensitization activities as explained in Appendix 7.5.1. This sub-chapter describes the sequence of these activities and how the expectations and opinions of the target population were reflected in the basic design of the WSS through the field contacts between the target population and consultant companies.

8.2.1 Identification

The first contact with the population begins with the identification attended by the Omda of the sector and some responsible from the AGR. The work mainly consisted of:

- Identification of the sub-project area
- Preparation of the list of beneficiary families
- Selection of relay persons

The identification work did not place a special emphasis on the selection of relay persons in the Study in 2004. Recognizing the usefulness of such persons, the Study Team required the consultant companies to promote the selection of relay persons in the identification for the Study in 2005.

During the visit to each locality, the sociologists contacted the target population to collect the above mentioned information and at the same time to select relay persons able to help the consultant company to accomplish various tasks, such as establishment of beneficiary families' list, organization of sensitization meetings and distribution and collection of different contracts or commitments. This process is important not only to select such persons but also for rapport building between the target population and the sociologists which will be useful for smooth implementation of activities from the next stage and ideally to raise a sense of ownership toward the projected RWSS from the beginning of the study.

Based on this concept, the sociologists were required to make the best of the relay persons especially in the Study in 2005.

8.2.1.1 Outcome of Identification

(1) Verification of the list of beneficiary families

The list of beneficiary families were collected and verified. The verification was completed in principle at the end of first visit of sensitization in the Study in 2004 and by the end of the second visit of sensitization in the Study in 2005 to supply water from benefit water from the projected WSS to as much population as possible. Table 8.2.1 shows the difference of the target population by sub-project between the identification implemented by the CRDA and that implemented in the Study.

The following table indicates a summary of the verification of the beneficiary families' lists for a total of sub-projects. Data verified in the Study revealed that there was an increase in the target population of forty-one (41) sub-projects. The population increased by 1-2 times in thirty-one (31) sub-projects and by more than 2 times in eleven (11) sub-projects. Meanwhile, the target population was decreased in 23 sub-projects.

Table 8.2.2 Difference of the target population from the identification card prepared by the CRDA[1]

Difference (time)		Sub-project (No.)	Sub-project (%)
<0.5		1	1.6
>0.5	<1	22	34.4
>=1	<2.0	31	48.4
>=2.0	<3.0	6	9.4
>=3		4	6.3
	Total	64	100

Source: Socio economic reports

This variation of the number of beneficiaries can be explained by the fact that some localities were often left unidentified in the preliminary study made by the CRDA and the local authorities tried to include localities of which water supply was considered to be insufficient.

(2) Selection of relay persons

Relay persons were selected through the discussion with the target population presented at the identification or the designation by the local leaders such as the "Omda" , the head of the "Cellule Destourienne"[2]. Table 8.2.1 shows the result of the selection of relay persons by sub-projects. The relay persons were mainly selected based on the following criterion:

- Motivation to assist the consultant companies by informing other beneficiaries of the sensitization meetings
- Confidence in the other inhabitants or recommendation of the others,
- Availability of communication means (Cellular phones in GSM),
- (Ideally) minimum educational level

In fact, it was not easy to select effective relay persons during the visit to the localities in the identification due to the time limitations to discuss sufficiently with the target population. The sociologists were often obliged to ask the target population, present by chance, to designate somebody or asked them to become relay persons and to represent their localities.

[1] The Mzouga-Zeldou 1st phase and 2nd phase sub-projects in Beja and the Ouled Ammar and Ouled Essaafi sub-projects in MAHDIA are considered as one project respectively. The total number of sub-projects in this section is accordingly 64..

[2] Cell of the primary political party.

Tendency of Relay Persons

In the Study in 2004, women relay persons were selected in only 1/3 of the sub-projects. In the Study in 2005, both men and women relay persons were selected in all the sub-projects and almost same number of women and men relay persons were selected in 18 sub-projects.

Table 8.2.3 Ratio of relay persons by gender

Indicator	Sub-projects 2005	Sub-projects 2006	Total
No. of sub-projects for which men and women relay persons were selected	11	33	44
No. of sub-projects for which men and women relay persons were selected in approximately same number	1	18	19

Source: List of Relay Persons

According to "Omdas" and the resident consultant companies, relay persons were effective in the preparation of beneficiary lists and sensitizing meetings and the collection of various commitments. However, the number of participants in the sensitization meetings did not increase.

8.2.2 Socio-Economic Survey

The socio-economic survey was implemented to collect basic information of the sub-project area such as present water collection, health and hygienic conditions, living conditions, human and social relations and then to identify factors influential to the sub-project effectiveness and sustainability. The methods of socio-economic survey are summarized below and the details are explained in Appendix 7.4.2.

8.2.2.1 Methods applied

The socio-economic survey was based on two complementary methods:

(1) Sample household survey with questionnaire based on the actual sensitization manual
(2) Appraisal of the sub-project areas through following PRA tools:

(1) Community mapping

An exercise was made to know the perception of the population about the configuration of the sub-project area guided by the sociologists while presenting the various elements on a large flip-chart. The maps were exposed during all the sensitizing visits and were used as a reference for explanations.

(2) Pair-wise ranking

The principal objective of this exercise is to recognize the position of the drinking water supply project by the population in its priority orders and also to know its concern with the

project. Interview with the participants was made following their way of thinking regarding the needs they expressed according to a set of priorities of them.

(3) Semi-structured Interview

It was made according to the guide of the directive interview with a group of relay persons, after the elaboration of the community map and the pair-wise ranking.

8.2.2.2 Observations

(1) Usefulness of PRA tools in the Study

The participatory approach with the aids of PRA tools was often appreciated by the target population according to the interview with relay persons (see Clause 8.3.5 regarding the result of the interview). Pair-wise ranking was in particular appreciated among different subjects as a tool to give opinions. The utility of other tools is explained below.

1) Effect of the visualization (Community Mapping)

The Community mapping elaborated at the beginning of the PRA session allowed the participants to visually re-examine the sub-project area and to express their various points of view based on a common understanding. This tool was used during the pair-wise ranking and the semi-structured interview that followed. For example, the participants explained the disadvantages of the current water supply, and their needs for development by indicating such points on the community mapping.

2) Verification of the localities to be targeted

This tool made it possible to identify the localities which were not included in the identification prepared by the CRDA[3]. It was also used to check the configuration of the localities, in other words, the spatial distribution of the population[4]. The denomination of the localities and their position on the network layout were verified by the participants in the sensitization meeting by referring to the community map[5]. Such cases may prove that the target population felt attached to the community map drawn by them.

8.2.2.3 Outcome of the socio-economic survey

The outcomes of the socio-economic survey were shared in a warp-up meeting held between the Study Team and the consultant companies in the Study in 2004 and the AGR

[3] For example, in Slatnia sub-project in SIDI BOUZID, two (2) localities were added through verification of localities marked on the community map in the presence of the personnel of the AGR and the “Omda”.

[4] For example, in Ouled Moussa sub-project in SIDI BOUZID, the participants explained that a locality was divided into two (2) sub-localities and asked for a BF for each by indicating houses in the community map at the first visit of the sensitization.

[5] The case was observed in Ghanzour sub-project in KAIROUAN.

attended them in the Study in 2005 as mentioned in Clause 7.4.

8.2.2.4 Identified specific themes

The following are major specific themes identified through the socio-economic survey.

(1) Importance of drinking water and necessary cost for its supply

The sub-projects where the population is used to consume water for free from conventional water sources such as springs, shallow wells or "wadis" (streams), the importance of water quality from projected WSS and its supply cost to be borne by the beneficiaries were explained. This theme also concerns the sub-projects of which target population was negatively influenced by problematic management conditions of neighboring GICs.

(2) Community-based management of the RWSS by the GIC

A lack of confidence in the GIC or in the neighboring GIC (prejudice) was sometimes noticed. Hence, it is necessary to explain the role of the GIC and to make the target population realize that the success of the GIC depends on the contribution of users.

8.2.3 First visit of sensitization

The first visit is practically the third contact with target population following the socio-economic survey. More concrete consultations start in the form of meetings. The mixed men and women or separate meeting is determined based on the number of households number, the configuration of the sub-project area and the local customs according to the execution program prepared for each sub-project[6]. The themes discussed in the meetings are explained in Clause 7.5.

8.2.3.1 Principal discussions with the beneficiaries

(1) Scope of the projected RWSS

Strong demand for private connections was observed in almost all sub-projects. Faced with such a request, the sub-project objective, "to supply the maximum number of population through the collective water supply" was stressed. In spite of the recommendations by Study Team not to explain on the conditions of the execution of private connections[7] that could not be committed by the Study, almost all the resident consultant companies had no choice other than to explain such conditions to calm the target population's persistent request for private

[6] Each consultant company was requested to prepare a detailed program for each sensitization visit including the following information: date, time, localities concerned by each meeting, place, type (mixed/separate) and specific topics if necessary.

[7] The explanation presented about the conditions of realization of private connections are i) taking in charge the expenses of the installation of the flow meter and the drainage equipment by the users themselves and ii) the permission of the CRDA after technical study.

connections. The objective of the Project was supposedly understood in most of the sub-projects except one that was excluded from the Study.

(2) Number of service installations

After the request for private connections, the increase in the number of service installations was often claimed. In response to it, the customary rule of DGGREE was explained that one communal tap was to be placed within 500m from a house and for approximately 20 families and it would be possible to increase the number of service installations as far as the sub-project eligibility (per capita construction cost) permits. The first visit was an occasion to confirm the social relationships, in other words, the existence of social conflicts, which necessitate to consider the number and location of the service installations and the technical conditions including the pipeline route (existence of wadis, cactus hedges, etc.)

(3) Requesting animal watering places

Animal watering places were frequently requested. It was explained to the participants that it would be possible to install them with agreement by the CRDA. At the same time, the problems caused by such facilities were raised: the hygiene around the facilities and the difficulty to measure the water consumption by respective beneficiaries when the commodity charge is applied.

(4) Future management by the GIC

The management of the projected Rural WSS was discussed in the sub-projects of "Extension GR". Advantages and disadvantages of the management of both new and existing WSSs by sole GIC (integration of the beneficiaries of the sub-project into the existing GIC) and those of two independent GICs were explained). There are sub-projects of which the majority of the target population preferred its own GIC due to the sense of mistrust of a neighboring GIC or the existence social conflicts with the people of existing GIC. On the other hand, there are other sub-projects of which population mainly preferred to be included in the existing GIC considering its experience in management. The decision was left to the target population up to the second visit.

8.2.3.2 Principal conclusions

(1) Participation of the target population in the sensitization meetings

Table 8.2.4 shows the record of the participated target population in first visit of the sensitization meetings per sub-project. The table below summarized the Table 8.2.4. The participation rate in the Study in 2004 was higher than that in the Study 2005. However, a little improvement was observed in women's participation. The number of sub-projects

where women's participation rate is less than 10% of the number of households was only 2 against the 8 sub-projects in the Study in 2004.

Table 8.2.5 Summary of the First Visit of the Sensitization

Indicator	Sub-projects 2005	Sub-projects 2006	Total
Average Participation Rate (Homme)	43.6	37.4	40.40
Average Participation Rate (Femme)	23.3	25.3	24.32
Average Participation Rate (Total)	66.9	62.0	64.33
No. of sub-projects with women's participation rate < 10% of the target households	9	2	11

Source: Socio-economic reports

(2) Acceptance of the sub-projects

The target population was informed of the objectives of the Project, its advantages compared to the disadvantages, water charge system and the duties of the beneficiaries. It seems that the presentation of the socio-economic survey result in a comparative way facilitated their understanding on the advantages of projected WSS: short distance to fetch water, stable and constant water supply throughout the year and decrease in expenditures for water.

(3) Elimination of a sub-project from the Study due to refusal of the collective water supply

In the Tesselmine and Souassi sub-project in Nabeul, the majority of the Tesselmine area refused the collective water supply for the private connection despite the efforts to convince them of the safe and stable water supply by the concerned parties (AGR, JICA Study Team and the resident consultant company in charge).

(4) Elimination of some localities due to the refusal of the sub-project

1) Etramis Edmain sub-project in Bizerte

Among the 212 families identified through the socio-economic survey, the majority of the population of a locality of 65 families, which is being supplied with water from an dam lake with free, refused the sub-project giving their priority to employment rather than chargeable drinking water supply. This locality was excluded from the scope of the sub-project after reconfirming its intention.

2) Kalboussi sub-project in Bizerte

The population of three localities with 22 families located near a tapped spring refused the sub-project for the notion of good sufficient water from the spring. Though the expectations and the opinions of the population had been consulted and incorporated into the alternative preliminary designs for making the sub-project optimum.

8.2.4 Second visit of sensitization

The second visit of sensitization was intended to reinforce the understanding of the target population of the topics dealt with during the first visit and to materialize them in the preparation of the feasibility study as well the management of the projected WSS.

This visit consisted of the organization of meetings for general information followed by meetings with small groups. The principal topics were discussed in the meeting for general information. The topics that require discussions at the sites for the service installation were the operation hours, the water charge system, the tasks of the tap keepers and the determination of the place to install the service installation in the site. Various commitments such as land transfer, permission to temporary use of land for the pipeline, the contract of keeping and managing the service installation were made.

8.2.4.1 Discussion and consultation with the beneficiaries

(1) Location of service installations

The requests of target population about the number and type of service installations were firstly considered by the engineers of the resident consultant company during the sensitization meeting. The engineers explained some technical constraints that prevent the increase in the number of service installations or their implementation. After the meeting, when the persons in charge of the Study came to localities, the target population consulted each other and indicated places where they like to install the service installations. After the acceptance of the land owner concerned, these sites were marked.

The request of the target population to add an additional service installation was taken into account in case that there were social or family conflicts in sub-projects.

The configuration of the sub-project area was also taken into account in the addition of service installations. The obstacles to access the service installation such as the existence of a dam[8], wadis or ground up and down were also considered. However, technical constraints sometimes prevent from satisfying the desires of the target population in the location and/or the number of service installations[9].

(2) Selection of persons in charge of tap keeping

Tap keepers of service installations were selected during the second visit of sensitization. The tasks of tap keepers were explained sufficiently, especially in the Study in 2005, to the

[8] In the Sidi Daher sub-project in Siliana, the existence of a dam dividing a locality into two sub-localities allowed this locality to install two (2) service installations for each sub-locality.

[9] In the Sidi Daher sub-project in Siliana, the implementation of second communal tap was technically impossible because the proposed sub-locality is located at the same elevation of the projected distribution tank.

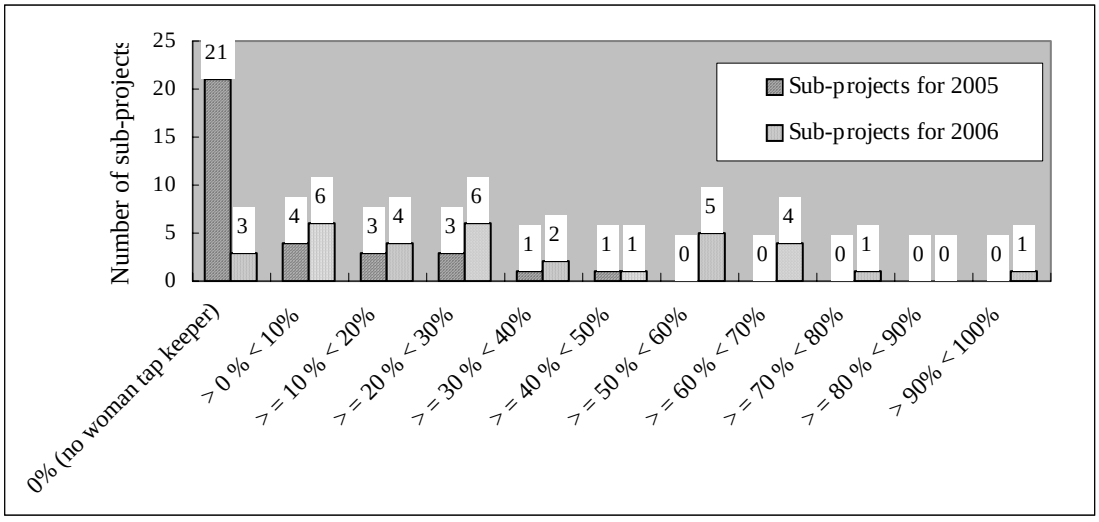
target population so that the tap keeper accepted its role after well understanding of its responsibilities[10]. They were selected in a following manner.

- Owner of land for the service installation in discussion stood to be a tap keeper.
- Someone stood to become a tap keeper regardless of being the land owner or not and authorized by others.
- Participants presented at the determination of the site for service installation recommended someone and authorized by people who would use the service installation.

1) Proportion of tap keepers by gender

The following figure shows a ratio of woman tap keepers (see Table 8.2.6 regarding the ratio by sub-projects). The ratio of woman tap keepers marked a considerable increase in the Study for the sub-projects for 2006. As for the sub-projects for 2005, woman tap keepers were not selected in around two-thirds (2/3) of the sub-projects (21 out of 33 sub-projects). The same case (no woman tap keeper) was observed only in three (3) sub-projects out of the 33 sub-projects for 2006 and woman tap keepers represented more than a half of projected service installations in the third (1/3) of sub-projects for 2006 (11/33 sub-projects). Viewpoints of the target population on woman tap keepers are analyzed in 8.3.

Figure 8.2.1 Ratio of woman tap keepers



2) Remuneration for the tap keeper (with commission or voluntary)

The commission for tap keepers was determined in the meeting for general information and it was commonly applied the projected WSSs in the Study in 2004. The choice between "tap keepers with commission" or "tap keepers on the voluntary basis" was left to the decision

[10] Considering the insufficient explanation about this topic, the Team prepared a presentation model for the 2nd visit of the sensitization in order to explain the tasks of tap keepers regarding 1) guarantee of the use of the service installation (BF) at the fixed period of time, 2) to apply the water charge agreed, 3) keeping the BF and around it in good conditions, 4) informing the GIC of abnormal conditions of the BF or potence.

among prospective users sharing same service installation in the Study in 2005[11]. Those who liked to reduce the water charge are likely to choose voluntary tap keeping. In case that water charge would be beyond the affordability of the beneficiaries, the "volunteer tap keeper" was recommended so as to limit the water charge within the affordability.

Voluntary tap keeping was applied to 22 WSSs. The rest could afford the commission considering the water rate to be applied. (see the following table).

Table 8.2.7 Type of work of tap keepers[12]

Comission	No. of WSS
Volunteer	22
20%	22
23%	1
25%	15
30%	1
40%	4
Total	65

Source: F/S Reports

(3) Water charge system

It was observed in the Study in 2004 that the sociologists in charge of the sensitization tended to insist the commodity charge without detail explanation on the water charge system. The JICA Study Team recommended the resident consultant companies to discuss with the target population in a practical manner in the Study in 2005.

1) Water charge system presented

In the sensitization meetings, following three (3) types of water charge were presented[13].

i) Flat rate on the family basis (monthly, every 2 months, every 3 months or annually)
ii) Commodity charge ((a) individual charge based on the consumption, (b) grouped charge; properly shared cost among users concerned with a service installation)
iii) Mixed method of the flat rate and the commodity charge

To know the preference of the population, the commodity charge was explained that it can

[11] The Study Team recognized that the commodity charge is divided into two options according to the choice of users, either properly sharing the cost among the members concerned with the service installation or paying the rate based on the consumption. The discussion was made at the site of service installation in order to allow prospective users of the same service installation to think about the tasks of the tap keeper.

[12] The Mzouga-Zeldou 1st and 2nd phase sub-projects in Beja and the Ouled Ammar and Ouled Essaffi sub-projects are considered as one WSS. The Faket et Khadem sub-project in Kasserine is divided into 2 WSSs according to the their respective water sources.

[13] Flat rate: a monthly fixed amount calculated on the basis of the annual budget of the GIC. The individual charge based on the consumption is a proportional payment according to the consumption of each user. Properly shared cost among users concerned with a service installation is a division of the cost for the water consumed. The mixed method: a flat rate is applied to recover the fixed cost as the basic charge and the commodity charge is applied to the consumption for the variable cost for the water supply.

be divided into two (2) options[14]. The choice was imposed to the target population attended either during the meeting if the sufficiency of the number of participants permitted or when locating the service installations in case the participation rate in the meeting was low.

2) Water charge system selected

The commodity charge was selected by the target population of 63 projected WSSs. The flat rate was opted by the two (2) sub-projects of Kalboussi and Etramis-Edmain in Bizerte where the flat rate is prevailed.

(4) Land acquisition

A few problems were observed regarding the land acquisition in the Study in 2004. In the sub-project of Ben Thameur et Bkir in Nabeul, the owner of land for the distribution tank refused after the third visit of sensitization. The location of the facilities was obliged to change, which affected the detailed design afterwards. Facing such a problem and similar problems often observed reportedly during the construction work of the sub-project. In the Study in 2005, the resident consultant companies were consequently required to complete the negotiation with the population regarding the land acquisition by the end of second visit of sensitization instead of third visit so as to avoid possible modification of the sub-project design in the later stage. As a result of it, the target population committed itself to provide the necessary land for free with a duly signed document without any problems.

(5) Operation Hours

Operation hours, which is one of the new themes for sensitization in the Study in 2005, were introduced to lead the target population to think about the workload of the tap keepers in relation to a commission expected and to have peak consumption hours, etc. of the projected WSS to analyze the distribution tank behavior so as to determine the appropriate capacity of it.

At the beginning, a lot of participants were reluctant to discuss this topic because they did not want to limit the operation hours that they could use the service installations. The above-mentioned objectives were explained repeatedly and the participants started to consult each other during the location of the service installations.

(6) Constitution of the provisional GIC committee

The participants in the meeting for general information designated the members for a provisional committee composed of 3, 6 or 9 members according to the configuration of the sub-project area. The selected members could be the members of the Board of directors on condition that they would be officially accepted by the general assembly of the GIC to be

[14] These two methods could be flexible in consultation among the users of the same service installation after starting the operation.

created. The members were selected among the inhabitants who were respected and who played a leading role in the sub-project area.

In case of "Extension GR" sub-project, the target population was consulted from the first visit that it could choose to be involved in the existing GIC or to create new GIC for the sub-project.

Table 8.2.8 shows the result of the constitution of the provisional GIC committee by sub-projects. Its summary is shown in a table below. In total, 48 provisional committees of the GIC were set up which consists of 45 committees for new GIC and three (3) for the preparation to be involved in the existing GIC. The member of said three (3) committee will be the member of Board of Directors of the existing GIC by convocation of the extraordinary general assembly of the GIC.

There are 28 sub-projects which could create the new GIC, among which 13 sub-projects for 2005 and eight (8) sub-projects for 2006 selected to be included in the existing GIC.

Table 8.2.9 Summary of the provisional GIC committee

Item	Sub-projects for 2005		Sub-projects for 2006		Total	
	Number	%	Number	%	Number	%
No. of WSS projected	33		32		65	
No. of Sub-projects planned to be integrated in the existing GIC for OM/M	14	42	14	44	28	43
No. of Sub-projects will be integrated in the existing GIC for OM/M	13	93	8	57	21	75

Source: Socio-economic reports

8.2.4.2 Principal Conclusions

(1) The participation of the target population

The participation rates of the meetings for general information and those with limited groups is shown in the following table. It should be noted that the number of participants in the meetings with limited groups in the Study in 2004 represented only the number of participants to locate service installations in general and the Study in 2005 put more emphasis on the subjects relative to the O/M of each service installation such as selection of tap keepers and their commission, operation hours and the water charge system. The participation rate is therefore incomparable and for reference only. The participation rate was higher than other two visits of sensitization both in the Study in 2004 and that in 2005.

Table 8.2.11 Summary of the result of the second visit

Indicator	Gender	Sub-projects for 2005	Sub-projects for 2006	Total
Average participation rate of the meeting for general information (%)	Men	59.2	33.7	46.9
	Women	35.5	24.1	30.0
	Total	94.7	57.8	76.8
Average participation rate of the meeting with restricted groups (%)	Men	44.4	48.5	46.5
	Women	41.3	52.7	47.3
	Total	85.7	101.2	93.8
Average participation rate for all the meetings (%)	Men	91.5	69.9	80.7
	Women	65.5	64.2	64.9
	Total	157.0	134.1	145.5
No. of sub-projects with women's participation rate < 10% of the target households		3	1	4

Source: Socio-economic report

(2) Incorporation of the opinions of the target population in the sub-project concept

The target population was well consulted concerning the number and the type of service installations as well as the pipeline route. The social and technical conditions were taken into account to a large extent.

(3) Preparation for the management and implementation of the projected WSS

The target population started to prepare for the O/M of the projected WSS by discussing the water charge system, the operation hours, the O/M of service installations and the establishment of a provisional GIC committee. The various commitments were duly signed without any problems.

(1) Elimination of a part of localities

1) Ouled Barka sub-project in KASSERINE

36 families out of 337 families were excluded due to the refusal of the sub-project after the change of the water source. The quality of the water source of the existing GIC that replaced the initially projected water source after the first visit of sensitization was not accepted by these families.

2) Ouled Massoud-Rizg sub-project in KASSERINE

382 inhabitants of 80 families out of 250 in four (4) localities were excluded following the refusal of the sub-project by the majority of such families. Such refusal, observed since the socio-economic survey, was related to existing water sources they're using; private shallow wells or groundwater observation wells executed by the CRDA. In spite of the efforts of the

resident consultant companies to hold an intensive sensitization with them, the participation was always insufficient and their refusal did not change. However, the water demand of these 80 families was taken into account for the distribution system design in case that they might join the sub-project in the future. The Study Team took the expectations and the opinions of the population into consideration by the end of the second visit and transmitted them to the feasibility study.

8.2.5 Third sensitization visit

The third visit of the sensitization started after the approval of the feasibility study report by the AGR which included the cost of one (1) m^3 of water and the amount of the revolving fund. The objective of this visit consisted of informing the target population of the results of the feasibility study and subsequent confirmation of their acceptance of the sub-project and their willingness to participate in the GIC expressed by the commitment to the revolving fund[15] signed by the household heads. The themes dealt during this visit are explained in Appendix 7.5.1.

This visit took place in a form of general meetings as well as meetings with small groups for the localities insufficiently attended by their people. The insufficient participation in the third visit was reportedly caused by the season in which the population to give its priority to marriage and religious festivals and the preparation for the beginning of school year.

8.2.5.1 Themes dealt with during the third visit of sensitization

(1) Proposed Water Charge

Table 8.2.6 presents the proposed water charge per sub-project. In most of sub-projects, the target population accepted it.

When the CRDA considered the proposed water charge high based on the affordability for water of the population, it was consulted whether it could accept or not to reduce the commission for the tap keepers. It was confirmed locality by locality during the second visit. Furthermore, when the population was unwilling to accept the proposed water charge, the sensitization concentrated on the explanation about the components of the cost of $1m^3$ water[16] supplied in order to make the target population understood that the water supply always necessitated the cost.

[15] The revolving fund is prepared to compensate for the deficit due to the delay of income in the beginning of the WSS operation while it necessitate at least the fixed cost in every month. The amount of the fund is to be equivalent to the estimated amount of the expenses for the first four (4) months assumed as full operation.

[16] For example, in Kalboussi sub-project in Bizerte, the population accepted reluctantly the amount of monthly flat rate of 5.5 DT; the beneficiaries were disappointed to hear the amount which is higher than the rate applied by the neighbouring GIC.

(2) Commitment to the revolving fund

The target population of most of the sub-projects signed the commitment to contribute to the revolving fund (see Table 8.2.11: the commitment rate by sub-project). The average rate is 87.5% and all the sub-projects satisfied the social eligibility which is 80%.

(3) Un-accounted for water (UFW)

This theme was newly introduced in the Study in 2005 (see Clause 9.1.5 (2) 2)). In the meeting, it was explained to the participants that the un-accounted for water is caused by various factors and a certain rate of water loss is included in the annual budget prepared by the GIC. If the water loss is higher than the expected rate, it may necessitate to increase the water rate in the following year to recover the cost for such a loss. In this regard, the resident consultant companies tried to raise the awareness of the target population on how it can control the water loss. The target population discussed practical manners to ensure the water economy[17].

8.2.5.2 Principal Conclusions

(1) Table 8.2.12 presents the participation of the target population in the meetings of the third visit per sub-project. The participation rates of the third visit of the sensitization was almost the same both in the Study in 2004 and in 2005. Such an insufficient participation might been caused by the facts that the period of the third visit coincided with the seasons of end of the harvest, the threshing of corn, the preparation of the stock for the coming year, marriage and religious festivals. These were commonly observed in the Study in 2004 and in 2005.

Table 8.2.13 Summary of the result of third visit of sensitization

Indicator	Sub-projects for 2005	Sub-projects for 2006	Total
Average participation rate (Men)	42.1	42.7	43.0
Average participation rate (Women)	22.3	22.1	21.9
Average participation rate (Total)	64.5	64.8	64.9
No. of sub-projects with women's participation rate < 10% of the target households	5	7	12

Source: Socio-economic reports

(2) The target population accepted the result of F/S which included the water charge and the amount of the revolving fund. In some of the sub-projects, voluntary tap keeper was recommended so as to maintain the water charge acceptable by the target population though a little reluctance in accepting the voluntary work.

(3) It was observed that the target population understood to a certain extent the new themes of the sensitization, such as operation hours, the UFW and the importance of water economy.

[17] It was recommended i) using a hose when filling the utensils with water, ii) keeping the utensils clean in order to avoid their washing at the service installation, iii) informing the tap keeper when observing the change of flow rate at the level of the tap.

However, these themes needed to be reinforced in the consolidation stage of the sensitization so that the beneficiaries could sufficiently understood to operate and manage the projected WSSs appropriately before starting their operation.

(4) The acceptance of the sub-project by the target population was confirmed by their signing for commitment to the GIC.

8.2.6 Conclusions and recommendations

(1) The relay persons selected seemed effective in various tasks. However, it was recognized that the selection of relay persons suitable for the expected tasks in a very short period was quite difficult.

(2) In general, the expectations and the opinions of the target population were consulted and incorporated in the WSS design through the collaboration between the engineers and the sociologists. According to the interview with relay persons, around 80% of the respondents told that the sensitization meetings were effective to discuss the O/M of the projected WSS (refer the section 8.3.5: the result of the interview survey on the relay persons).

(3) The target population had the expectations for the projected WSSs to avoid the various disadvantages of the current water collection. The target population showed its acceptance of the Project by the commitment rate of 87% to the revolving fund.

(4) In spite of the acceptance, the demand for private connections had been repeated in every contacts with the target population which necessitates the efforts of the sociologists to make the population understood on the scope and significance of the Rural Water Supply Project.

8.3 Gender Approach

This sub-chapter describes the way in which the gender issue was taken into consideration in the Study. The impacts on women, as a case of relay persons, are shown at the end.

8.3.1 Definition

The "gender" is a sociological concept to be distinguished from the "sex" which is relevant to the biological domain. The difference relative to gender designates the men and women's roles defined by a society, determined by the cultural, religious and historical practices.

8.3.2 Gender approach and its significance in the Study in 2005

The starting point of the gender approach is the socio-cultural difference between men and women. In this context, it is necessary to account for this difference that one of genders cannot benefit from the different opportunities such as access to information, participation in sensitization meetings and in the decision-making. Since women's participation is often lower than that of men on the qualitative as well as quantitative level, gender approach in the Study focused on women.

Furthermore, women are expected to be major users of WSS projected, as the implementation of the sub-project will make service installations closer and they use more frequently service installations[1]. It is therefore relevant to raise women's awareness on water related issues so that they become more conscious about the importance of the community-based O/M of the WSS and the responsibilities to be assumed by women.

8.3.3 Approaches introduced in the Study for sub-projects for 2006

8.3.3.1 Objectives

Considering the limited participation of women observed in the past, the Study aims at reinforcing women's involvement in order to guarantee their access to information on the projected RWS, the integration of opinions of large numbers of users, in particular those of prospective major users. It also aims at involving these users in the decision-making regarding the operation of WSS projected. The specific objectives are set as follows:

(1) Strengthened participation of women in the sensitization meetings
(2) Selection of woman tap keepers to make them responsible in future management of service installations
(3) Selection of women as members of provisional GIC committee

[1] Currently, water transport is born not only by women but also by men depending on the type of the water sources, means of transport and the distance.

8.3.3.2 Means to achieve these objectives

The following means were introduced in the Study to achieve above mentioned objectives. The recommended approach in line with the Study flow is indicated in Appendix 8.3.1.

(1) Selection of women and men relay persons per locality (see ch.8.1 and 8.2.1)
(2) Organization of sensitization meetings for women

8.3.4 Results and observation

8.3.4.1 Viewpoint of the target population on women's participation

The subject relative to gender was added to the household survey in the Study in 2005 to grasp viewpoints of the target population on women's participation at different levels. 4 questions are included in the household survey: women's participation in the sensitization meetings, woman tap keepers, woman members of the GIC board of directors and women's ability to repair communal taps. Similar questions were also surveyed through the interview survey with relay persons.

(1) Women's participation in sensitization meetings

According the household survey, the majority of the respondents were in favor of women's participation in sensitization meetings. There was no difference by the regions, yet if this question is examined per sub-project; it revealed that the acceptance rate in two sub-projects was rather limited[2].

Table 8.3.1 Women's participation in sensitization meetings

Answer	Seacoast region		Northwest hilly region		Middle west semi-arid region		Total	
	(Number)	(%)	(Number)	(%)	(Number)	(%)	(Number)	(%)
Accept	225	84.6	245	79.0	538	82.8	1008	82.2
Do not accept	40	15.0	65	21.0	111	17.1	216	17.6
No answer	1	0.4	0	0.0	1	0.2	2	0.2
Total	266	100	310	100	650	100.0	1226	100

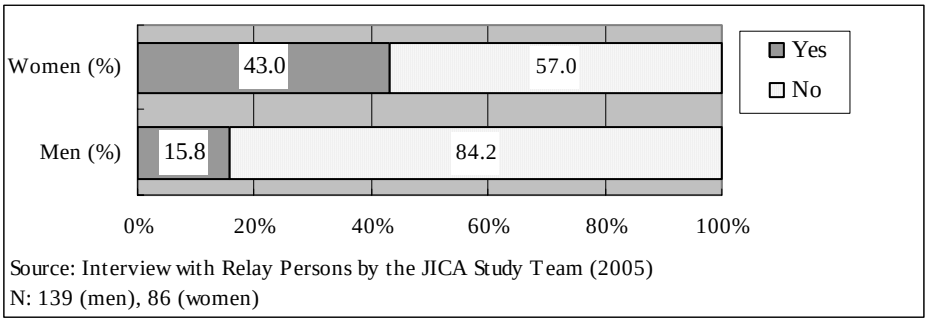
Source: Socio-economic report for the project of 2006

(2) Obstacles to the participation in the sensitization meetings

Obstacles to the participation in the sensitization meetings were surveyed through the interview with relay persons. The result shows that women face more obstacles than men.

[2] Khouldia sub-project in KAIROUAN and Enjaimia sub-project in GAFSA represent 53.3% of acceptance on women's participation in the sensitization meetings.

Figure 8.3.1 Obstacles to the participation in the sensitization meetings



Source: Interview with Relay Persons by the JICA Study Team (2005)
N: 139 (men), 86 (women)

One of the major obstacles commonly declared by men and women was lack of information or the delay of information on the sensitization meetings. Other obstacles declared indicate the difference specific to the gender. Economic activities were considered as important obstacle for men, particularly for those working outside of the sub-project area. The three obstacles were told by women following the lack of information,

i) Household tasks, especially if there is nobody in the family with whom they share household tasks like children)
ii) Distance and access to the meeting place, especially if it is far from their houses, it is difficult to get the permission from family members to attend the meeting leaving household tasks unfinished.
iii) Meeting time

Table 8.3.2 Type of obstacles

Type of Obstacles	Men (Number)	Men (%)	Women (Number)	Women (%)	Total (Number)	Total (%)
Lack or delay of Information on the meeting	10	45.5	13	35.1	23	39.0
Distance and/or acces to the meeting place	3	13.6	10	27.0	13	22.0
Meeting time	3	13.6	5	13.5	8	13.6
Household tasks	0	0.0	11	29.7	11	18.6
Economic activities	14	63.6	3	8.1	17	28.8
Care of family members (children, aged parents)	1	4.5	5	13.5	6	10.2
Ceremonial occasions (marriage, funeral)	2	9.1	0	0.0	2	3.4
Difficult acceptance of the family	0	0.0	2	5.4	2	3.4
No interest in the sensitization meeting	0	0.0	1	2.7	1	1.7
No. of respondents did not show any obstacle	22		37		59	

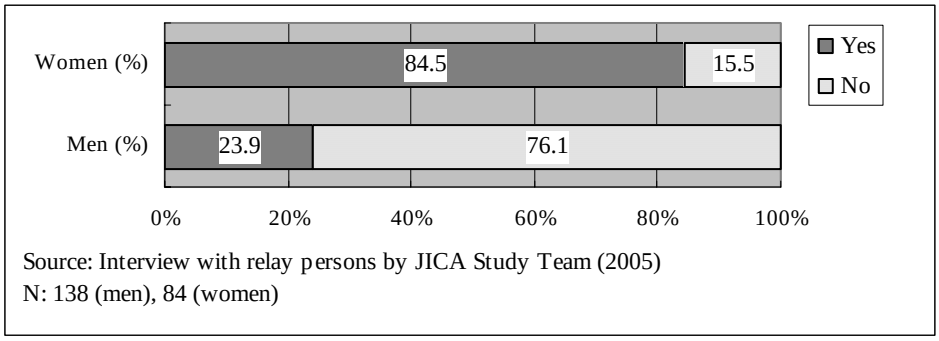
Source: Interview with relay persons relais by the JICA Study Team (2005)

As shown above, household tasks are major obstacles in relation to the division of labor between the genders. However, it also revealed that women were able to arrange their time to attend the meeting depending on the importance they put in such community activity. According to a woman relay person having attended the meeting regularly, she tried to attend the meeting by starting household tasks earlier to attend the meeting.

(3) Freedom to attend the meetings

According to the interview with relay persons, women are less free to attend the meeting compared with men. The majority of woman relay persons needed permission to attend the meeting, though the majority of men accepted in principle the women's participation in the sensitization meeting. On the contrary, the majority of men attend the meetings more independently.

Figure 8.3.2 Necessity to ask permission to attend the meeting

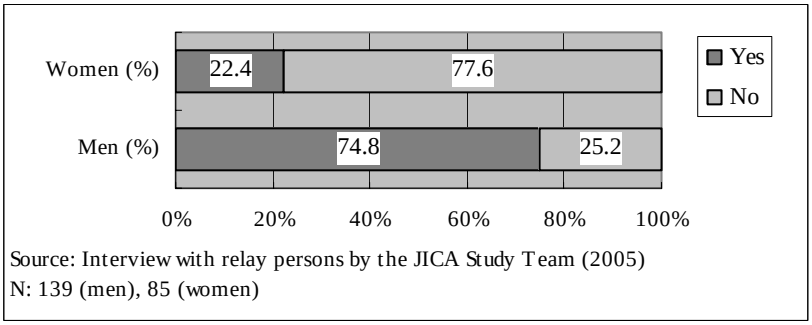


Source: Interview with relay persons by JICA Study Team (2005)
N: 138 (men), 84 (women)

(4) Experience in attending other meetings

The interview with relay persons shows that men have more experience in attending so-called "meetings", in many cases, that relative to "cellule destourienne (see the figure and the table below). Due to such difference in the experience, men were in general more active to speak out, give their opinions and ask questions in the meetings.

Figure 8.3.3 Experience in attending a meeting



Source: Interview with relay persons by the JICA Study Team (2005)
N: 139 (men), 85 (women)

Table 8.3.3 Type of meetings attended

Type of meeting	Men		Women		Total	
	(No. of answers)	(%)	(No. of answers)	(%)	(No. of answers)	(%)
Cellule destrourienne	60	57.7	8	42.1	68	55.3
Vocational Training	2	1.9	4	21.1	6	4.9
Meeting at municipality or delegation level	3	2.9	0	0.0	3	2.4
Meeting at working place	7	6.7	1	5.3	8	6.5
Other development projects	21	20.2	6	31.6	27	22.0
Others (meeting relative to the existing GIC, school, etc.)	31	29.8	3	15.8	34	27.6
No. of respondents having experience in attending any meeting	104		19		123	

Source: Interview with relay persons by the JICA Study Team (2005)

The differences by gender shown above should be kept in mind to understand the result of the sensitization activities presented below.

8.3.4.2 Organization of sensitization meetings from the gender perspective

(1) Organization of sensitization meetings

The type of sensitization meeting depends on the customs of the sub-project area, the preference of man as well as woman beneficiaries. In case that men do not accept women's attendance in the same meetings with them, the resident consultants were requested to hold separate meetings for women. Women sociologists took charge in this issue, when customs did not allow the attendance of men from outside. The majority of men accepted women's participation in the sensitization meetings. Thus, in the majority of the sub-projects, meetings were organized for men and women together. However, the separate meetings were held in four (4) sub-projects due to the socio-cultural factors[3].

As mentioned in Clause 8.3.4.1. (2), the information on the meeting did not often arrive in advance. Even such a case, men could be participated on the spot but it was difficult for women to attend without arranging their domestic chores. The sociologists carried out door-to-door visits or individual contacts by localities or by gathering women in several close localities for sensitization meetings.

(2) Participation of the target population in the sensitization meetings

As indicated in Clause 8.2.3.2, 8.2.4.2 and 8.2.5.4, the participation rate of women in the sensitization meetings was always lower than that of men during all the three (3) visits of sensitization. Around 20-25 % of the target households on average, namely, one woman out of five households participated in the meetings.

Nevertheless, this rate exceeds slightly that of men regarding meetings with limited groups during the second visit of sensitization. This case was observed in the Study in 2005. In fact, women more attended the meetings for limited groups such as in locating service installations and in the discussion to select tap keepers, tariff system and operation hours.

Though the woman relay persons are selected from among those having means of contact (mobile phone), even such women were not reportedly informed in advance. According to the report from the sociologist, it was difficult to contact woman relay persons directly since a mobile phone is shared with other family members, usually possessed by the household head.

[3] The sub-projects of Sidi Hassen and Kalboussi in BIZERTE, Esbiaat, El Argoub et Soualhia in LE KEF and Gouaad in KAIROUAN. In the last sub-project, the separate meetings were organised only in the first visit considering the progressive acceptance of men.

Despite such a presence inferior to men's presence, women were satisfied with their participation in the meetings. As shown in Clause 8.3.4.1 (4), it was the first time for the majority of women to attend so-called meeting. Due to the lack of experience, women were silent or hesitated to give their opinions or ask questions actively during the meeting.

In some sub-projects, women were not motivated to attend the meetings because of their illiteracy[4] saying that they were not capable to understand anything.

8.3.4.3 Selection of tap keepers

(1) Results of the household survey in the Study in 205

The acceptance rate of woman tap keepers remains mixed. The acceptance rate by sub-project varies between 3.3% and 100%. It is relatively low in the Middle west semi-arid region compared to other two regions. Four (4) sub-projects show low acceptance rates: 4 out of 5 respondents are against woman tap keepers[5].

Table 8.3.4 Acceptance of woman tap keepers

Answer	Seacoast region		Northwest hilly region		Middle west semi-arid region		Total	
	(Number)	(%)	(Number)	(%)	(Number)	(%)	(Number)	(%)
Accept	155	58.3	187	60.3	330	50.8	672	54.8
Do not accept	110	41.4	123	39.7	318	48.9	551	44.9
No answer	1	0.3	0	0.0	2	0.3	3	0.2
Total	266	100	310	100	650	100.0	1226	100

Source: Socio-economic report for the project 2006

(2) Women's capacity to make small repairs

Despite the average acceptance of woman tap keepers, three out of four respondents (75%) do not consider women to be capable to make small repairs of communal taps.

Table 8.3.5 Women's capacity to make small repairs

Answer	Seacoast region		Northwest hilly region		Middle west semi-arid region		Total	
	(Number)	(%)	(Number)	(%)	(Number)	(%)	(Number)	(%)
Capable	66	24.8	75	24.2	154	23.7	295	24.1
Not Capable	198	74.4	235	75.8	496	76.3	929	75.8
No answer	2	0.7	0	0.0	0	0.0	2	0.2
Total	266	99.9	310	100	650	100.0	1226	100

Source: Socio-economic report for the project 2006

(3) Results of selection of tap keepers

The number of woman tap keepers increased considerably in the Study in 2005. There were only three (3) sub-projects in which women were not selected as tap keepers in the Study

[4] The case was observed in the sub-projects of Kalboussi and Sidi Hassen in Bizerte, and Maamria in Kairouan.
[5] Gard Hadid (16%), Ouled Moussa (16.7%) sub-projects in Sidi Bouzid, Enjaimia (3.3%) and Smaidia (10%) sub-projects in Gafsa.

in 2005[6]. In the Study in 2004, woman tap keepers were not selected in twenty-one (21) sub-projects out of 33, namely around 2/3 of the sub-projects 2005. As indicated in the Figure 8.2.1, woman tap keepers represent more than a half of all the service installations in around 10 sub-projects for 2006. In case of the sub-projects for 2005, the largest ratio of woman tap keepers in a sub-project was 40%, observed in Rmadhnia sub-project in Mahdia.

(4) Remarks

1) The difficulty of selecting women as tap keepers is ascribed to men's reluctance as well as that of women. For instance, there are men who are still believed that tap keeping is men's task considering the needs to deal with troubles might be taken place at service installations. Other men told that women are unable to manage money due to their low educational level in case the commodity charge is applied.
2) With regard to women's reluctance, there are women who claim that generally men are responsible for activities outside of the house[7].
3) There existis a kind of self-censorship exerted by women noting that a society dominated by men is not yet ready to accept drastic changes in the roles given to men and women. They also recognize that the acceptance of additional tasks does not exempt them from the household tasks. Indeed, even if men accept to share domestic tasks with women, they are not actually however ready to get involved in such tasks. Hence, women are confronted with additional tasks without being released, even partially, from the conventional tasks defined by society as their responsibilities.
4) The target population in a sub-project selected woman tap keepers for 90[8]% of projected service installations. It reflected the absence of men from the community for migrant works. Their long or frequent absence let women to take the extra family responsibilities.

8.3.4.4 Provisional committee of the GIC

(1) Results of the household survey

A majority (about 70%) of the respondents showed opposition to women's participation in the provisional committee of the GIC from the beginning of the socio-economic survey. The acceptance rate does not vary according to regions.

[6] Among three sub-projects, the results of households survey of the two sub-projects of Enjaimia and Smaidia in Gafsa revealed that the majority of the respondents did not accept women as tap keepers.
[7] This case was observed in Sidi Achour sub-project in Manouba.
[8] Nine (9) out of ten (10) service installations will be managed by women. in Hsainia sub-project in Kairouan.

Table 8.3.6 Women members of the GIC committee

Answer	Seacoast region		Northwest hilly region		Middle west semi-arid region		Total	
	(Number)	(%)	(Number)	(%)	(Number)	(%)	(Number)	(%)
Accept	93	35.0	93	30.0	219	33.7	405	33.0
Do not accept	171	64.3	217	70.0	431	66.3	819	66.8
No answer	2	0.7	0	0.0	0	0.0	2	0.2
Total	266	100	310	100	650	100.0	1226	100

Source: Socio-economic report for the project 2006

(2) Results

Women were not designated in thirty (30) sub-projects out of 47 sub-projects[9] for which provisional committee of the GICs was constituted. An important increase in women members in that committee was marked in the Study in 2005 through more focus on women's participation in this structure. In the Study in 2004, a woman was designated as member of that committee only in one sub-project. In the Study in 2005, the absence of women in the committee was observed only in 11 sub-projects in the Study in 2005.

Table 8.3.7 Women members of the provisional GIC committee

Ration of women members of provisional committee of GIC	Sub-projects 2005		Sub-projects 2006		Total	
	Number	%	Number	%	Number	%
No. of Sub-projects for which women were selected as members of provisional GIC committee	20		27*		47	
0 %	19	95.0	11	40.7	30	63.8
> 10 < 20 %	1	5.0	5	18.5	6	12.8
> 20 < 30 %	0	0.0	3	11.1	3	6.4
> 30 < 50 %	0	0.0	8	29.6	8	17.0
Total	20	100	27	99.9	47	100

Source: Socio-economic reports

* Members to be integrated in the existing GIC for the future were selected in 3 sub-projects.

The results of the household survey regarding women members of the GIC reflects clearly the current viewpoints of the target population. Even in the case of the provisional GIC committee, men do not seem to appreciate women's participation on the pretext that women are very busy. Besides, women themselves are not very keen to participate in considering it as an additional task. Necessity of going out for meetings of the GIC prevents women from being members of the GIC committee.

8.3.5 Impact of the sensitization activities on women

8.3.5.1 Interview survey on relay persons

As mentioned in Clause 8.2.1.1, the number of woman relay persons increased considerably in the Study in 2005. The Study Team conducted interviews with relay persons so as to grasp

[9] The people of six (6) sub-projects will participate in the existing GICs and did not select members for the GICs.

impacts on women through their participation in the sensitization activities. The outline of survey is explained in Appendix 8.3.2.

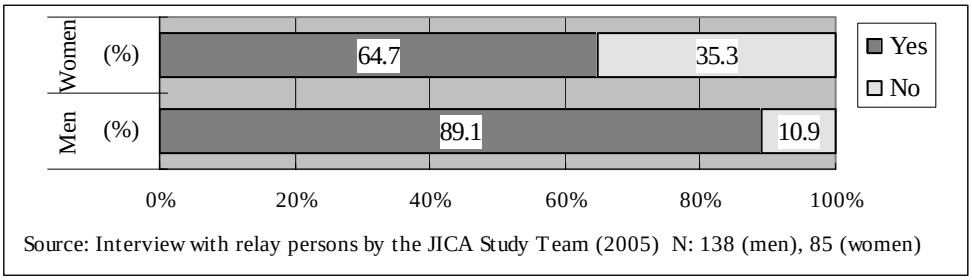
8.3.5.2 Survey results

(1) Evaluation

1) Utility of the sensitization meeting

The majority of man respondents consider the sensitization to be useful as an occasion of expressing themselves or giving their opinions. The rate of women with same viewpoint is lower than that of men, probably due to less experience in attending the meetings.

Figure 8.3.4 Usefulness of sensitization meeting for giving opinions



Source: Interview with relay persons by the JICA Study Team (2005) N: 138 (men), 85 (women)

2) Subjects appreciated

Among subjects discussed during the socio-economic survey and sensitization meetings, men mostly appreciated the subjects relative to service installations (number, type and location). Needs ranking seemed to have satisfied women as well as men by giving them an opportunity to express themselves.

Table 8.3.8 Subjects appreciated for giving opinions

Subject	Men (Number)	Men (%)	Women (Number)	Women (%)	Total (Number)	Total (%)
Pair-wise ranking	38	30.9	22	40.0	60	33.7
Service points (number, location, type)	41	33.3	10	18.2	51	28.7
Water charge and tariff system	25	20.3	4	7.3	29	16.3
Community mapping	5	4.1	1	1.8	6	3.4
Operation of service points (tap keepers, operation hours)	5	4.1	5	9.1	10	5.6
Land transfer (pipeline route, location of hydraulic facilities)	15	12.2	0	0.0	15	8.4
Individual connections	5	4.1	5	9.1	10	5.6
Future O/M (GIC, repair)	8	6.5	2	3.6	10	5.6
Acceleration of the sub-project implementation	3	2.4	3	5.5	6	3.4
Investment cost	1	0.8	0	0.0	1	0.6
Water quality	3	2.4	0	0.0	3	1.7
Un accounted for water (UFW)	1	0.8	1	1.8	2	1.1
No particular subject	15	12.2	11	20.0	26	14.6
No. of respondents concerned	123		55		178	

Source: Interview with relay persons by the JICA Study Team (2005)

3) Reasons for no opinion

In case of men, no opinion in the sensitization meetings implied their acceptance. However, in case of women, around a half of women, around a half of them could not show their opinion due to their fear of speaking in front of men.

Table 8.3.9 Reasons for not having given opinions

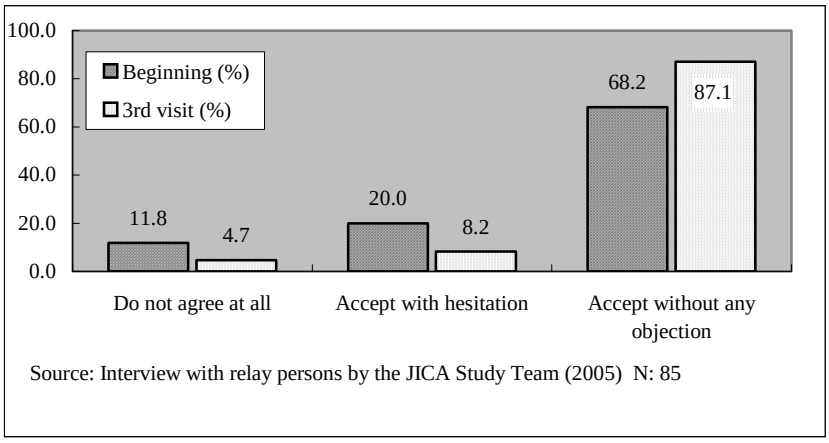
Answer	Men (Number)	Men (%)	Women (Number)	Women (%)	Total (Number)	Total (%)
I'm too shy to speak in public	2	13.3	7	24.1	9	20.5
I'm afraid of speaking in men's presence	0	0.0	8	27.6	8	18.2
I accepted all the explanations	13	86.7	13	44.8	26	59.1
The sociologist did not ask our opinions	0	0.0	4	13.8	4	9.1
No. of respondents concerned	15		29		44	

Source: Interview with relay persons by the JICA Study Team (2005)

(2) Change in men's attitude

According to woman relay persons interviewed, men's attitude regarding women's participation in the sensitization meeting changed positively during the Study. With diminution of the rate of refusal or acceptance with hesitation, the proportion of acceptance without any objection increased by the end of the Study (see the figure below)

Figure 8.3.5 Women's viewpoint on men's attitude regarding women's participation in the sensitization meeting

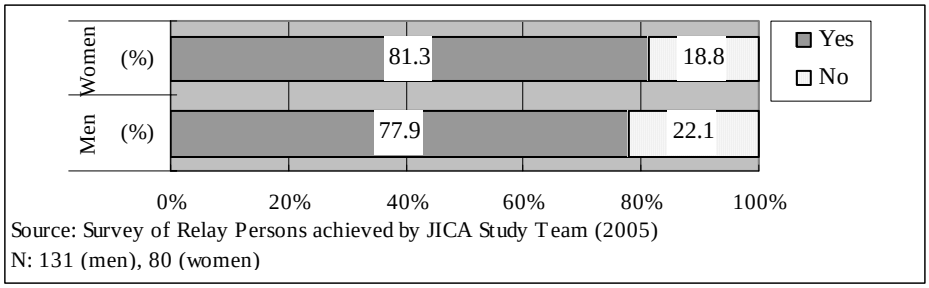


Source: Interview with relay persons by the JICA Study Team (2005) N: 85

(3) Impacts on the relay persons

The majority of men and woman relay persons recognized some positive changes in their behavior, viewpoint, and consciousness (see the figure below). It should be noted that men who did not find any positive impact are those experienced in other community activities such as meeting for "cellule destourienne". Women without any positive impacts regard their low educational background or their timidity as a reason of the limited impact.

Figure 8.3.6 Impacts on relay persons



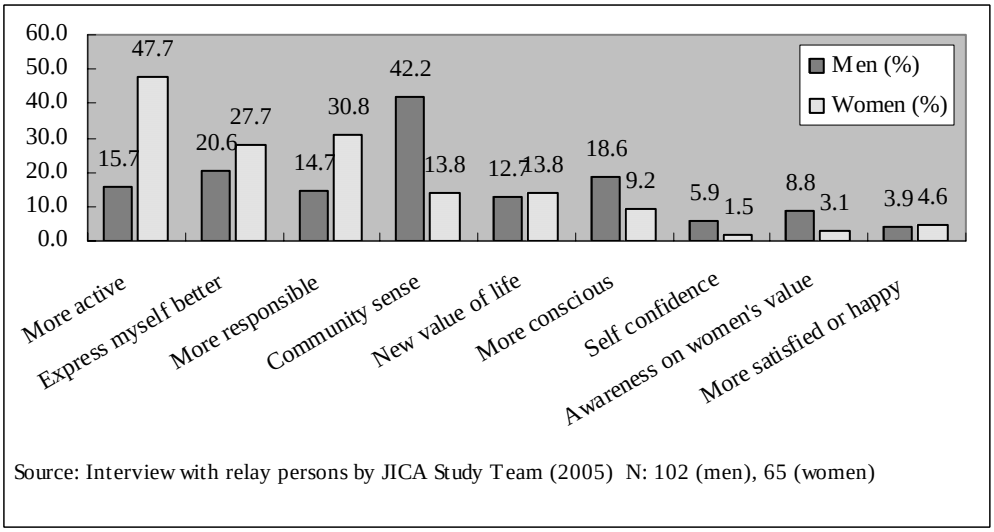
Source: Survey of Relay Persons achieved by JICA Study Team (2005)
N: 131 (men), 80 (women)

The impacts are classified using the key words in the answers shown in the table below.

Table 8.3.10 Classification of impacts

Type of impacts	Key Words for Classification of Impacts
Character (more active)	"More active", "Less shy", "Dynamic" "Audacious", "Serious", "Open"
Communication	"Express my self better" "Give my opinions" "Discuss"
Sense of Responsibility	"Responsible" "Others respect me" "Appreciated by others" "Encourage others to participate"
Community sense	"Contact with others" "Consolidate or improve relation with others" "Exchange of ideas" "more gathering" "listen to others" "getting know each other"
New value	"Value of existence" "Freedom in the life" "Discovery of something new" "Feel educated"
More conscious	"More conscious of water related issues" "Getting to know the process of development project and meetings"
Self-confidence	"Confident in myself"
Awareness on women's value	"My viewpoint on women changed"
Satisfaction	"I'm happy" "I'm satisfied with this opportunity"

Figure 8.3.7 Impacts declared



Source: Interview with relay persons by JICA Study Team (2005) N: 102 (men), 65 (women)

Impacts told by the relay persons differ by gender. Those by women seem to be concentrated on personal capacity or character such as "capacity to express myself better than before" "more active or open" "feel responsible". Women seem to have gained these participation in the sensitization meeting.

Meanwhile, impacts on community were more recognized by men. Though most of them had experience in attending the meeting, they appreciated the sensitization meeting as means of consolidating the relation between the target populations.

8.3.6 Conclusions

(1) Women's participation is always lower than that of men. The selection of woman relay persons did not lead to drastic improvement in women's participation in the sensitization meetings for the following reasons. Indeed, it is not only motivation of relay persons that may promote women's participation in the meeting, due to various obstacles to the participation as seen earlier.

(2) The degrees of participation ranging from simple attending to joint decision-making differ by sub-projects. In some sub-projects women spoke during the meeting actively and expressed themselves like men. In others, women attended without speaking or asking questions because they were not used to express their opinions in the presence of men.

(3) Regarding the type of relay persons, two types are distinguished: those so active to encourage other women to participate in the meetings and those others who did not take at all their responsibilities due to the lack of direct information on the sensitization meetings and insufficient awareness on the responsibilities expected.

(4) It was recognized that active and dynamic relay persons could play a leading role and positively influence other women regarding participation in the discussions in the meetings.

(5) The ratio of woman tap keepers increased considerably in the Study in 2005 compared to that of the Study in 2004. There were a number of woman tap keepers selected among relay persons. Such development may be considered as one of the achievements gained through reinforcement of women's participation as relay persons.

(6) Women's participation as GIC members proved not to be easy considering the difference of the experience in community activities and educational backgrounds by gender. It was however noted that men accept educated women, especially young women, to take tasks of a GIC member. It can be concluded that women's participation in the direction of the GIC (i.e. board of directors) is a long and complex process. This started rather timidly and calls for more consolidation against regression, which might happen in case of a relaxation in the sensitization for consolidation.

(7) Impacts on woman relay persons are focused relatively at personal aspects such as capacity to express themselves, to become more active or less shy. From such impacts, it can be concluded that women have changed positively through their participation in the sensitization activities. Woman relay persons can not take tasks as expected until they gain

self-confidence enough to encourage others to participate. In this respect, the impacts on women given by experience in participating in the sensitization activities could be considered as a first step in their participation in community activities.

8.4 Basic Design

8.4.1 Determinants of sub-project design

The basic factors that determine the design of each sub-project are the following:

(1) Natural conditions

- Identification of the water sources in terms of quantity and quality
- Topographic condition (flat, mountains, etc.)

(2) Social conditions

- Identification of the localities[1] and the public institutions to be served
- Land acquisition for installations and permission to install pipelines
- Design and location of service installations such as BF, BP[2] and Potence[3]
- Consensus of population regarding number and location of service installations
- Identification of social conflicts
- Operation hours of projected WSS
- Private connections of neighboring GIC which make the transmission unforeseeable

(3) Economic conditions

- Availability of power supply
- Construction cost and financial eligibility
- Water charge and amount of revolving fund to be applied
- Commitment rate of participation in GIC

8.4.2 Basic data

Tables 8.4.1a and 8.4.1b show the demographics and domestic animals in the area of sub-projects for 2005 and 2006, respectively.

8.4.2.1 Demographics

(1) Present population in subproject area

The present population in the sub-project areas was surveyed in the feasibility study, as summarized in Table 8.4.2.

[1] Group of several households considered like the minimum administrative unit
[2] Branchement Particulier; the connection to public institutions
[3] One of the service installations in the rural WSS to supply a big tank with water from above it.

Table 8.4.2 Present population in sub-project area

	Nos. of sub-project	Total population	Grouped population	Scattered population	Average per sub-project
Sub-projects 2005*	33	23,881	21,864	2,017	724
Sub-projects 2006**	33	31,201	26,901	4,300	945
Total	66	55,082	48,765	6,317	835

Note: *: data as of 2004, **:data as of 2005

(2) Population growth rate applied

Table 8.4.3 shows the results of the 1994 census with regard to the population growth rate in Tunisia. The annual growth rate for projection of "Non Communal" in the table is applied by DGGREE for RWS project.

An annual growth rate of 1.2% was applied to the governorate of Manouba in the SAPROF 2002, which however was changed to 1.9%, the same growth rate of Ariana, in this Study by the instruction of DGGREE.

The projected population of sub-projects for 2005 and 2006 is calculated based on the present population and the annual growth rate, as shown in Tables 8.4.1a and 8.4.1b, and is summarized in Table 8.4.4.

Table 8.4.4 Projected population in sub-project area

	Nos. of sub-project	Population (1st year)	Population (final year)	Project Period[4]
Sub-projects 2005	33	24,496	28,468	2006-2020
Sub-projects 2006	33	31,834	36,937	2007-2021

8.4.2.2 Livestock

Number of livestock in sub-project area is also shown in Tables 8.4.1a and 8.4.1b. The number of the livestock is assumed to be unchanged during the sub-project period.

8.4.2.3 Projected water source

Water sources are identified by CRDA at the planning stage of subprojects. The following water sources are generally used for RWS projects:

1) Deep well
2) Tapped spring
3) Existing WSS

In addition, dam lakes are utilized in the governorate of Jendouba, however, utilization of

[4] The projected WSS can assumedly supply population with water by the end of this period.

dam lakes is quite limited due to the necessity of water treatment.

The following table shows water sources of 66 subprojects for 2005 and 2006:

Table 8.4.5 Water sources of sub-projects

(Unit: number of sub-project)

Deep well	Spring	Existing (SONEDE)	Existing (GR)	Existing (irrigation)	Total
10	1	23	26	3	65[5]

The deep wells have already been constructed and the production capacity of deep wells was verified by the pumping test by CRDA. An existing tapped spring will also be utilized as the water source of a subproject.

The existing WSS includes “SONEDE Connection”, “GR Extension” and “Irrigation system”(see Appendix 8.4.1).

The following table shows water analysis/control of water sources generally conducted by concerned organization/ agencies for RWS projects:

Table 8.4.6 Water analysis/control for the RWS Project

Organization/ agency	Activity	Time of activity
RDPS[6]	Analysis of water source of deep well, shallow well, spring, etc	Identification stage of sub-project
RDPS	Analysis of water supplied through rural WSS	Periodical
SONEDE	Control of water quality supplied by SONEDE	Periodical
GIC	Monitoring of residual chlorine of supplied water	Periodical

8.4.2.4 Service Installations

There are three (3) types of service installations applied to the rural WSS, which are the communal tap, potence and particular connection to public institutions. The design concept of these facilities prepared by DGGREE is shown in the following table:

Table 8.4.7 Design concept of service installations of the RWS System of DGGREE

Service facility	Capacity	Target population/ institution	Installation requirement
Communal tap	0.5 l/s	Grouped population	Within 500 m from the farthest house
Potence	2.0 l/s	Scattered population	Within 2 km from the farthest house
Particular Connection	0.5 l/s	Mosque, school, dispensary	Individual connection

[5] Mzougha-Zeldou 1st and 2nd sub-projects of the Study in 2004 are under one WSS and Ouled Ammar and Ouled Essaafi sub-projects of the Study in 2005 is the same and Faket El Khadem sub-project of the Study in 2004 has two WSSs.

[6] Regional Department of Public Sanitation

In case of the 15 pilot sub-projects (see Section 7.2), the designed capacity of the communal tap and potence is individually calculated based on the number of population and livestock on locality basis covered by these facilities. Design discharge of the particular connection is fixed at 0.5 l/s

8.4.3 Basic design

8.4.3.1 Water demand projection

The water demand projection is made based on the Guidelines prepared by DGGREE. Projected water demand and the designed water supply of each sub-project are shown in Tables 8.4.8a and 8.4.8b for subprojects 2005 and 2006, respectively.

(1) Domestic water demand

The domestic water demand was calculated for each year of the sub-project period based on the projected population and per capita consumption specified by the DGGREE.

(2) Livestock water demand

The water demand was calculated based on the number of livestock and the specified unit water consumption of DGGREE. The livestock water demand, however, is limited to 40% of the domestic water demand of the final year of the project period. The obtained water demand is fixed throughout the sub-project period.

(3) Total water demand

The following table shows the total water demand of sub-projects 2005 and 2006, respectively in the final year of the sub-project period:

Table 8.4.9 Total water demand in the final year of sub-projects

(Unit: m^3/day)

Sub-Project	Domestic Use	Livestock Use	Total
Sub-projects 2005	978	269	1,247
Sub-projects 2006	1,224	401	1,625

8.4.3.2 Unaccounted-for Water

The unaccounted-for water includes leakage from the facilities, waster used for washing vessels, waste flow during the change of vessels, waster used for washing the water supply facilities. The rate of unaccounted-for water is assumed to be 15% of the total water demand and it is fixed during the sub-project period in the Study. The volume of unaccounted-for water is calculated in Tables 8.4.8a and 8.4.8b.

However, the actual rate was around 27% according to "Synthesis Report on the Situation of the Water Users Groups for Drinking Water Supply for the Year 2002". The same report for

the year 2003 mentioned that the rate equal to or inferior to 15% accounted for 39 % of the GICs surveyed while the rate equal or superior to 30 % accounted for 25 %.

8.4.3.3 Maximum daily and hourly water supply

The projected average daily water supply for the sub-project service areas is obtained from the projected water demand and unaccounted-for water. Since the water demand fluctuates seasonally and hourly, the maximum daily water supply and the maximum hourly water supply are estimated in order to determine the size of transmission pipes by the former and the size of distribution pipes by the latter. However, in the RWS project, the design flow rate of the service installations is generally far bigger than the maximum hourly water supply, and therefore the size of distribution pipes is determined by design flow rate specified by DGGREE.

(a) Maximum daily water supply

The maximum daily water supply is calculated by multiplying the average daily water supply by a peak factor (see Table 8.4.10), as shown in Tables 8.4.8a and 8.4.8b.

Table 8.4.10 Peak factor for the maximum daily water supply

Peak factor	Region	Governorate
1.25	Northern region	Ariana, Manouba, Bizerte, Beja, Jendouba, Le Kef, Siliana
1.50	Southern region	Kairouan, Sidi Bouzid, Sousse, Mahdia, Sfax, Kasserine, Gafsa

A peak factor of 1.25 was applied to the Governorates of Kairouan, Kasserine and Mahdia in the JICA Study 2000 and the SAPROF 2002. The reason for change of the value was not clarified by DGGREE. Moreover, it is noted that the design guideline of DGGREE does not specify which governorates belong to “north” and “south”.

(b) Maximum hourly water supply

The maximum hourly water supply is calculated by multiplying the average hourly water supply by a peak factor of 1.8. However, as discussed earlier in this Section, the flow capacity of distribution pipes is determined by the design flow rate of service installations and therefore the said value of peak factor does not properly reflect the water demand on locality basis. To remedy the situation, the hourly peak factor is calculated individually on sub-project basis (see Section 7.9). This modified method is applied in the 15 pilot sub-projects (see Section 7.2).

8.4.3.4 Possible withdrawal from projected water source

The capacity of the projected water source shall assure the maximum daily water supply. The possible withdrawal from the projected water source is compared with the projected

maximum water supply in Tables 8.4.11a and 8.4.11b for sub-projects 2005 and 2006, respectively. As seen in the tables, all the projected water sources will satisfy the water demand of sub-projects.

8.4.3.5 Outline of water supply system

The rural WSS generally comprises the following:

(1) Intake works at water source
(2) Transmission system (pipeline and pumping station)
(3) Disinfection facilities
(4) Distribution tank
(5) Distribution system
(6) Service installations

Water is transmitted from a water source by gravity or pressurized flow to a distribution tank and distributed in the projected service area by gravity. In the transmission pipeline, a relay pumping station is installed if height difference and/or distance between the water source and the distribution tank are big.

Dynamic pressure and static pressure should be carefully studied in order to assure stable water supply at service installations and to avoid damage from high pressure to water supply facilities. A break pressure is installed to reduce dynamic and static pressure, if necessary.

Disinfection is made in principle by injecting javel water[7] using a dosing pump in the transmission pipeline and sometimes in the distribution pipeline by installing flow variable type dosing pump detecting the distribution pipe flow rate in case that distribution is directly made from the connection point with SONEDE or GR WSS.

Design flow rate of service installations is mentioned in Section 8.4.2.4.

8.4.3.6 Land acquisition

It is the policy of the Government of Tunisia that the private land necessary for the RWS projects should be rendered by the beneficiaries without compensation. Land is necessary for temporary use in laying pipes and also as the permanent site of the water supply facilities.

It will be required to review the design of the projected WSS if the designated land is not available. A part or whole of the sub-project will be cancelled in case land acquisition problems can not be settled.

In case of the Bir Ben Zahra sub-project in Nabeul, a landowner refused the cession of land for the projected elevated tank after the third visit of sensitization though it had agreed

[7] It is the hypochlorite solution and sold in general as the name of “javel water”

at the second visit of sensitization. As a result of it, it necessitated the efforts of people concerned to modify the design without changing the location of service installations.

8.4.3.7 Intake for water source

The water sources of sub-projects for 2005 and 2006 include 12 deep wells, one (1) tapped spring and 52 existing WSSs (see Section 8.4.2.3). Out of these, intake works for "SONEDE connection" is made by SONEDE or under the supervision of it.

In sub-project Agba in the governorate of SILIANA, the existing tapped spring used by the population in neighboring localities will be remodeled for distribution of water to the projected service area.

Intake works to the existing WSSs (SONEDE connection, GR extension and Irrigation system) is made by connecting pipe with a sluice valve and a water meter to the existing distribution pipeline.

8.4.3.8 Transmission

(1) Transmission system

Two types of transmission are considered in the Study.

(a) Transmission to the distribution tanks by dynamic pressure at the connecting point
(b) Pump pressurized transmission

If conditions permit, direct distribution is made by making use of said dynamic pressure.

The number of each transmission type applied to the sub-projects for 2005 and 2006 is shown in the table below;

Table 8.4.12 Type of transmission

	transmission		direct distribution	Total
	dynamic pressure	pump		
No. of Sub-projects	16	36 (+6)*	12	66

* Two transmission systems are planned in each six (6) sub-projects.

(2) Pumping facilities

(a) Number of pump sets

Out of the 66 sub-projects for 2005 and 2006, 37 systems necessitate pumping for transmission. The transmission systems are further classified by the number and location of the pump, as shown below.

Table 8.4.13 Pump pressurized transmission system

Description	No. of sub-project 2005	No. of sub-project 2006	Total
One (1) pump in relay pumping station	10	13	23
One (1) pump for deep well	1	6	7
Two pumps in the relay pumping station	2	0	2
One (1) pump in deep well and one (1) pump in relay pumping station	0	3	3
One (1) pump for deep well and more than two (2) pumps in the relay pumping station	0	2	2
Total	13	24	37

Among 37 systems, in two (2) sub-projects, the existing submersible pump of deep well will be replaced by a new one. In other two (2) sub-projects, a pump will be installed in the existing pumping station to increase the capacity.

Parallel operation of two pumps is designed in three (3) sub-projects for having design discharge by single-phase motor pump in case that three phase current is not available.

Taking into account reserving or spare pump for every pumping stations, the total number of the pump set is 94 (47 sets) as shown in Table 8.4.14a and Table 8.4.14b.

(b) Pumping station and relay pumping station

Determination of location of a relay pumping station is considered as the trade-off between the distance from the power line and the utilization of the dynamic pressure at the connection point of existing distribution/transmission pipeline, or the tank, if the land acquisition is not crucial.

Capacity of the relay tank in relay pumping station, in principle, should have a two hours operation volume of the pump, based on the guidelines prepared by DGGREE. However, the capacity is increased in the following cases:

a) Outflow rate from the tank is lager than inflow rate
b) Inflow volume to the tank during the operation is not assured
c) A projected tank is used in common with an existing project
d) A tank has the function of water distribution also

In five (5) sub-projects, an inline pump is installed in the transmission pipeline for booster pumping. Pressure fluctuation in the suction pipe should be minimized as much as possible so as not to take place the cavitation.

(c) Type of pump

Inline pump is commonly used in the relay pumping stations considering easy maintenance, however, the pump efficiency is usually lower than that of a submersible pump of which horizontal installation type is projected in six (6) sub-projects.

A necessary motor output for pump operation and its energy consumption are discussed in Appendix 9.1.1 “Selection of pump”.

(3) Electrification

The engine generator and power supply from STEG can be considered as the power source for the pumping station. However, the application of engine generator is limited in the sub-project design due to its higher operation cost. Fortunately, no engine generator is used as the power source for subprojects 2005 and 2006.

In principle, three phase current is used as the power source, however, if it is not available, the maximum utilization of single-phase[8] current is considered.

The following table summarizes the electrification of 43 newly constructed pumping stations.

Table 8.4.15 Electrification of pumping stations

	Available current		To be Installed		Phase Converter	Total
	3 phase	1 phase	3 phase	1 phase		
No. of sub-projects	15	11	13	3	1	43

(4) Transmission pipeline

The transmission pipe is designed based on the maximum daily water supply considering the possible operation hours and the planned elevation of distribution tank. The pipe diameter is determined using the BRESSE’s formula[9] which gives an economical diameter.

The static pressure, dynamic pressure and pressure rise/drop due to transient phenomena (see Section 10.3.8.4) are calculated. In case the maximum allowable operating pressure is less than 16bar[10], High Density Polyethylene pipe (HDPE pipe) is applied. The HDPE pipe is further classified into PN[11]10, PN12.5 and PN16 according to the design strength. PN10 and PN16 are applied in this Study. In case the operating pressure exceeds 16bar, Ductile Cast Iron Pipe is applied. The characteristics of HDPE pipe is described in Appendix 8.4.2.

[8] The output of the single-phase motor is limited to 2.20kw in Tunisian market.
[9] $D = 47.32\ Q^{1/2}$ (mm), where, Q is discharge in l/s.
[10] 1 bar is around 1.02kg/cm^2
[11] The nominal pressure PN corresponds to the maximum allowable operating pressure in bars

Tables 8.4.16a and 8.4.16b show the transmission pipe length of sub-projects 2005 and 2006, respectively. The total length of the pipeline by grades of the pipe strength is shown in the following table:

Table 8.4.17 Length of the transmission pipeline by grade of pipe strength

(Unit: m)

HDPE PN10	HDPE PN16	DCIP PN25 /galvanized steel	Total
142,439	49,884	7,010	199,333

(5) Analysis of transient phenomena

Sudden changes in flow velocity in the transmission pipeline may cause substantial pressure surge or drop which is called “Water Hammer” or “Hydraulic Transient Phenomena”. It may occur at the time of; (i) start of pump operation, (ii) sudden stop of pump operation due to power failure, and (iii) opening/closing of valves.

Damages due to the water hammer are as follows;

1) Pumps and its components including pipes, or valves may be damaged because of pressure surge
2) Pipeline may be squashed or damaged due to pressure drop

Several preventive measures can be considered against the transient phenomena such as surge tanks, air chambers, air valves, etc. The air chamber is commonly applied in the RWS projects.

Although the simulation output of the transient phenomena modeling computer software shows that pressure surge exceeding the allowable pressure of PN10 in the 19 pumping systems, it can be solved applying PN16 pipe and ductile cast-iron pipe. Beside air chamber and air valves are used to protect against pressure drop.

The measures against the transient phenomena taken for the subprojects for 2005 and 2006 are summarized in Tables 8.4.18a and 8.4.18b.

8.4.3.9 Distribution system

(1) Distribution tank

Since the distribution system by gravity is applied to the rural WSS, it necessitates the distribution tank unless distribution is made by dynamic pressure of the existing system.

The inflow through the transmission pipe is steady while out flow by water demand through distribution pipe is fluctuated. The distribution tank is necessary to stock water when the water demand is small, and to supply to meet the water demands in peak hours.

Tables 8.4.19a and 8.4.19b show the distribution tanks to be used in sub-projects 2005 and 2006, respectively. The total number of tanks which have the distribution function is 91 as shown in the following table:

Table 8.4.20 Number of tanks which have distribution function

Existing	Projected			Total
	Distribution tank	Relay tank	Other project[12]	
11	74	2	4	91

Some of the relay tanks are given the function of water storage as shown in the above table. Three (3) distribution tanks are scheduled to be constructed by other sub-projects.

The storage volume of the distribution tank is, in principle, determined as 50% of the average daily water supply volume based on the guideline of DGGREE. However, there is a possibility of interruption of water distribution in case the water demand far exceeds the transmission flow rate during peak hours.

Taking into consideration of the above, the storage capacity of the tank is checked, in the study of sub-projects 2006, based on the calculation of hourly changes of water volume (tank behavior) and is enlarged according to the results of calculation of tank behavior. In the calculation, hourly water demand is estimated on the assumption of the operation hours of service installations proposed by the beneficiaries. (see Table 8.4.21)

It is noted that the inflow to the distribution tank depends on the control system of the pumping station. In case of the control system using water level sensors, the pump will only be restarted when the water level of the tank comes down to the minimum designated water levels. It might cause the water supply interruption in the starting of water supply. (see Appendix 9.1-5 “Minimum Water Level Setting to the Distribution Tank”)

Table 8.4.22 shows comparison of the storage volume of the tank based on DGGREE method and the results of tank behavior analysis. The assumed minimum designated water level of the tank with the control system using water level sensors is also mentioned in the table.

(2) Service installations

The design concept of service installations is discussed in Section 8.4.2.4.

The location of service installations is determined through consultation between the engineer and the sociologist in charge of the Study and the beneficiary population. It was intended to install a communal tap in each locality as much as possible. In case a social

[12] The distribution is made by making use of the projected distribution tank of neighboring water supply or irrigation project.

conflict was recognized in a locality, the number of communal tap was increased, if technical and financial conditions permit.

Tables 8.4.23a and 8.4.23b show the number of communal taps, potences and particular connections projected under the sub-projects 2005 and 2006.

The grouped population per communal tap of 114.0 in sub-project Enjaimia in the governorate of Gafsa (sub-project for 2006) is by far the largest of any sub-project in the Study, which, however, is considered to be accepted considering that in DGGREE customary rule one communal tap is to be provided for 10-20 families.

(3) Distribution system

(a) Distribution pipe

The branched distribution system is commonly applied in the RWS project (see Figure 8.4.1). Selection of the distribution pipe is made based on the number of service installations to be constructed with their standard flow rates. It is noted that CRDAs of Sousse, Mahdia, Sfax, Nabeul and Ariana apply 90mm as the minimum outside diameter of the distribution pipe considering the instruction of SONEDE while most of other CRDAs apply 75mm.

The grade of pipe strength is selected according to the pipe inner static pressure in the projected WSS. When the static pressure exceeds 10 bars, PN16 is applied. However, DGGREE instructed to apply PN16 whenever the static pressure exceeds 9 bars to prevent fatigue failure of pipes.

(b) Optimization of the distribution system based on DGGREE method

Optimization of the distribution system is made with the aid of a computer program and following the guideline of DGGREE, including; (i) design flow rate of service installations, (ii) standard velocity in distribution pipes, (iii) calculation of head loss by the formula of William-Hazen, (iv) the minimum dynamic pressure, etc.

In case the minimum dynamic pressure in the distribution system and/or the static pressure in the downstream section exceed the allowable level, break pressures are considered in the distribution system, while pressure reducing valves are considered at service installations in case that the minimum dynamic pressure exceeds 5 or 6 bars[13].

(c) Optimization of the distribution system of pilot sub-projects

Modified design method was applied in optimization of the distribution system in the 15 pilot sub-projects. The main objectives of the method is as follows

[13] This pressure depends on CRDA.

- to make the flow rate of the service installation appropriate for the water meter so as to reduce the error as much as possible
- to protect the devices of the service installation from the cavitation and water hammer which might be caused by high flow rate
- to assure appropriate flow at all the projected service installations even under the condition of peak time that all the service installations are fully opened (it is assumed as free discharge condition).

The calculation step of the modified design method is shown in Appendix 8.4.3.

The length of distribution pipe of sub-projects 2005 and 2006 are shown in Tables 8.4.16a and 8.4.16b, respectively. The total length of the distribution pipeline by grades of the pipe strength is shown in the following table:

Table 8.4.24 Length of the distribution pipeline

(unit: m)

HDPE PN10	HDPE PN16	Galvanized steel	Total
827,263	81,736	100	909,089

In the above table, the galvanized steel pipe will be installed in the rocky area of sub-project Esbiaat, El Agroub et Soualhia in the governorate of Le Kef.

8.4.3.10 Operation and control of the pumping system

It is necessary to control the pump operation in the manner that the pump should be stopped when the tank is full and should be restarted when the tank is nearly empty.

The control system of pump operation applied in the RWS projects includes; 1) water level sensors with pilot cable for signal transmission, 2) pressure gage with electric contacts and 3) water level sensors with radio signal transmission (For details, see Appendix 8.4.4). According to the guideline of DGGREE, the pilot cable is applied for the distance less than 1.5 km between the pumping station and the distribution tank, while the pressure gauge and the radio transmission systems are applied for the distance up to 3.0km and exceeding 3.0km, respectively.

The above criteria for selection of the control system by the distance are not strictly followed by CRDAs. Especially the radio transmission system is not always utilized due to need of authorization by relevant ministries, which may delay the construction works, experienced operation and maintenance skills and expensive installation/OM cost. Pressure gauge system is applied in 11 sub-projects although the distance exceeds 3.0km.

Table 8.4.26 shows the number of sub-projects for which each type of the above control system is applied. (see Tables 8.4.14a, 8.4.14b)

Table 8.4.25 Number of sub-projects by applied pump on-off control system

	Pilot cable with electrode	Pressure gauge	Radio with electrode	Total
No. of sub-projects	19	24	2	45

8.4.3.11 Disinfection

The water sources of the sub-projects are classified into the existing WSS, new deep well and spring. The water from the existing system should be disinfected before supplying to the projected system except the water source of the "Irrigation system". However, the result of water analysis revealed that residual chlorine was not detected at a number of the projected water sources. Therefore the disinfection system should be installed in sub-projects mentioned in the above and relatively large scale sub-projects.

DGGREE instructs that the residual chlorine concentration shall be more than 0.1mg/liter at the farthest service installation in the rural WSS and for this purpose it recommends to make the chlorine concentration at the injection point 0.8mg/liter.

In Tunisia, 12 degrees of hypochlorite solution named "Javel water", which is familiar for the population as bleach, is used for disinfection.

The number of disinfection facilities for sub-projects 2005 and 2006 is summarized in Table 8.4.26

8.4.3.12 Ancillary facilities

(1) Washout

Washouts are installed at concave points on the pipeline to drain water from a pipeline in case of repair or maintenance, and cleaning of the pipeline.

(2) Air valve

Air valves are installed at each convex point of a pipeline in order to; (i) discharge accumulated air in the pipeline during the operation, (ii) discharge air before start of operation and after cleaning the pipeline, (iii) draw air into the pipeline for cleaning.

(3) Sluice valve

Sluice valves are installed mainly at the branching point of a pipeline to isolate the downstream part for repair and maintenance. At the branching point, the sluice valves are, in principle, provided on both the main and branch pipes. The sluice valves are also installed at the connection points to the distribution tanks, existing WSSs, etc.

(4) Break pressure

Break pressures are provided, in general, to reduce the static water pressure to lower than 9 bars in the downstream section of a pipeline, so that use of PN16 can be avoided to economize the cost. Break pressure are also used to reduce the dynamic pressure at service installations to lower than 5 to 6 bars and thereby maintain proper working condition of the facilities.

(5) Pressure reducing valve

The pressure reducing valves are used to reduce and maintain the pressure in the downstream side of the valves. The valves are installed, in general, at the inlet of service installations where the operating pressure exceeds 5 to 6 bars at the branching point to the service installation in the distribution pipe, with the target operating pressure of 3 bars in principle.

(6) Flow control valve

The flow control valve is used to regulate the flow rate in the pipe. The device is projected at the inlet of the distribution tanks, relay stations and/or break pressures in case appropriate flow rate can not be assured at service installations because of the excess flow to the said hydraulic facilities.

Tables 8.4.27a and 8.4.27b show the number of ancillary facilities and hydraulic control equipment of sub-projects for 2005 and 2006, respectively.

8.4.3.13 Personnel for O/M

Pump operators and system care-taker are generally employed by GIC for O/M of the rural WSS while tap keepers are selected among the members of GIC.

The pump operator will be employed for O/M of WSS which has a pumping system, and assume two functions; (i) O/M of the pumping station and (ii) maintenance of pipeline. The system care-taker will be employed for O/M of the pipeline system of WSS which does not have pumping system while the service area is relatively large. Both the pump operator and system care-taker will be employed for relatively large WSS with pumping system.

The tap keeper is generally assigned to each communal tap and potence for O/M of the installation and collecting water charge.

In addition to the above, a technical director is employed for management of relatively large scale WSS. For subprojects 2005 and 2006, technical directors will be employed in several sub-projects.

The pump operator and the system care-taker will be paid with fixed salary by the GIC, while the tap keeper will get commission fee which is included in the water charge. There are a number of tap keepers who confirmed to work as volunteers.

In case of “GR extension” WSS which will be merged with existing system such as Chraifia, Hsainia, etc., the pump operator/system care-taker of the existing GIC will also assume the O/M of the new subprojects. Besides, in subproject Mkimen, two pump operator/system care-takers will be newly employed for O/M of the WSS of the whole complex.

The work tasks of the above-mentioned personnel are described in Appendix 8.4.5.

8.5 Financial Analysis of Sub-projects

8.5.1 Construction cost

The construction cost of each sub-projects is estimated through the feasibility study under the Basic Study.

The construction cost consists of following six (6) categories of cost items:

1) Facilities for water sources: pipe connecting work to the existing system including a water meter and sluice valve with a concrete box, etc.
2) Pipeline material: Pipes and fittings
3) Pipeline construction: pipe laying work with ancillary facilities, service installations
4) Civil works for installations: distribution tanks, break pressures, relay pumping stations, etc.
5) Electrification: power supply line and transformer which will be entrusted to STEG on exclusive contract basis
6) Major equipment: a pump set, disinfection system, etc.

Apart from above, physical and price contingency is considered as 15% of the construction cost.

Tables 8.5.1 and 8.5.2 present the estimated construction cost of sub-projects for 2005[1] and 2006 respectively with its breakdown according to above and following Table 8.5.3 shows the construction cost with its breakdown of total 65 WSSs under the Study.

Table 8.5.3 Construction cost of total 65 WSSs

			2005	2006	Total
Present Population			23,881	31,201	55,082
Projected Population at the end of the sub-project period			28,468	36,857	65,325
Maximum Daily Water Supply in 2020		m^3/day	2,042	2,717	4,759
Construction Cost	Facilities for Water Source	TD	45,900	16,000	61,900
	Pipe material	TD	4,155,999	5,403,964	9,559,964
	Pipe Laying	TD	4,570,834	5,109,700	9,680,534
	Civil Works	TD	1,476,100	2,821,550	4,297,650
	Electrification	TD	206,200	888,750	1,094,950
	Equipment	TD	478,600	835,200	1,313,800
	Contingency	TD	1,640,046	2,261,175	3,901,221
Total Construction Cost		TD	12,573,680	17,336,339	29,910,019
Unit Construction Cost	Per Capita Construction Cost	TD	442	470	458
	Per 1m^3 water Construction Cost	TD/m^3	6,157	6,381	6,285

The total construction cost of 65 projected WSSs is around 29,910,000TD and its average is 460,000TD. Unit construction costs imply that the scale of projected WSSs in two years

[1] Though the Rquiat sub-project is scheduled to start the construction work in 2007, it was included in the sub-project for 2005 according to the Study phase.

is almost similar.

Regarding the per capita construction cost to judge sub-projects eligibility, it also shows in the Tables 8.5.1-3. The per capita construction cost ceiling as one of the criteria of the eligibility for the implementation of the sub-projects for 2005 and that for 2006 are 729TD and 766TD respectively. As table shows that the highest one among the 33 WSSs for 2005 is 728.8 and that among 32 WSSs for 2006 is 764.6TD. All the sub-projects are accordingly judged eligible on the financial basis to realize them.

Following table shows the average construction cost with its breakdown by the region. Most of the sub-projects are located in the Middle west semi-arid region (29 out of 65). The scale of the sub-projects in the said region is the biggest in terms of average number of beneficiary population and average construction cost. In contrast, the per capita construction cost of the Northwest hilly region of which average number of beneficiaries is the lowest among three regions is the highest and those of other two regions are similar. Rather hard topographic conditions of the Northwest region might increase the per capita investment cost. It implies the said region has disadvantageous conditions to construct the water supply system under the Rural Water Supply Project.

Table 8.5.4 Average construction cost by region (TD)

	Seacoast region	Northwest hilly region	Middle west semi-arid region	Whole region
Number of Sub-projects	20	16	29	65
Construction Cost	380,831	397,751	549,289	460,154
Average Population in 2021	882	745	1,233	1,005
Per Capita Construction cost	432	534	445	458
Facilities for Water Sources	1,445	1,113	524	9,559,964
Pipeline material	130,604	112,356	177,593	9,680,534
Pipeline Construction	117,411	139,080	176,105	4,297,650
Civil Works	51,418	65,331	76,690	1,094,950
Electrification	12,825	11,841	22,379	1,313,800
Equipment	17,455	16,150	24,355	3,901,221
Contingency	49,674	51,880	71,643	29,910,019

8.5.2 Operation and maintenance cost[2]

O/M costs can be considered as the annual budget of the GIC and it comprise following:

(1) Fixed cost
- Rated maintenance cost
- Management cost of GIC
- Salary of personnel except tap keepers

[2] Detail is explained in Appendix 7.10.1.

- Subscription for SONEDE in case of “SONEDE connection”
- Subscription for STEG in case that projected WSS necessitates electricity

(2) Variable cost
- Water charge in case that sub-projects shall purchase water from SONEDE or an existing GIC
- Electricity
- Disinfection

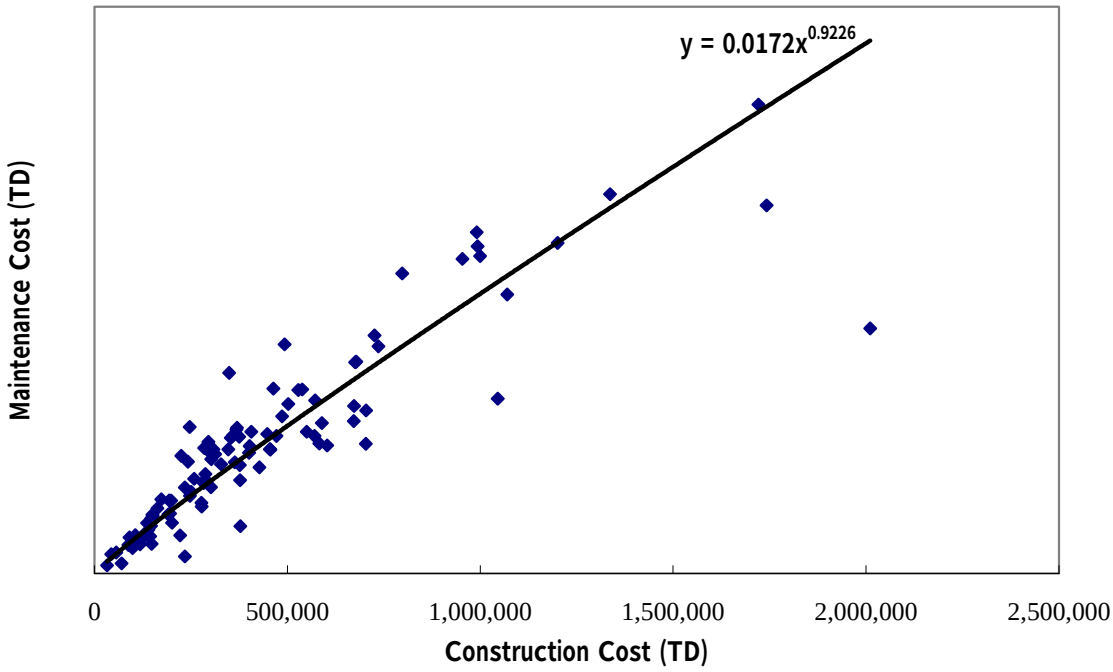
Table 8.5.5 and 8.5.6 show the O/M costs of projected WSSs for 2005 and 2006 respectively. Table 8.5.7 shows the fixed cost and the variable cost in the first year of the water supply service by the type of the projected water source, and by with and without pumping and likewise personnel. It implies as follows:

1) Maintenance cost shares 50% of the O/M cost of all the sub-projects.
2) There is not big difference between “with pumping” and “without pumping”. In case of the “with pumping”, the costs for maintenance including personnel affect the O/M cost due to the existence of the “Deep Well”. On the other hand, the costs for the purchase of water of the “without pumping” is higher than that of the “with pumping”.
3) The fixed cost as well as the variable cost of the “Extension GR” is the highest among five (5) types in terms of the water source. Maintenance cost in the fixed cost and the cost for the purchase of water of “Extension GR” are higher than those of “Deep Well” and “SONEDE Connection”. Following seem to be the reason; i) Average daily water supply of the “Deep Well” is the highest among the five types and ii) the density of the houses seems to be lower than other two (2) types of WSSs.
4) There is not big difference between the costs for the purchase of water of “Extension GR” and “SONEDE Connection”.
5) The small scale WSSs can not afford to employ the personnel for O/M and the weight of the maintenance cost in the O/M cost is big because pipeline length per capita seems to be rather long due to small beneficiaries.

It can be concluded that the rated maintenance cost is the critical component of the O/M cost of the Rural WSS related to the sustainability of the sub-project.

Table 8.5.8 presents the rate of the maintenance cost to the total construction cost of 65 projected WSSs and the 36 WSSs covered by the JICA Study in 2000. It shows the rates exists between 0.15% and 1.26% and the averaged rate on total 101 WSSs is 0.63%. Following Figure 8.5.1 shows the correlation between the construction cost and the maintenance cost.

Figure 8.5.1 Correlation betwenn Construction Cost and Maintenance Cost



As shown in the figure, following formula can roughly estimate the maintenance cost from the construction cost without applying rather complicated maintenance cost rates specified by DGGREE.

$$\text{Maintenance Cost} = 0.0172 \times (\text{Construction Cost})^{0.9226}$$

It is preferable to determine the maintenance cost by considering the particular conditions of the projected WSS and the project area with having the rough estimation, e.g. using above formula.

8.5.3 Financial analysis

As described in Chapter 7, the commodity charge to be applied to the first year of the projected water supply service is determined through the calculation of FIRR of the sub-project. The cost of $1m^3$ water is equivalent to the amount of the operation and maintenance cost portion of the necessary price of water for having 5%[3] of FIRR. The calculation is made according to the assumption specified in the financial guidelines prepared by DGGREE. The result of the analysis is shown as the calculated water charge presented in the following clause 8.5.4.

Table 8.5.9 show the computation of necessary water charge to have FIRR of 5% and net annual discount cash flow of total 65 WSSs considered as sole project.

[3] This discount rate is considered as similar to the inflation rate of Tunisia.

Calculated water charge is 0.643TD without considering the commission for tap keepers. It is lower than one (1) TD which is generally considered as the affordability for water of the rural population in Tunisia.

The revolving fund is considered as the revenue of the GICs in the financial analysis of the Study in 2005 so as to keep the GIC's accounting balance always positive during the sub-project period. Table 8.5.10 shows the computation of the water charge under said condition as if 32 projected WSSs is implemented as a sole project. The result shows that the net discount cash flow of the Project becomes in red during first three years of the water supply service. The revolving fund amount for this computation is 11.2TD.

Table 8.5.11 shows the result of the financial analysis with the adjustment of the water charge got by the computation shown in Table 8.5.10 in order to make the cash flow balance always in black throughout the project period of all the WSSs and keep the revolving fund amount within the affordability[4] of the population in the rural area.

It should be noted that applied water charge to four (4) sub-projects, which will be merged with their existing GICs, is lower than the calculated ones. The water charge of these sub-projects will be reviewed in the second year of the operation after the consultation with the population of both new and existing GICs referring the feasibility study report. The FIRR of total 32 WSSs calculated under conditions above is 5.2% and adjusted water charge is 0.685TD.

8.5.4 Cost of $1m^3$ water and water charge applied

Cost of $1m^3$ water is calculated based on the construction cost and yearly O/M cost during the project period. It is the total of fixed cost and variable cost portion of the necessary water price to have 5% of FIRR.

Once the cost of $1m^3$ water is got, the water charge to be applied to the projected WSS is determined considering commission for tap keepers. The rate of commission is determined considering the estimated its monthly amount in order to raise up their motivation, however, if the water charge exceeds one (1) TD, the rate of commission is decreased and sometimes they are requested to work on the voluntary basis.

Table 8.5.12 and Table 8.5.13 present the cost of $1m^3$ water and water charge applied to 33 projected WSSs for 2005 and that for 2006. The median, maximum and minimum costs are 0.621TD, 1.414TD and 0.273TD respectively. The cost for $1m^3$ water of Ezzaguaya and El Ouena sub-projects in LE KEF, Tirasset sub-project in Manouba and Ouled El Faleh sub-project in Sousse exceeds one (1) TD, however, the number of WSSs of which applied water charge including commission of tap keepers is one (1) TD and over are 22. one (1)

[4] It is judged by AGR.

TD/m^3 is considered as the affordability of the rural population

The cost seems to be mainly affected by the existence of the pumping station and the type of the water source. Following table shows the comparison of the average cost[5] according to the above conditions:

Table 8.5.14 Comparison of water cost by the design conditions of WSSs

	No. of Sub-projects	Average cost (TD/m^3)	Average Daily Water Supply in the 1st Year (m^3/day)
SONNEDE Connection with pumping	13	0.618	41.24
SONNEDE Connection without pumping	10	0.624	21.15
Extension GR with pumping	18	0.799	32.69
Extension GR without pumping	10	0.671	27.81
Deep Well	9	0.500	70.62

note: The WSSs of which water source is "spring" and "irrigation" are excluded due to their scarcity.

The table shows that the payment for water to SONED or existing GIC, and the scale of the WSSs might be the reasons of the cost difference between "SONEDE Connection" and "Extension GR", and "Deep Well". The cost of "SONEDE Connection without pumping" is higher than that of "SONEDE Connection with pumping" is ascribed to the burden of the maintenance cost due to less scale of the WSSs of "SONEDE Connection without pumping".

SONEDE applies the progressive water charge system and its lowest one is 0.159TD/m^3 including tax. It takes for granted that the population who is supplied with water by GIC WSSs of "SONEDE Connection" desires to have water supply from SONEDE directly.

8.5.5 Revolving Fund

The conception of the revolving fund applied to the Rural Water Supply projects was not clear before the Study in 2004. As a result of it, the revolving fund got through the financial analysis was decreased in a number of sub-projects after the consultation with the concerned AGR without clear reason.

The Study Team considers the revolving fund as follows:

When the projected WSSs are put in service, GICs who manage them can not get any income during the first several months while the GICs always necessitate the costs for water supply. The beneficiary population is requested to contribute certain amount of money to compensate for the debt balance during the period as the revolving fund.

The amount of the revolving fund is determined as the four (4) months portion of the GIC's first year expenses on condition that 100% of the budgeted water supply volume is consumed by users.

[5] based on 80% of the average daily water supply in the first year (average daily water supply in 2006 x 365 x 0.8)

When the calculated amount of the revolving fund had been considered to be higher than the affordability of the population, the calculated water charge was adjusted a little so as to make the revolving fund with in the affordability of beneficiaries. As a result of it, the amount of revolving fund to be applied of a number of sub-projects was reduced. This procedure was applied after the consultation with AGR, if necessary. Table 8.5.12 and 13 show the calculated amount of the revolving fund of 33 WSSs for 2005 and 32 WSSs for 2006 respectively and that to be applied to them determined after the consultation with AGR concerned.

8.6 Detailed Design

8.6.1 Detailed design

8.6.1.1 Geotechnical survey

The geotechnical survey was carried out for the following 13 sites of the projected elevated tanks.

Table 8.6.1 Projected elevated tanks of sub-projects 2005 and 2006

Sub-projects 2005			Sub-projects 2006		
Governorate	Sub-project	Dimension	Governorate	Sub-project	Dimension
Nabeul	El Bassatine	H12m x 50m^3	LeKef	Forna	H15m x 25m^3
	Bir Ben Zahra	H15m x 25m^3	Sousse	Chraifia	H15m x 50m^3
Sousse	Ouled El Fellah	H12m x 25m^3	Mahdia	Ammar&Essaafi	H20m x 100m^3
Kairouan	Ouled Abbes	H15m x 50m^3	Kasserine	Bnana/ O. Benajeh	H12m x 50m^3
	Ouled Boudabbous	H15m x 25m^3		Oued Lahtab	H12m x 50m^3
Sfax	Gargour-Brahma-Fkayha	H12m x 150m^3	Gafsa	Enjaimia	H12m x 100m^3
				Smaidia	H15m x 25m^3

The purpose of the survey is to grasp geological profile and allowable bearing strength value of the foundation ground. The field survey consists of test boring and the standard penetration test (SPT). Safety and soundness of the foundations were examined based on the technical data collected through the field survey and technical analysis.

(1) Field survey

Methodology of the field geotechnical survey

Test boring was made at the construction site and core samples were obtained. The borehole is 10m in depth and approximately 70mm in diameter. Geological profile of the foundation soil was established based on the collected samples.

SPT was carried out for each one meter depth of soil for the total depth of 10m. The number of blows to penetrate the SPT sampler to a depth of 30cm was recorded as N-Value of the soil.

Results of field survey

The geological logs revealed in general that the surface layer up to 10m in thickness consists of sand and clay. The sand layer is seen to be a mixture with cement, gravel or tuffaceous clay. This layer is intensively consolidated with N-values almost exceeding 50. The clay layer is generally mixed with gravel, tuffaceous gravel or sand. Out of 13 investigated sites, rocky layer was observed at two (2) sites with a thickness of 1.5 m

within 5 m from the surface of the ground. No groundwater was observed in the layer investigated.

(2) Stability analysis of the elevated tank

Stability of the projected elevated tanks was analyzed to confirm the safety of theme during the critical period of time of sirocco or earthquake. Procedure of the analysis is as follows:

1) Bearing capacity of foundation ground was estimated applying the Terzaghi's formula with N-value got through SPT.
2) The weight of the elevated tank was calculated and the stress given to the foundation ground is calculated in order to compare with the strength of the ground.
3) After confirming the safety of the tank in terms of the bearing capacity of foundation ground, the stability against the horizontal load caused by strong wind which might be associated with sirocco was analyzed.
4) The safety on the risks of turning down of the tank by the wind and foundation ground failure by the stress given by the weight of the tank and added by the wind to the foundation ground were confirmed.

Thus, the long term basis safety with respect to the stability of all the projected elevated tanks under the Study were confirmed. Appendices 8.6.1 and 8.6.2 present the details.

8.6.1.2 Preparation of design for installations

The detailed design was made by applying the standard design prepared by DGGREE for the installations of sub-projects categorized as follows:

- Intake works
- Transmission and distribution pipeline
- Distribution tank and relay tank
- Ancillary works of pipeline
- Service installations
- Other facilities (disinfection station and GIC office)
- Pump facilities including power supply

If the standard design can not be applied or is not prepared, the design was made by the resident consultant company or made use of applicable other design for similar installations and borrow the standard design of SONEDE. Application of the standard design for distribution tank to that for the relay tank is the case of the former and the use of the standard design of SONEDE for the elevated tank with over 100m^3 capacity is the latter case.

The following table shows the existing standard design of DGGREE and SONEDE applied to the Study:

Table 8.6.2 Standard design of DGGREE and SONEDE applied to the Study

(1) Standard design of DGGREE

Pumping station:	The pumping station consists of a control room and a room for chlorination facilities. There is another type adding a room for an engine generator to above. If a GIC office is necessary, this type is applied. Typical alignment of an air valve, a sluice valve, a water meter, etc. is provided.
Tank (semi-buried type):	The design of semi-buried tank is established for the storage capacity of 10, 15, 20, 30, 40, 50, 60, 75, 100 and 150 m^3. Soil embankment is provided around the tank so as not to increase the temperature of water in the tank.
Tank (elevated type):	The standard design of the elevated tank is established for the capacity of 25, 50 and 100 m^3 with a standard pillar height of 9, 12 and 15m.
Break pressure:	A water level is controlled by a float valve installed in an inlet pipe. The break pressure applied to the Rural WSS has the storage capacity of 8m^3.
Service installations:	The communal tap (BF) consists of a service pipe, a concrete stand on a concrete apron which has a opening for drainage. There is a box for a water meter, a stop cock, etc in the back of stand. The potence is designed for supplying a big tank with water from the above of it. The height of it is accordingly about 2m.
Ancillary facilities:	Typical design of manhole structures which accommodate drain valve, air valve and sluice valves is available. It is necessary to adjust the size of the structures based on the actual arrangement of valves and fittings to be installed.

(2) Standard design of SONEDE

Branching Works: (intake works)	There are two types of standard design of branching works for SONEDE Connection, one is on the ground type and the other burried one. Selection of the type depends on CRDA.
Tank (elevated type):	The SONEDE type is used for the tank capacity greater than 100m^3. The design differs from GR type in the structures of the foundation, pillar and tank.

In addition to the above, additional design was made for GIC office and chlorination station. The design of independent GIC office is applied in 15 sub-projects for 2005 and 2006. Besides, an independent chlorination station is designed in 8 sub-projects which do not have a pumping station.

Typical designs prepared in the detailed design of sub-projects for 2005 and 2006 are

shown in Appendix 8.6.3.

8.6.1.3 Work quantity survey

The construction work of sub-projects for 2005 and 2006 generally consists of pumping station, pipeline, distribution tank, relay pumping station, service installation, electromechanical equipment and electrical works and chlorination equipment. In the feasibility study, the quantity of work was calculated on approximate basis using number of facility unit, etc. In the detailed design, the work quantity calculation was made in detail according to the detailed design drawings.

The work quantity survey is in principal is made on the following items:

(a) Construction of pipeline and civil work

(i) Supply of pipes and fittings
- Pipe (HDPE pipe, 10 or16 bars of allowable working pressure, Galvanized steel pipe, DCIP)
- fittings

(ii) Laying of pipes and fittings
- Earthwork (excavation, backfill, sand bed, rock excavation if any)
- Laying of pipes and fittings

(iii) Construction and equipment of ancillary works
- Earthwork (excavation, backfill)
- Concrete work
- Equipment (valves, cast iron or galvanized fittings, miscellaneous)

(iv) Construction of civil works (distribution tanks, relay station, break pressure, GIC office, chlorination station, etc.)
- Earthwork (excavation, backfill)
- Concrete work
- Mortar coating (water proof, ordinary)
- Equipment (valves, water meter, special parts, miscellaneous)

(b) Electro-mechanical and electrical works

(i) Pump and accessory equipment (relay station, existing pump station)

(ii) Pilot cable for control of pump operation

(iii) Chlorination device (injection pump, dozing device, tank)

(c) Electrification

(i) Power supply from STEG (transformer, power line)

In the above, the design work quantity of (i) earth work (excavation, backfill), (ii) concrete work (concrete, reinforcing bar, framework), (iii) waterproof coating, (iv) doors

and windows, etc. are fixed corresponding to the standard design of pumping station and distribution tanks by DGGREE.

8.6.2 Tender document

8.6.2.1 Application of the model tender documents prepared by DGGREE

The CRDA of each governorate is in direct charge of realization of RWS sub-projects from the planning stage to implementation of the project. DGGREE has elaborated standardization of the detailed design, tender procedure and technical specifications for pipe and fittings, civil works and electro-mechanical equipment so that each CRDA could develop the Rural WSS under the same conditions as much as possible.

DGGREE updated the tender document to be applied to the implementation of sub-projects for 2004 to 2006 with the finance of JBIC (Phase II) committed in October 2003. The tender work of each sub-project will generally consist of two lots of (i) construction of civil works and (ii) installation of hydro-mechanical-electrical works. The following document is prepared for each of the two lots above mentioned:

- Notice of tender
- Special Administrative Conditions
- Technical specifications

In the above, the Special Administrative Conditions provide similar clauses for each of the two lots.

Particular attention will be made on the following clauses which will indicate the characteristics of the construction contract of the RWS sub-projects:

(1) The contract will be given to the tenderer who offered the least cost estimate among those who complied with the minimum technical requirements such as human resources, construction equipment, experiences in the past three years and technical background (selection of the contractor)

(2) Construction work should be carried out under the supervision of the administration in order to avoid possible problems in the future. The contractor and the supervisor should confirm work activities already done by mutual signing the site diary. Meetings should be held every day and minutes of meetings should be prepared. (confirmation of work activity)

(3) The administration will inform provisional approval once construction has been completed and upon request of the contractor. Completion drawings shall be

prepared with the presence of representatives from the administration and GIC. The date of provisional approval should be the date of commencement of the guarantee period. (provisional acceptance)

(4) The guarantee period of the constructed works is fixed at 12 months starting from the date of provisional acceptance. The contractor is responsible to make good any defect of execution during this period before final approval by the administration. (guarantee period)

8.6.2.2 Procurement lots

The tender lot for implementation of each sub-project was proposed by resident consultants and determined by the concerned CRDA after discussion with JICA Study Team, as shown in Table 8.6.3.

Because of the small construction work and in order to simplify the tender procedure and execution of the work, the number of tender lot was limited to one or two. In all the sub-projects, Lot 1 is allotted to construction work (pipeline, ancillary facilities of pipeline and civil works) and electrical equipment, if necessary. Lot 2 however is considered as one contract on CRDA level.

The equipment of disinfection system is generally included in Lot 2 which however, is included in Lot 1 in case that there is work contract for electromechanical equipment and electrical works.

8.7 Study on Quality Control of Construction Works

The objective of the Study is confirm the functional durability of facilities constructed in Phase I and recommend improvement plan of abnormalities, if any, to be reflected in Phase-II.

Current conditions of facilities were identified by visual observation. Based on the findings on site and study of the existing document, recommendation was made to modify the existing Standard Specifications, Standard Drawing and quality control manual of DGGREE.

8.7.1 Site investigation

8.7.1.1 Selection of sub-projects and facility for observation

Twenty (20) projects in nine (9) governorates were selected as the site of observation focusing on the projects; (i) which include not only pipeline facilities but also civil work such as semi-buried tank and elevated tank, and (ii) which are located in the governorates where the present study (Phase II) is conducted.

The said projects included four (4) projects (Jahfa, Chouaoula and Ain Trarib in Jendouba and Complexe Bousslim in Mahdia) under construction to investigate construction process as well as constructed facilities.

Investigation was made on the following facilities of the said projects:

1) Intake
2) Pipeline and appurtenant structures
3) Pumping facility
4) Distribution tank
5) Service facility

Investigation was focused on the items that would affect functional durability of facilities. However, observation items of pipeline were limited to the appurtenant structures since all the pipes have already been backfilled. Besides the civil works, operational condition of pumping equipment and chlorine dosing facilities was checked through noise/vibration in case the equipment was in operation.

The following major items were focused in the investigation:

1) Water leakage (pump station, pipe, tank)
2) Pipe support (pump station, appurtenant structure, tank)
3) Finishing of building (pump station, tank)
4) Finishing of wall (tank)
5) Drainage from pit

6) Surface condition of concrete (pillar of elevated tank)
7) Pumping equipment/ chlorination facility

8.7.1.2 Observed problems and their frequency of observation

From observation records of twenty projects, major eight problems in five categories were identified with the frequency of observation, as shown below.

8.7.1 Major problems and observation frequencies

Item of Problems	Frequency of observation
1) Civil work: - Cracks on mortar coating on the outside wall of the tank, etc. - Cracks on waterproof mortar on the inside wall of the tank	 43% 26%
2) Piping work: - Water leakage from the pipe joint - Unstable pipe support	 3% 4%
3) Electrical/Mechanical work: - Breakdown of chlorine facility	 8%
4) Building works and miscellaneous work: - Incomplete finishing of the buildings, fittings, etc. - Stagnant water in the valve pit	 3% 31%
5) Earth work: - Subsidence and erosion of the earth embankment coverage	 58%

8.7.1.3 Other findings in the site investigation

(1) Formation of honeycomb on concrete structures

1) Projects in Jendouba

Honeycomb was observed on the concrete surface of semi-buried tanks and relay pumping stations of projects Jahfa, Chouaoula and Ain Trarib in the governorate of Jendouba.

2) Projects in Mahdia

Many repairing traces were observed on the inner surface of pillars of the elevated tank of project Complexe Bousslim. The repairing trace indicated that defects in concrete surface such as honeycomb had occurred.

Moreover, honeycombs were observed on concrete surface of structures of other projects in the photos taken by the technical assistance consultants of projects 2000-2001.

(2) Design of relay pumping stations

The current standard drawing for relay pumping station assumes to utilize a submergible pump installed in a semi-buried tank. On the other hand, in-line pump has actually been adopted recently.

(3) Quality control by CRDA

It was confirmed in all nine (9) CRDA offices that the work site record for civil and pipe work was properly maintained and completion drawings were prepared by the contractors. Completion test of concrete samples was done in eight CRDA out of nine (9). However, trial mix for design of concrete was not executed in nearly half of the CRDA offices which the team visited.

It was confirmed that water pressure test of pipes and waterproof test of distribution tank were executed in several CRDA offices. However, the record of rinsing and disinfection could not be checked in any of the CRDA offices.[1]

8.7.2 Examination on results of the site investigation

8.7.2.1 Major problems and proposed actions

The identified four (4) problems having a frequency of observation more than 10% and other findings were examined in terms of cause, effects and possible countermeasures.

(1) Cracks on mortar coating on the wall of distribution tanks

The direct cause was judged to be contraction of mortar. The crack is judged not to be a defect which would affect functional durability of the facility.

(2) Cracks on waterproof mortar coating on the inside wall of the tank

The direct cause was judged to be contraction of mortar. The crack would deteriorate the function of the waterproof mortar itself. Instructions of SIKA are quoted in the standard quality control manual of DGGREE. It is required that the contractor should strictly follow the instruction.

(3) Stagnant water in the valve pit

In project Chabbia, there were some valve pits. The stagnant water inside was presumed due to water leakage from the pipe joint. The water would accelerate deterioration of the valves and pipe joints. The valve pit was provided with ventilation window and because of the low humidity in the project area, the effect of the problem will be small.

(4) Subsidence and erosion of the earth embankment coverage

Cause of subsidence is insufficient compaction of the earth embankment. Slope of the embankment is eroded by rainwater. If the earth embankment coverage subsides, its function would decline. The erosion would also deteriorate the durability of the coverage. It is necessary to consolidate compaction and to improve stability of the side slope of embankment. For this purpose, it is recommended to change the slope to 1:1.5 and

[1] Several disinfection test records were kept by the technical assistance consultants for project 2000/2001.

compaction should be made manually with a layer of 0.30 m maximum. It is also recommended to add such descriptions to Article 45 of the Technical Specifications.

(5) Honeycomb on the concrete structures

Direct cause of the honeycomb is segregation of aggregate from cement mortar. Concrete with honeycomb is not watertight. In addition, it has problems in structural strength and durability.

It is essential that the contractor execute trial mix test and determine mix proportion of the concrete. Volumetric dosing should be accepted only on the condition that the contractor establishes a dosing method clearly and it is approved by AGR. In addition, It is necessary that the contractor should establish secure proper work method for placing and compaction and which should be confirmed by AGR.

Compaction of concrete is insufficient.

(6) Design of relay pumping station

Basically, it is proposed to apply the existing standard design of semi-buried tank to relay station. By so doing, construction could be done in the same way, and formwork could be reused.

(7) Quality control by AGRs

(a) Daily worksite record

The exact portion of work in the pipeline was not recorded in most of the cases. The evaluation report[2] prepared by the technical assistance consultants for Project 2000/2001 indicates that the quality control level for pipe line work is inferior to that for civil work.

The current sheet of daily work site record does not fit well to the nature of current AEP projects. It is proposed to modify the sheet of daily work site record so that information is recorded more systematically and precisely.

(b) Preparation of execution drawing

Execution drawing was not properly prepared by the contractor such as the case for installation of pipe through concrete wall and for pipe protection in river crossings in projects Jahfa and Chouaoula.

Preparation of proper execution drawing is essential for securing quality of work. However the existing provisions of the Administrative Specifications and the Technical Specifications are inconsistent with regard to preparation of execution drawings..

It is proposed to modify descriptions of the Technical Specifications in accordance with

[2] Evaluation and Completion of Mission 2, Nippon Koei / SCET Sept, 2003

those of the Administrative Specifications.

8.7.2.2 Consideration on lifespan of each facilities

DGGREE assumed a lifespan of each kind of facility that is currently applied for AEP projects[3] ranging from 7 years for electromechanical works to 40 years of concrete structures. As a result of the site investigation and consideration, it is recommended to maintain the current lifespan for the following reasons:

(1) Observed problems previously mentioned are judged not such serious as to necessitate reconsideration of the life span considering their effects on the durability, frequencies and possibility of improvement by countermeasures.
(2) It is possible to attain the currently applied lifespan, if the facilities are constructed with proper quality control and are properly maintained. Honeycombs were all repaired and all the concrete structure was covered with mortar coating with thickness of 20-30 mm.

8.7.3 Proposal on the standard specification, drawings and quality control manual

The following modifications on the current standard specification and drawings are proposed as a measure to prevent the defects previously mentioned. A new standard drawing for relay pumping station and modified sheet of daily work site record are also proposed.

Proposed modification/new proposal	Basis for Proposal
4.1 Standard Technical Specification	
(1) Modification on Article 6 of sub package II (pipe laying works and appurtenant works) and Article 19 of sub package III (civil works)	Section 3.1 (7)
(2) Modification on Article 24 of sub package III (civil works)	Section 3.1 (5)
(3) Modification on Article 45 of sub package III (civil works)	Section 3.1 (4)
4.2 Standard Drawings	
(1) Modification on earth embankment coverage of the semi-buried tank	Section 3.1 (4)
(2) New Standard drawing for relay pumping station	Section 3.1 (6)
4.3 Quality Control Manual of DGGREE	
Modification on the sheet of daily work site record	Section 3.1 (7)

8.7.3.1 Proposal on the standard technical specifications

(1) Modification on Article 6 of sub package II and Article 19 of sub package III

The following procedure should be prescribed:

1) Joint reconnaissance visit to the site by AGR and the contractor
2) The contractor prepares and submits execution drawings to AGR based on the tender drawings and findings in the site visit

[3] "Technical and Financial Guideline", DGGREE

3) AGR approves the submitted execution drawings and return the drawings with notification "*Bon pour Execution*".

Moreover, it shall be clearly mentioned that the contractor shall complete all the necessary details in the drawings necessary for execution of the works and submit them to AGR for approval.

(2) Modification on Article 24 of sub package III

It should be clearly prescribed that mix proportion of concrete B5 shall be determined by a trial mix test executed in a laboratory. The test procedure should include the descriptions about the following:

1) Requirement of concrete
2) Trial mix test
   - Determination of unit content of water
   - Determination of fine aggregate percentage
3) Final mix proportion

(3) Modification on Article 45 of sub package III

The following description should be supplemented to Article 45:

"The embankment around a semi-buried tank shall be executed and compacted per layer of 0.30 m by manual tamping or using plate compactor. Slope of the embankment shall also be compacted in the same way."

8.7.3.2 Proposal on the standard drawings

(1) Modification on earth embankment coverage of the semi-buried tank

It is proposed to change the design of earth embankment coverage of the semi-buried tank, as follows:

	Current	Proposed modification
Crest Width	35 cm	50 cm
Side slope	1:1	1: 1.5

(2) New standard drawings for relay pumping station

It is proposed to apply the standard drawings of a semi-buried tank with modification of the size of valve room. Capacity of the tank shall be determined to meet the requirements for respective projects. The proposed drawings only indicate the standard configuration. Detail of the design shall be determined according to the particular conditions, and the detail execution drawings shall be prepared by the contractor.

8.7.3.3 Proposal on modification of daily worksite record

It is proposed to modify the daily worksite recording sheet from the following viewpoints.

1) Executed work shall be recorded classifying into civil work and pipeline work.
2) Material delivered shall be recorded with delivery location.
3) Exact portion in the pipeline/structure where the work was executed shall be indicated.
4) Execution of quality control test shall be recorded.
5) Instruction/order to the contractor shall be classified into quality control, construction schedule and coordination with the other work, contract and financial matter, and safety control.

9 LESSONS LEARNED

9.1 Lessons Learned from the Study in 2004 and Feedback to the Study in 2005

9.1.1 Preparation of the sub-projects

Before starting the study on the Rural Water Supply projects, the CRDA had prepared the sub-project identification card shown in Figure 9.1. The data and information in the card were the basis of the contract on the study of the sub-projects between the JICA Study Team and the resident consultant company.

However, The Study Team confirmed that the data and the information in the card did not given any clear idea on the sub-project area in terms of number of localities[1], sub-project area. In many cases, the number of localities, which is the basis to hold the sensitization meeting, is far bigger than that shown in the card.

The model of the contract on the sub-project study prepared by DGGREE specifies that the contract amount can not be changed except the topographic survey works and the contract between the Study Team and the resident consultant company in principle follow the model.

The sociologists of the resident consultant company seemed to be discouraged to contribute the sensitization due to such increase of the number of the localities. The Study Team was afraid that it might cause insufficient sensitization and will influence the sustainability of the sub-projects.

The Study Team requested to the resident consultant companies to prepare the offer for the contract based on the reconnaissance in the sub-project areas so as to give the clear idea of the tasks to the sociologists for sufficient sensitization.

9.1.2 Identification

(1) Accomplishment of beneficiary families list

The target population had been identified by the end of 1st visit of the sensitization activities in the Study in 2004, since the optimum preliminary design of the projected WSSs was selected among alternatives after that, it was difficult to add other localities identified after the 1st visit.

In the Study in 2005, definitive determination of prospective beneficiary families and population was put off until the end of second visit of the sensitization activities so as to

[1] Small group of households like the minimum administrative unit

ensure the access to water for people in need as much as possible. This method seemed to have given more flexibility and accuracy in determination of target population.

(2) Reinforcement of identification of relay persons

As indicated in the chapter 8.2, the participation of the target population in the Study in 2004 was not necessarily sufficient. Insufficient participation of prospective users may cause their insufficient understanding on the sub-project and then affect the sustainability. This result was supposedly related with sociologists' approach, as often observed in their dependency on Omda. Meanwhile, the target population reportedly collaborated with the resident consultant efficiently for the organization of meetings and collection of necessary contacts and commitment in some cases.

To ensure effective sensitization activities by making sufficient number of prospective users to participate in the sensitization meetings, the sociologists were required to select competent man and woman relay persons by locality. The result is summarized in 12.2.1.

9.1.3 Socio-economic survey

(1) Presentation of household survey result

Data obtained from the household survey was not necessarily accurately presented in the socio-economic report for the sub-projects 2005 due to the lack of thorough analysis and triangulation of data. In this regard, the following were especially required:

1) Current water collection: Data to be classified by types of water source when several water sources existed in the sub-project area; distance and time spent to fetch water, appreciation of water taste and quality.
2) Economy: Data on annual income to be classified by its level (e.g.1,000 TD, 1,000-1,499 TD, 1,500-1,999TD…..more than 3,000TD) instead of average only.
3) OM/M of existing GIC (in case of integration of the sub-project into the existing GIC): It is to be analyzed in such detailed way to grasp perspective of future OM/M.

9.1.4 Detailed Survey

The Study proceeds to the detailed survey stage after the identification of the sub-project for having information on the basic infrastructure such as access to the sub-project area, power supply, inventory of the existing water supply system in case of "Extension GR" sub-project, the authorized flow rate and the minimum dynamic pressure at the connection point in case of "SONEDE Connection" sub-projects, etc.

However, the meeting on the first visit of sensitization revealed that the engineers of the resident consultant company tended to neglect the survey and would to made it in the later stage if they needed particular information in the course of the study. It sometimes put the

engineers to remake the sub-project conception due to the delay or lack of the necessary information.

The Study Team reinforced the Study through the meeting with the resident consultant on the review on the result of the socio-economic survey and detailed survey before starting the first visit of the sensitization, the Team requested concerned AGR to attend the meeting. The participants verified the necessary data and information for the study in the meeting.

9.1.5 Sensitization

(1) Land acquisition

Contracts for land acquisition were usually collected during the third visit of sensitization, especially those for hydraulic facilities after their legalization at the municipality or the delegation.

Since the delay of collection of contracts for land acquisition on hydraulic facilities affects reportedly the finalization of sub-project design in a case, it was required to the resident consultant companies to accomplish the collect all the necessary contracts by the end of second visit so as not to affect the D/D. The contacts relative to land acquisition were required to be attached in the draft F/S report.

(2) Important themes to be introduced

1) Operation hours

It was recognized that the responsibilities of tap keepers, type of their work (work with commission or voluntary work） and their workload were not sufficiently discussed in the selection of such persons. The workload of tap keepers should be considered in line with the amount they can get as commission.

As reported in 8.2.4, a theme on operation hours of service installations, namely starting and closing time of water supply service, was introduced in the sensitization activities not only for appropriate calculation of tank capacity in relation with peak hours but also for let prospective users consider workload of tap keepers.

2) Un-accounted For Water (UFW)

It was observed that actual UFW rate was relatively high comparing with design UFW ratio of 15% in the RWS projects[2]. It will make the water charge higher than expected in the following year. It was supposed to be effective to raise awareness of the target population on this subject and the significance of water economy before it starts to use

[2] 27% in average of GIC (Summary Report of the situation of the GIC/WSS (2002)

the WSS, since the loss of water can be reduced at the service installations through the careful attention by the tap keepers as well as users of WSS.

9.1.6 Planning

The Study Team, concerned AGR and the resident consultant company held the meeting on the selection of the most appropriate preliminary design of the WSS to be applied to the sub-project.

However, the alternative preliminary designs prepared by the resident consultant are mainly focused on the distribution pipeline route and they are mainly evaluated from the cost price.

It is necessary to prepare the alternative preliminary designs from different view points such as the construction cost, the O/M cost, the easiness of the O/M, etc in order to prepare the most appropriate projected WSS which will be operated and maintained by the beneficiary population. For example, the study on the easiness of the O/M of different types of pump can present alternative conceptions of the WSS.

The Study Team prepared the following form to evaluate alternative preliminary designs for the said meeting for the Study in 2005:

	Construction Cost	O/M Cost	Easiness of O/M	Overall Judgment
Design A				
Design B				
Design C				

9.1.7 Design

The design guidelines prepared by DGGREE describes the flow rate of the communal tap as 0.5 L/s, i.e. 1,800 L/hour and projected lpcd in the first year of water supply service is 35 liters including water for animal watering. It means that one communal tap can supply 51 people without considering the time to change a tank, etc. Considering the practical operation of the communal tap, less than 30 people per hour seems to be appropriate and it should be decreased in every year due to increase of water consumption.

Several communal taps in the Gargour-Brahma-Fkayhia sub-projects of CRDA SFAX were designed for over 200 people. Moreover, the design population per service installation exceeds 300 people in one sub-project under the JICA Study executed in 2000. It means that the WSSs of such sub-project should operate over ten hours continuously and it seems to be quite difficult.

However, there reportedly is not any complaints from the users on the convenience of the

water supply. It suggests that the flow rate of the communal tap is not fixed at 0.5 L/s and might be more.

It was confirmed by DGGREE that 0.5 L/s was the flow rate to determine pipe diameters and was not fixed accordingly.

This fact leads to following modifications of the design method applied to the RWS projects in the Study in 2005:

1) Introduction of the conception of the hourly peak factor
2) Consideration on operation hours of GIC WSS
3) Study on the distribution tank behavior (variation of water level during the operation) based on the operation hours
4) Determination of the flow rate of each communal tap reflecting the water demand of users who will use it.
5) Hydraulic simulation is made on the assumption that each communal tap can not control the flow (the dynamic pressure at the connection point in the distribution pipe and the pressure loss head of the service installation determine the flow rate.)

There were other three (3) subjects to be discussed for the appropriate design of the Rural WSS. Appendix 9.1.1 shows them and the following are the title of the subjects:

1) Waste of energy
2) Necessity of flow control at the free discharge inlet of the tank
3) Selection of electromotor pump

The Basic Study Main Report for the Study in 2004 describes on the subjects above and they are reflected to the Study in 2005.

9.1.8 Financial analysis

9.1.8.1 Revolving fund

The amount of revolving fund was determined as the four months' amount of flat rate[3] which was settled through the financial analysis explained in Chapter 7. However, the objectives as well as definition of the revolving fund was not clear and therefore the revolving fund was not included in the financial analysis. It necessitates to make the objectives and the definition of the revolving fund clear and preferably include the funds into the financial analysis so as to improve the cash flow of the GIC accounting.

The amount of revolving fund was defined as the four months' amount of the first year's

[3] One of the water charge systems that each user household pays a fixed amount of money, regardless of the volume of water used.

expenses of GIC WSS operation with 100% and it was included in the cash flow computation so as to make its balance always positive.

9.1.8.2 Cash flow of GIC accounting

The cash flow of GIC accounting was confirmed in the financial analysis, however, even if the cash flow showed the negative balance in several years from starting the water supply service of the GIC, there was not any recommendation to improve such situation except to require the subsidy by local or central government which was practically difficult.

Improvement of the GIC cash flow balance during the sub-project period is made by including the revolving fund as the revenue of GIC into the financial analysis and making necessary adjustment of the water charge to be applied in case that only the revolving fund is not sufficient to improve the cash flow balance.

9.2 Lessons Learned from the Study in 2005

9.2.1 Identification

The time allocated for the identification seemed to be insufficient considering the importance of task to be accomplished. The selection of relay persons was sometimes formal and did not meet with objective criteria as mentioned in Clause 8.2.1.

The selection of relay persons requires more flexibility because there were relay persons who were not conscious enough about the responsibilities awaited from them. The relay persons considered to be ineffective could be replaced with the consensus of the beneficiaries.

It was found that relay persons selected were not sufficiently initiated into tasks expected such as encouragement of neighbors to participate in the sensitization meetings and information to the absent on the result of them. They were not sufficiently implicated in the sensitization meetings as resource persons or mediators.

More time should be allocated to discuss effective relay persons and initiate them into expected role of relay persons from the beginning. Specific meetings with relay persons need to be organized as recommended in the actual sensitization manual.

An early commencement of the tasks which the relay persons have to achieve should be planned, in order to give them a better a sense of responsibility and to make them aware of the pivot role which they have to play in the sub-project zone. The relay persons should not be regarded only as antennas of contact or agents of collection of the beneficiary and commitment lists, instead they should be considered as vehicles of information, able to radiate in the zone and to transmit useful information about the sub-project and to replace the sociologists in the role of sensitization and explanation of the topics developed during

meetings, especially when the population does not understand well these topics. It would be also desirable that sociologists establish more positive and more human relations with the relay persons so that they realize that their contribution is necessary and is strongly appreciated and that it helps to reinforce the sub-project sustainability.[4]

The time devoted to the identification was short viewing the importance of the tasks to be accomplished. The choice of relay persons was sometimes formal and does not obey the objective criteria.

The relay persons were not initiated to tasks expected from them, and were not involved in the sensitization activity as resource and relay persons.

9.2.2 Socio-economic survey and detailed survey

9.2.2.1 Socio-economic survey

Socio-economic survey was rarely conducted reportedly in the feasibility study in RWS in this country, though the actual sensitization manual specifies this step with specific document for this survey. In this respect, the fact that socio-economic survey based on the household survey and PRA was implemented in the Study in 2004 and 2005 can be regarded as one of achievements in study in RWS in this country. However, the way in which this survey was conducted needs to be improved from several viewpoints.

The data collected in the household survey was still found not to be appropriately processed and analyzed. According to the verification on the questionnaires filled by the Study Team, it seemed that the sociologists seemed not to have spared enough time for the interview with people for the household survey. In some cases, open questions were not almost filled in. How to conduct the household survey is clearly mentioned in the socio-economic survey manual, attached document to the actual sensitization manual. Such existing document should be more referred by sociologists.

The data processing was not appropriate. For instance, the data on current water collection was not presented by several water sources currently used. Distance, time to spent, appreciation on water taste and quality need to be analyzed by water sources so as to grasp current situation more accurately.

Moreover, the data collected was not sufficiently utilized to identify specific needs or themes for the sensitization. The sensitization should be made based on the result of the socio-economic survey for targeting more important themes for a sub-project. For example,

[4] The actual sensitization manual specifies that the meetings with groups of relay persons are utilized to refer to typical elements of the target population, opinion leaders who will play community leaders (direction of GIC, collection of commitments to revolving fund. They are also expected to diffuse the information relative to awareness raising in the target area (p. 11, Sensitization Manual, DGGREE, 1998)

following themes should be at leased grasped before the first visit of the sensitization more strategically. .

- Amount affordable to pay
- Water charge method preferred
- Viewpoint on water sources currently used. If water sources of free of charge are currently used, such as shallow wells or natural water sources, use of such water sources and their appreciation should be analyzed.
- Inconveniences relative to current water supply
- Viewpoint on future OM/M such as willingness to participate in GIC if the water cost/m^3 exceeds 1TD, willingness to be member of GIC and so on.
- Viewpoint on land transfer
- Viewpoint on existing GIC needs to be studied before discussing with the target group in case of extension GR
- The degree of population awareness of the suffering threatening human health when bad quality water is used.
- The population perception of women's role in the sub-project and the identification of possible objections to the emergence of women as important actors in the community.

All above-mentioned items are included in the household survey, however, items verified in the review meeting before first visit of sensitization activities were limited to those relative to current water supply due to the study period limited and probably due to the lack of recognition of usefulness of socio-economic study by resident consultants. Only limited sociologists included specific themes for sensitization activities based on the result of household survey.

In general, the socio-economic survey takes risk to be viewed as a mere contractual task to be filled in by the consultant who is not fully aware of its impact on the parameters of the project study.

9.2.2.2 Detailed survey

The Study Team confirmed that the resident consultant companies sometimes had the difficulties to collect necessary information and data concerning the existing systems of SONEDE and GR (Extension GR) which were considered as the water sources of the sub-projects. The reason might be the relationship between the private consultant company and the administration.

In this case, the strong support of concerned CRDA was indispensable, however, such support was not sufficient in many cases and sometimes not made timely.

The lack of necessary documents due to the absence of a good archiving system, and the charging of the consultant companies to make up for all the insufficient information confirmed in the field, including the preparation of completion drawings, collecting the data and information on the hydro-electro-mechanical system, etc of the existing WSS may be the big burden to the consultant company and therefore it might give negative influence to the progress of the Study.

9.2.3 Sensitization

9.2.3.1 Water charge method

As mentioned in Clause 8.2.4, the water charge system was explained in more detail in the Study in 2005. Advantages and disadvantages in each water charge method were explained. However, the sociologists tended to insist commodity charge as best water charge method though target population preferred other methods such as flat rate. They took rarely conditions specific to each sub-project such as existing tapped springs.

In the sub-project of Kalboussi of CRDA Bizerte, the target population accepted reluctantly the proposed flat rate, 5.5 TD/month, since the proposed amount was higher than that applied by several neighbor GICs. The individual payment was discussed during the meeting on the socio-economic report attended by CGIC of CRDA, DGGREE, consultant companies and the Study Team.

The fact that the target population is used to water from arranged springs freely needs to be considered in such a case. If advantage and disadvantages in each method, such as ensuring fixed incomes for GIC during the whole year in flat rate and in mixed fate, were considered carefully, the commodity charge cannot be recommended easily in this sub-project.

The water charge system should be also more flexible in the future though one method was opted during the first phase of sensitization. The target population can be free in selecting among different water charge methods by discussing with CGIC according to the budget planning.

9.2.3.2 Reinforcement of new themes for the sensitization activities

It may be concluded that the new themes for sensitization activities, i) the operation hours and ii) the UFW succeeded to raise awareness of the target population on the suitable use of the projected RWSS. However, it was noted that there was a difference in the assimilation of these themes between the consultant companies and them in the explanation to the target population according to the assimilation level

It is recommended to introduce these topics into the sensitization of consolidation so that

they would be assimilated until the moment of the startup.

As for the operation hours, the theme needs to be more flexible. The Study Team did not intend to fix the open and closing time rigidly. However, due to the field observation, some of the consultant companies tended to explain operation hours calculated by technical study to the target population as fixed ones according to its suggestion.

it will be necessary to sensitize the population again that this issue should be taken into consideration by the users per service installation and through the consultation with the GIC.

The CGIC can plan small meetings with the relay persons that were selected during the first phase of the study to sensitize them about these new topics and to make them assume the role of relay sensitizers during the sensitization of consolidation.

9.2.3.3 Women's participation

The experience of exclusive women meetings in some sub-projects showed its effectiveness and its positive impact on the implication of women in the process of the debate. Women tend to express themselves less when they attend mixed meetings and give the impression that they are intimidated by the presence of men and especially those who are foreign to the project zone. They seem to be more at ease in exclusively women meetings directed by women sociologists. The principle of mixed meetings should not be put into question. Nevertheless, an exclusive women meeting per sub-project is desirable in order to give women the opportunity to express their concerns which are not necessarily those expressed by men and in order to take into account their understanding level of the topics exposed during sensitization meeting.

In addition, the implication of women in the sub-project life should be a major sensitization topic during the three visits and also during the sensitization of consolidation in order to reduce men's reluctance concerning women's implication in the sub-project life and to lead women to become aware of their role within the community.

9.2.4 Planning

The resident consultant companies still prepared alternative preliminary designs to select the most appropriate conception of the sub-project focusing the construction cost. The Study Team evaluated the alternatives with the consultant company using the form shown in Clause 9.1.4. before having the meeting with concerned AGR on the selection.

The Team made the recommendation for the AGR to select the preliminary design which offered the low O/M cost and/or easy O/M for the sustainability of the sub-project. However, it seemed still difficult for the engineers of the consultant companies as well as AGR to have the idea to evaluate the project from various viewpoints.

9.2.5 Design

The Study by modified design methodology revealed a number of subjects to be discussed for the improvement of the Rural WSSs as well as the sustainability of the projects. Following are subjects to be discussed and the details are shown in Appendix 9.1.1.

(1) Determination of Transmission Flow Rate
(2) Conceptions on Distribution System and Service Facilities
(3) Connection with two tanks by gravity flow
(4) Influence of Potence to Distribution
(5) Minimum Water Level Setting to the Distribution Tank
(6) Using a Break Pressure as a Distribution Tank
(7) For keeping good function of Break Pressure
(8) Loss Head of Service Installations (Convert to Pipe Length)
(9) Selection of pump
(10) Booster Pumping Head
(11) Installation of Air Valves
(12) Notes on Flow Control Valve
(13) Notes on Pressure Reducing Valve
(14) Installation of Water Meter
(15) Celerity of Water Hammer
(16) Waste of Energy

9.2.6 Financial Analysis

The result of the financial analysis shows that the maintenance cost is the principal portion of the water charge and it occupies around 50% regardless of the difference of water source, with or without pumping, etc.

Since the maintenance cost is estimated by multiplying the given rate to the price of the construction items such as pipe laying works, hydraulic installations, etc., it can not be decreased even if the GIC maintain the WSS well and it may discourage the GIC to make the effort to decrease the maintenance cost.

As there are around 1,500 Rural WSSs in the country, it is recommended collecting the data of the WSSs on the actual maintenance cost per year and their age, then the rates for maintenance cost calculation are to be reviewed, if necessary.

On the other hand, the GIC is required to manage more rationally the maintenance budget by: using it exclusively for its objects, depositing remaining budget during a fiscal year, and

making a maintenance contract with repairing workshops in order to have competitive prices. If the maintenance budget can be saved during one or more years, the GIC could be authorized to reduce the maintenance rate in the coming years and to use the deposited funds.

10 FOR THE SUSTAINABILITY OF THE RURAL WATER SUPPLY PROJECT

The Rural Water Supply Projects invites the population to change its conventional water sources for domestic use to the communal taps and potencies for good hygiene, alleviation of water fetching, etc. The stable and good quality drinking water supply is consequently indispensable to prevent the population from returning to the conventional water sources.

It does not only decrease the effect of the project but also makes necessary cost recovery of the WSS insufficient and worse the WSS suspends its operation.

Following clauses describe the recommendations for the sustainability of the Project based on the experience and observation through the Study.

10.1 Review of Water Charge System

DGGREE as well as CRDA recommends to apply the commodity charge system of which collected amount of money reflects the consumption, however, it necessitates the cost to collect the money, e.g. the commission for tap keepers which is 20% to 40% of the water charge.

Though it is not included in the budged of the GIC, a book of coupons might be necessary for effective application of the commodity charge system so as to decrease the workload of the tap keepers, e.g. to avoid to handle small coins for change.

Considering such water charge collection cost, the Study Team recommends reviewing the advantage of the flat monthly rate for families which does not necessitate the high cost to collect the money and less burden of the tap keepers.

Indeed, the flat rate system encourages medium and high income group to use water for productive use. However, it is possible to alleviate this disadvantage by preparing the several grades in the flat rate system according to assumed consumption based on the number of livestock, the area for kitchen garden, etc. of households.

On the other hand, considerable number of beneficiary population does not seem to be quite satisfied with the service level of the projects due to uniform water charge system (beneficiaries pay evenly) in spite of different distance between a communal tap and houses of user who use it (uneven benefit)

This discontent to the collective water supply system will cause delay of payment or nonpayment for water, illegal connections, etc. which will make the GIC’s accounting balance in red and finally interrupt the water supply service.

Introduction of the water charge system considering such uneven conditions of the users may be one of the solutions. Mixed rate, which consists of the low flat rate for basic service

and relatively high commodity charge for extra service, might be the most possible water charge system though it requires further study to prepare such water charge system.

10.2 Promotion of Water Consumption

The Study Team confirmed in the third visit of sensitization that the main concern of the population is the water charge and anxiety on the charge increase.

As shown in Table 8.5.7, the fixed cost portion of the water charge occupies over 50% and therefore if the actual consumption is bigger than the projected one, the water charge can be reduced due to decrease of maintenance cost per one (1) cubic meter.

Since the capacity of the Rural WSS is the peak day water demand in the final year of the sub-project period, the users can consume the water exceeds the projected water demand in the first year of the water supply service up to the capacity.

It is preferable to explain above mentioned to the population and encourage the water consumption appropriately in order to keep its hygiene well and to improve its living standard.

It might necessitate to change the current water consumption standards[1] though it is not clear whether they are on the concrete basis. Moreover, it might leads to new standards based on the statistical consumption data of existing WSSs.

Financial analysis to establish the GIC's budget based on the assumed consumption, which rise from 62 % in the first year to reach 90 % at the end of the sub-project period, could also be questioned. Unless it was established based on the statistical data, it is susceptible to be modified. On the other hand, the annual increase rate of the consumption is fixed at 2,5 % by year for grouped population and it is not considered for the scattered population without taking into consideration the development of the private connections even in the rural settings. If the capacity of the water resources permits, it is preferable to allow to modify these parameters so as to make the assumption of the financial analysis closer to the actual conditions of the RWS. Consequently, it is expected to decrease the water charge and to increase the water consumption and vice versa.

10.3 Coexistence with Conventional Water Sources

Before constructing the rural water supply system, population collected the water from shallow wells, springs, wadis, etc. with free of charge. They sometimes exist near a user's house and some of their quality looks like good for the population. It gives the idea to the

[1] 25 lpcd for grouped population and 20 lpcd for scattered population

population that the communal tap of the rural water supply system does not necessarily decrease the workload of water fetching. Such conventional water sources hinders the population from consuming the rural water supply system and it affects the GIC's accounting balance. Therefore, the parties concerned persuade the population not to use the conventional water sources.

As long as the population does not feel any inconvenience on such water sources, it is difficult to prevent them from collecting water from them.

On the other hand, limitation of water resource availability is predicted in the near future.

Considering the facts above, the rural water supply projects should consider to co-exist with conventional water sources with disseminating the notion on the benefits of the water supply, especially for the hygiene.

In this regard, the water consumption from them for animal watering and kitchen garden water use, etc. should be taken into account the water consumption prediction of the Rural WSS design and take necessary measures to keep the water charge within the affordability of the rural population, for example, to make the financial observation period longer than 15 years which is now applied to the design.

10.4 Operation Hours of the Water Supply System

Since the GIC has to manage the WSS under limited human and financial resources, it is difficult to operate the WSS from early morning to late evening. The Study Team had introduced the theme on the operation hours of the projected WSSs in the second visit of sensitization. The resident consultant company proposed the operation hours to be applied based on the result of the sensitization.

It is quite inflexible, for example, all the service installations will open and close at the same time in most of sub-projects. Minor opinion might be neglected in the proposal. Moreover, there was not any objection to such proposal from CRDA and DGGREE.

The Study Team considers that the operation hours should be flexible for the convenience of the users and therefore proposes to reinforce the discussion on this theme in the future by adding following points:

1) Operation hours in Friday, the day for pray.
2) Can tap keepers have holidays
3) Are the operation period of hours same in summer and in winter
4) Possibility to have different operation hours communal tap by tap

10.5 Location and Number of Service Installations

One communal tap for one locality is applied to the Rural WSS design as if it were the standard, in fact, this conception was applied to the Study regardless of the number of the population in the locality. In case of the pilot sub-projects, the flow rate of the communal tap was modified to meet the water demand of the locality instead of increase the number of communal taps.

The Study Team recommends preparing the standard flow rate of service installations considering the risk of cavitation, the nominal flow of water meter, pressure loss, etc. for the efficient design of WSS. Because, if the flow rate is different by communal taps, the engineer shall have the pressure loss of the service installations one by one.

Once, the standard flow rate of service installations are determined, the maximum number of population borne by one service installation is to be estimated.

Finally number of service installations for a locality should be determined to satisfy the water demand of it. Then location of them is to be studied after the consultation with the beneficiary population, however, rather high place in the locality is preferable for the future development.

The more number of hydraulic installations increases, the more the maintenance cost increase for the rather high rate of it to calculate the maintenance cost. The Study Team recommends that the GIC should fully maintain the service installations and DGGREE is to lower the maintenance cost rate as much as possible so as not to raise the water charge.

10.6 Practical Participation of the Beneficiaries

When a sociologist asked population, for example, who would repair the WSS, most of the answers are “GIC”. It implies that most of the population does not consider to establish and manage GIC by itself. The Study Team is afraid that this indifference to GIC may influence the sustainability of the sub-project.

Raising the population’s sense of the ownership of the WSS by introducing themes relative to its life in the study stage, requesting it to work for the construction works in the construction stage and giving the maintenance work of the communal tap mentioned in the previous clause and other hydraulic installations in the operation stage. Following are detail:

(1) Study stage

Introduction of themes relative to the life of population:

* Operation hours
* UFW and water charge

* How to reduce the UFS
* small repair of the communal tap
* Water charge system
* Timing of water charge payment

(2) Construction stage

There are reportedly less chances for the population to work for the construction work of the sub-projects due to the development of construction apparatuses and equipment. However, participation in the construction work is good occasion to know the system of water supply and also have cash income. It is recommended to give the obligation to the contractors for the works to employ certain number of population.

It might necessitate a criterion in order to assure mentioned above and also the follow-up to be really respected the obligation by the contractors.

It takes for granted that people who participate in the construction works will consider the WSS precious.

(3) Operation stage

The population is requested to take care of hydraulic installations, especially the communal taps and to do the maintenance and repair works in need arise. The maintenance cost rate of the communal tap is reduced instead.

For making it effective, the explanation how much water charge can be reduced should be explained in the sensitization.

Similar to above, how to give the population incentive for having the practical participation in GIC is one of the keys to the sustainability of the sub-project. Once the population becomes aware of the advantage of the participation in GIC, there will be progressive autonomous management of GIC.

From this point of view, the sensitization in the stages of consolidation and maintenance is required to organize training sessions for the small repairs of the communal taps to the key persons of the GIC (the relay persons, for example).

11. FOR BETTER DEVELOPMENT OF THE RURAL WATER SUPPLY PROJECT

This chapter presents the points that the Study Team observed or learned through the Study in two years for better development of the Rural Water Supply Project.

11.1 Review of the Criterion on Sub-project Financial Eligibility

As Table 8.5.4 indicates that the average per capita construction cost of the Northwest hilly region is the highest among three regions and the number of the sub-projects under the Study is the lowest and so do the number of the beneficiary population accordingly, while the water supply coverage in 2001[1] of the four governorates in the said region occupied from the lowest to the fourth among all the governorates in Tunisia.

The topographic conditions of the region and the scarcity of the good water sources may hinder the development of the water supply.

On the other hand, following are the objectives[2] of the RWS Project in Tunisia:

>to increase the rate of water supply in rural area

⇩

>to increase the utilization of water in rural area
>to protect public health
>to improve the standard of living
>to prevent rural exodus

For preventing rural exodus, it is important to decrease the disparity between the regions or governorates and, for this purpose, to give advantage to the sub-projects which are located in deprived area or unfavorable conditioned areas for water supply projects, for example, such sub-projects are able to have a little bit higher construction cost per capita ceiling as one of the criteria to judge their financial eligibility. Rather tight condition is to be given instead to the sub-projects which are located in favorable conditioned regions.

11.2 Preparation of Sub-projects

As presented in Tables 11.2.1 and 11.2.2, the number of localities identified through the Study is 1034 while that described in the sub-project identification cards is only 222. The total length of the centerline survey of the pipeline routes accordingly increased by 62% comparing with the total pipeline length described in the cards.

The contracts on the sub-projects study with the consultant companies are always made based on the initial information of CRDA concerned and the contract amount is fixed except

[1] SAPROF Report for the Rural Water Supply Project (Phase 2), September 2002, p. F-1
[2] Information from the person in charge of the RWS Project in 2000

that of the topographical survey.

The increase the workload mentioned above might discourage to carry out the good study and it accordingly affects the quality of the Study. The tasks of the sensitization seems to be the first victim by the discouragement because it is easy to modify the work program so as to keep the study cost within the contract amount the quality due to the fact that the quality of the sensitization will appear in very late project period.

The RWS project comprise several stages in the realization of it, a party who works in one of the stages shall do its best for parties who will work in the following stages. Though the case of the preparation of the sub-project identification card is noted in here, the consideration of the effective work by the people in charge for the following stages is seemed to be one of the keys to develop the RSW project implementation.

On the other hand, the JBIC Loan budget of the sub-projects under the Rural Water Supply Project (Phase 2) was estimated through the SAPROF Study referring the sub-project identification cards. The Team is afraid of the budget shortage of the sub-projects due to the difference mentioned above.

11.3 Promotion of Beneficiaries' Participation

11.3.1 Some modification of the sensitization manual

The current manual of sensitization is well structured. However, JICA Study Team noticed that, when put into practice, this manual is rather limited to the description of the preliminary sensitization stage which is closely linked with the feasibility study. On the other hand, there is no concrete explanation on the method to follow the sensitization activities in order to practically apply the manual. The sensitization applied to the Study was based on a dynamic approach to the manual from a global view while taking into account the problems observed in similar studies, as presented in 8.1.

11.3.1.1 Enrichment of sensitization manual

The table 11.3.1 presents a summary appraisal of the theoretical and practical aspects of sensitization predicted by the current manual of sensitization and the application to the Study. The following elements of enrichment were introduced:

- The development of an integrated participative approach
- A participative approach is developed in various stages: the identification; the three visits of sensitization carried out through a socio-economic survey as a basis of the structured and methodical sensitization activities
- To encourage the key persons in the community to have more responsibility; actually so do the relay persons who played a positive role as agents of contact and

commitments' collection;

- To use additional diversified techniques of surveys and participative diagnosis for the socio-economic survey by applying the household survey through questionnaires and the tools of the PRA as mentioned in the 7.4 and 8.2;
- The recommended approach, in other words, the combination of questionnaire survey and the tools of the PRA allowed further knowledge of the reality in the field
- Structuring the sensitization themes, particularly by introducing specific themes of sensitization
- Instituting the practice to present the result of the socio-economic survey to the target population during the first visit of the sensitization
- Informing of the results of the detailed survey to the parties concerned, and setting the points on the elements to be targeted in the following stages as stipulated in the clause 7.4.;
- Presenting the projected WSS components to the target population during the first visit of sensitization in order to give them the opportunity to think over their expectations and then to response the suggestions which will be integrated into the optimum preliminary design of the sub-project
- The lists of the beneficiaries has fixed during the second visit of sensitization in the Study in 2005, thus allowing the definitive identification of all the localities to be served by the sub-project
- Topographic survey will begin after the second visit of sensitization in which the optimum preliminary design of the sub-project and all the localities to be served are defined
- The direct involvement of the engineers in the sensitization for a better explanation of: the conception of projected WSS in the first visit, the optimum preliminary design in the second visit, and the results of the feasibility study in the third visit of sensitization. Dialogue among the engineers, the sociologists and the target population was also developed
- Inventory or accumulation of the specific themes of the sensitization identified through all the sub-projects in order to determine the most appropriate ones among them
- Involving the target population in some design aspects of the sub-project: the choice of pipeline routes, water supply method, cost recover method, location and number of service installations, operation hours, and tap keepers

11.3.1.2 Remarks according to the Studies in 2004 and 2005 (Positive points and negative points in the application of the sensitization)

In spite of the enrichment of the sensitization manual, the JICA Study Team noticed some limitations in applying the sensitization manual to the field due to the lack of; the guide in

practice on the one hand and the involvement of relay persons on the other hand.

(1) Involvement of relay persons

As mentioned in the clause 9.1.4, the time granted to the identification was brief grasping the importance of tasks to carry out. The choice of the relay persons was sometimes formal and did not obey objective criteria.

The persons were not introduced to tasks expected from them and were not involved enough in the activities of sensitization as resource and relay persons for the projects.

(2) Involvement of women

In spite of the progress observed in the involvement of women, particularly in the tap keeping and in the membership of the GIC's provisional committee, women were sometimes weakly involved in the sensitization activities and their presence in some meetings was sometimes formal, as analyzed in clause 8.3.

The social objection to women's involvement in community life was not treated by a specific program of the sensitization.

(3) Introduction of communication tools

The communication tools do not vary widely and the informative approach is not enough considered to the extent of the knowledge of the target population, notably informing the numerical data about the water charge, etc. during the third visit.

(4) Organization of sensitization meetings

Importance is given to the general information meetings, whereas the meetings of small groups are insufficiently organized during the second and third visits of sensitization.

(5) Process of data collected through the household survey

As mentioned in clause 9.2.1.1, the data were not processed sufficiently to define the specific themes of sensitization.

(6) Interaction between the various phases of sensitization

The specific themes in the sensitization for consolidation, which will be made during the construction period, were not identified with the population during the third visit.

11.3.2 Better application of the sensitization manual - design of the Practical Guide of the sensitization manual

Designing a practical guide of the sensitization manual is suggested in Appendix 11.3.1 for a better application of the sensitization manual while taking into account the concluded

lessons mentioned in the previous clauses.

11.3.3 Constraints on the sensitization

The application of the suggested practical guide could improve the sensitization activities to a certain extent; however, it is noteworthy that the development of the sensitization is made under a constraint of the capacity of the parties in charge of the sensitization who actually work for the sensitization in the field.

As mentioned in clause 9.1.1, the identification of sub-project area sometimes leads to unfavorable surprise for the consultant company who notices that the tasks shall cover a population much wider than that foreseen initially. The Study Team is afraid that this surprise discourage sociologists to have good fruits of the sensitization.

The traditions of meeting and dialogue in rural settings are not enough developed, therefore, the sociologist finds difficulties in encouraging people to participate in the sensitization meeting and making them understood the concepts of it and responsibility on the OM/M of projected WSS in a short time. The notions of shared responsibility and of taking projects in charge by the rural communities remain abstract concepts that only a few sensitization meetings stand short of familiarizing and taking hold them in people's mind.

The conception of genre is recently developed in rural environment; the traditional roles of men and women in rural society are the product of so many centuries that a lot of patience is needed to make effective introduction of the conception in the rural areas and keep certain balance between roles.

In some areas, particularly in the coastal region, where the SONEDE system is highly developed, the population have more ambitions than those in other rural regions regarding their pursuit of the individual water supply service, which may create a gap between the proposed collective WSS and their own desire in domestic comfort.

11.3.4 Promotion of women's participation

(1) Selection of effective women relay persons

The usefulness of women relay persons was recognized in some cases especially when women enough active and motivated. In this regard, the first contact with the target population to identify such persons and their initiation to responsibilities expected are important. As observed in Clause 8.3.5, impacts on women through the participation in sensitization activities were confirmed to some extent. Though most of them were related with impacts on personal character or consciousness, such impacts are indispensable to raise their awareness as one of users of the projected WSS.

Considering the lack of experience to attend meetings and to take responsibilities at

community level of the majority of women in the rural area, it might be effective to select several women relay persons by locality (e.g. two women relay persons in stead of one) so that they may cooperate each other to make others to participate in the sensitization meetings.

(2) Support of women selected as members of the provisional committee of the GIC

It is considered as an achievement that at least one woman were selected as a member of provisional committee of the GIC of each sub-project under the Study in 2005. It is however necessary to follow up and to support these women continuously in the technical assistance so that they can participate effectively in the activities of GIC and women users' opinions are reflected to the O/M of WSS.

Furthermore, women's participation in the GIC is a crucial factor in the project sustainability, since women will be main users of WSS and they may have a keen awareness of the water-related issues. Meantime, the third (1/3) of the respondents accepts women members of the GIC board of directors. This positive element needs to be consolidated by raising awareness of the target population, and by explaining to men as well as to women that gender roles are not static and that they need to evolve according to the social dynamics.

11.4 Review of Design Methodology

11.4.1 Design consideration on the distribution system by gravity

Usually the service installations such as connection pipe with fittings, a water meter, stop cocks, a tap are distinguished from the distribution system by design method in urban water supply.

The distribution system is generally designed as looped network to make the fluctuation of the dynamic pressure in the system small while the number of houses determine the diameter of service pipe considering the rate of simultaneous use by households and their water demand.

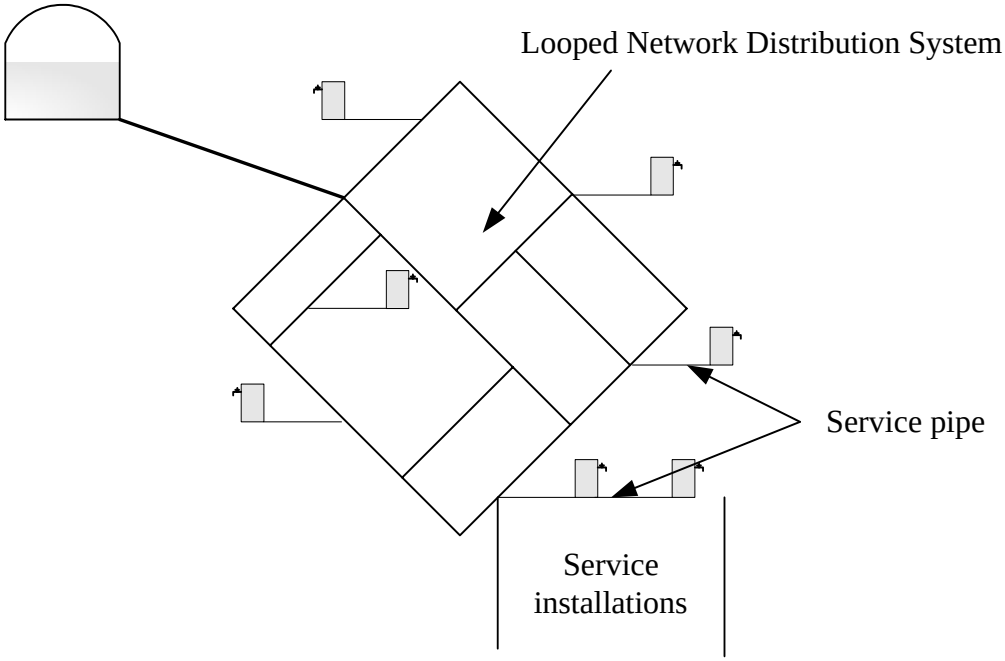
Following mathematical expression presents how to determine the flow rate, i.e. the diameter of the service pipe:

$$Q = (q_1+q_2+\cdots\cdots+q_n) \times p$$

where

Q : Design flow rate of the service pipe at the branching point from distribution pipe
q_i : water demand of a household
p : simultaneous use rate

Figure 11.4.1 Distribution system and service installations



In case of the design of the sub-projects under the Study except pilot sub-projects, if the distribution system is assumed as the distribution tank, it is similar to the design methodology of the service pipe though the simultaneous use rate was not applied.

As discussed in Appendix 9.1.1, “Conceptions on Distribution System and Service Facilities”, there are two types of water supply system, i) the direct type and ii) the receiving tank type.

The design conception applied to the Rural WSS is similar to that of the direct type service system that taps are connected to the distribution pipe directly and the pressure fluctuation of the distribution pipe affects to the flow rate of the taps.

It is preferable to introduce the separate consideration on the distribution system and service system in order to the water supply service more stable. For this purpose, how to stabilize the distribution pressure is important.

Preparing several independent sub-service areas in the service area by constructing small distribution tanks seems to be one of possible solution. Appendix 11.4.1 presents the detail.

There might be other solutions, for example, to extend a distribution pipeline to each sub-service area in which service installations are located on similar elevation.

The water supply engineers are requested to find out every possible ways considering site conditions, financial constraints, above-mentioned, other points mentioned in Appendix 9.1.1, experiences in other similar countries, etc. to realize more stable water supply system.

11.4.2 Review of the presently applied design guidelines

The present design guidelines were prepared in 1994 and it does not meet the needs of the engineers who work for the Rural Water Supply projects due to the technological as well as social development, etc.

Furthermore the Government of Tunisia has been constructing over thousand of Rural WSSs, however, the OM/M data from such WSSs have not been reflected to the guidelines.

Following are points to be reviewed the guidelines:

(1) Particular unit consumption (lpcd for the population)

It is to be reviewed based on the field survey, water demand by scattered population is especially.

(2) UFW rate

It is recommended setting 15% at the first year of the water supply service and it is to be incrementally increased with 1% per year then it will come to 29% at the end year of the financial observation period of the project due to the fact that actual UFW rate of the Rural WSS is 27%[3] in average.

(3) Peak factors

The daily peak factor, which is the ratio between the maximum and average daily water supply, seems to be similar among countries because there is not considerable difference of the maximum temperature between north region and south region.

The peak factors of three regions calculated based on the result of the socio-economic survey are 1.35 for the sea coast region, 1.30 for the Northwest hilly region and 1.29 for the Middle west semi-arid region.

As for the hourly peak factor, which is the ratio between the maximum and average houly water supply, 1.8 is specified in the guidelines, however, there seems to be no available data when it was determined.

It is consequently recommended that the implementing agency should review the peak factors based on the data got through the field survey so as to make the design capacity of the Rural WSS appropriate.

[3] 27% in average of GIC (Summary Report of the situation of the GIC/WSS (2002)

(4) Velocity of pipe inner flow

The velocity of pipe inner flow is specified as from 0.4m/s to 1.2m/s. However, all the CRDAs applied 75mm and over as the minimum outside diameter of the distribution pipeline for supposedly developing private connections. It makes quite difficult to keep the velocity between the specified values due to small water demand of the RWS.

As the practical way, it is recommended specifying the minimum diameter of the distribution system. However, if rather big diameter comparing with the pipe inner flow rate is applied like mentioned above, the velocity might be very small and there is the risk of tuberculation[4]. It necessitates to install the washouts appropriately, especially at the pipe dead end unless a washout is installed near it.

(i) Conveyance and transmission pipeline should be designed based on the maximum daily water supply.
(ii) Distribution pipeline should be designed based on the maximum hourly water supply
(iii) Diameter of distribution branch pipe (BFs connect to this pipe) should be determined according to the number of households that the pipe supplies with water.
(iv) Flow rate of a service installation should be determined based on the maximum hourly water supply to households who use it referring the following tables.

	BP and BF		Potence
Necessary flow rate	=>0.5	<0.5	2.0
Minimum flow rate	0.5	Necessary flow	2.0
Maximum flow rate	0.9	0.9	2.5

If the maximum hourly water supply exceeds the standard flow shown above, another BF is to be added.

Designation of pipe inner velocity can not be practically applied

(5) Capacity of the distribution tank

50% of the maximum daily water supply in the final year of the sub-project period is recommended based on the tank behavior analysis made by the Study in 2005, however, if it is difficult to have sufficient transmission flow rate, the capacity is to be determined through the tank behavior analysis.

(6) Operation period of time (New Article)

Operation period of time of the projected water supply system to be applied to the distribution tank behavior analysis is two hours in both morning and evening which give the analysis the most severe condition.

[4] Knob-like deposits on pipe inner surface by impurities

11.5 Necessity of the Design Guidelines for the Private Connection

The Study Team confirmed that there are strong request for the private connection by the rural population even in the sub-projects area.

Considering the presently applied design conditions, the minimum pressure at the service installation is 1 bar, the estimated water demand per capita is around 50 liters including animal watering, and the minimum flow rate of the smallest diameter of pipeline is 0.5 liter/second (43.2m^3/day) are sufficient to develop the yard connection[5]. The realization of the private connection seems to be possible and to be able to start anytime soon.

However, the introduction of the private connection may associate the increase of the domestic water demand and hourly peak water demand due to increase of number of taps. The hourly peak factor determines the capacity of the distribution system and it is especially relative to the distribution tank capacity.

Most of the sub-projects applied 75mm as the minimum outside diameter to the distribution pipeline. CRDA Sfax, Mahdia, Ariana and Bizerte applied 90mm. The Team takes it for granted that the reason is for the development of the private connections. However, it does not seem to consider the number of households who take water from a BF.

As discussed earlier, presently applied design methodology leads to general WSS conception to construct a distribution tank at high point in a service area and deliver water by gravity through rather big diameter pipe for reducing friction loss head to service installations. As a result of it, the increase of the service installations brings the leap of flow and then it decrease the flow of service installations which are located potentially (topographically) unfavorable service area. In brief, even if the rather big diameter is applied to the distribution pipelines, unless flow allocation to each localities and the potentially disadvantageous localities are taken into consideration, the development of the private connections with similar service level to all users seems to be quite difficult.

It is consequently recommended preparing the design guidelines for the private connection and to incorporate the conception of it into the collective water supply design in order to make the Rural WSS more stable and to make it possible to develop more convenient water supply system in the near future which is the desire of the rural population.

[5] "Private connection" is executed in many cases installing a tap in the garden of houses. It is generally considered that the water consumption of the yard connection is lower than that of the house connection.

12. CONCLUSION

The financial eligibility, which is assessed by the per capita construction cost, as well as the social eligibility, which is judged by the commitment rate to the revolving fund of the beneficiary households, of all the 65 sub-projects to realize the WSS are confirmed through the Basic Study under the Study on the Rural Water Supply Project (Phase II).

The maximum and minimum design capacity of studied 65 WSSs are 314.6m^3/day and 6.5m^3/day respectively. Median is 51.21m^3/day. Needless to say, the capacity is quite small in comparison with that of the urban WSSs. In spite of such small scale, the WSS always requires OM/M cost similar to those of the large scale ones. This OM/M cost reflects to the water charge applied to the sub-projects.

One (1) TD/m^3 has been always considered as the affordability of the rural population in the RWS project, however, four (4) sub-projects exceeds this value. Even the sub-projects of which proposed water charge is less than one (1) TD sometimes request tap keepers to work on the voluntary basis and tap keepers and pump operators with relatively low salary. Even if they agree with such condition now, it does not necessarily assure long basis contribution.

On the other hand, the strong request for the private connection may bring the population dissatisfaction with the collective water supply. It may affects the motivation of the population on the participation in OM/M of the projected WSSs through the GIC.

The parties concerned to the Rural Water Supply Projects in Tunisia are requested to continue the efforts to build the ownership of the projected WSS of the population so as to maintain and reinforce the active participation in the GIC.