

7.4 Project Cost

7.4.1 Project Cost for Water Supply

Project cost is estimated in the following table.

Table 7.4.1 Project Cost

(Nakfa)

Description	Local C.	Foreign C.	Total	Remarks
1. Construction cost				
Borehole	45,009	717,189	762,198	
Well pump	52,802	745,422	798,224	
Transmission pipeline	1,990,949	4,869,427	6,860,376	
Booster pump	3,984	247,994	251,978	
Pump pit	125,531	77,941	203,471	
Reservoir	588,430	242,765	831,195	
Distribution pipeline	3,798,946	2,687,686	6,486,631	
Individual connection	0	0	0	
Communal water point	234,253	89,263	323,516	
Control house	1,197,963	71,506	1,269,469	
Temporary road	1,633,500	0	1,633,500	
Sub total	9,671,366	9,749,193	19,420,560	
2. Engineering fee (10% of 1.)	-	1,942,056	1,942,056	
3. Administration cost (2% of 1.)	388,411	-	388,411	
4. Physical contingencies (10% of 1.+2.+3.)	1,005,978	1,169,125	2,175,103	
Total	11,065,755	12,860,374	23,926,129	
5. Price contingencies (6% p.a.)	1,367,727	1,589,542	2,957,270	
Ground total	12,433,483	14,449,916	26,883,399	

7.4.2 Project Cost for Sanitation

Table 7.4.2 Cost Estimation of Latrines

Description	Year 2005	
School Latrine - PFL	Construction cost	373,628
	Price contingencies	46,180
	Total	419,808
Public Latrine - CFL	Construction cost	323,627
	Price contingencies	96,181
	Total	419,808
Ground total	839,616	

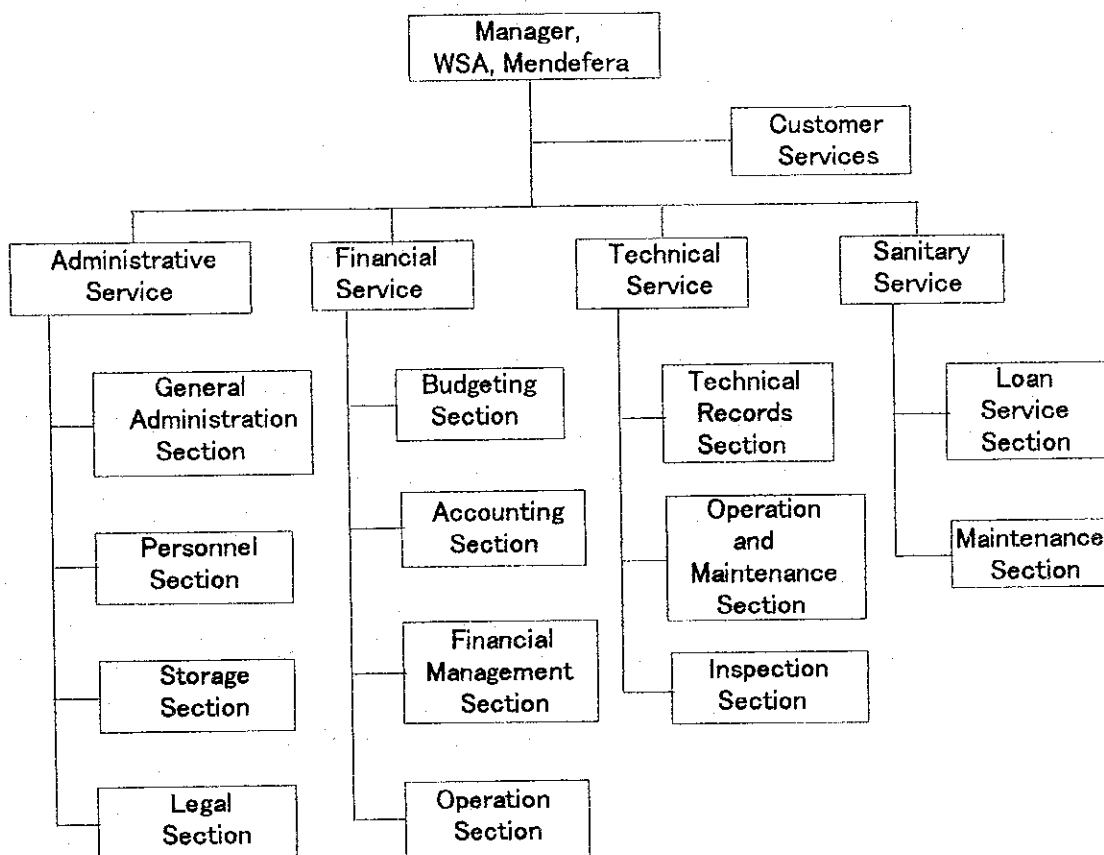
7.5 Sustainability of Water Supply Facilities

7.5.1 Capacity Building for WSA

The success of implementing this water supply project lies on the competency and capability of the manpower of WSA Mendefera particularly in terms of quantity and quality. With this end and view, the functions and number of personnel to be required in the target year of 2005 shall be planned.

The WSA Mendefera aims at supplying clean and safe water in a sustainable and sufficient manner and therefore the WSA personnel should be technically and financially competent.

Figure 7.5.1 Proposed Organizational Set-Up of WSA, Mendefera



WSA Mendefera will consist of Manager, Administrative Service, Customer Services, Financial Service, Technical Service and Sanitary Service.

The Manager will be responsible for the successful management of WSA Mendefera and will represent the WSA in dealing with committees, town municipality and national WSA. The Customer Service will serve as window for communicating with the consumers.

Administration Service comprises 4 sections; namely General Administration, Personnel, Storage and

Legal sections.

General Administration Section takes charge of secretarial/clerical works. Guards and janitors belong to this section. Personnel Section is responsible for recruitment, assignment and training of personnel and remuneration. The national WSA is proposed to be responsible for training of personnel, while the municipal WSA is proposed to re-train or newly train personnel when need arises using its own fund. Storage section takes charge of storekeeping and procurement of materials/supplies. Lastly, the Legal Section is responsible for complaints, lawsuits and penalties.

Financial Service must be filled by competent and sufficient number of experts. This section encompasses budgeting, accounting, financial management and operation. Budget Section prepares the annual and monthly budget of income and expenditures. Accounting Section prepares financial statements based on daily financial transactions. Financial Management Section analyzes and evaluates financial performances. Operation Section takes charge of meter reading, billing and collection, and cash water selling.

The communal water points are to be managed by the communities themselves. Since the study team did not make a proposal in terms of financial and personnel needs, it was assumed that WSA Mendefera would help the communities in the management of the facilities in some manner.

Technical Service must compose of adequate number of staff and must be competence. Technical Service covers Technical Records, Operation and Maintenance and Inspection sections. Records of equipment and supplies such as acquired date, numbers, plans, dimension, breakdowns and repairs are kept in Technical Records Section. Operation and maintenance of pumping stations, reservoirs, pipelines, communal water points are responsibility of this Operation and Maintenance Section. Inspection of the above-mentioned facilities is regularly carried out by Inspection Section.

In addition to the organizations related to water supply, the WSA Mendefera proposes to provide intermediary services for expanding the sanitary facilities as well as sanitation services. Thus, Sanitary Service handles Loan Service and Maintenance sections. Loan Service Section provides loan/subsidy to clients for the installation of septic tank toilets, and keep related records. Maintenance Section will regularly take charge of toilets with a vacuum truck, and regularly cleans and maintains drainages.

The total number of personnel is proposed to be 37 in 2005 (Appendix G, Table-1). It was calculated based on the volume of water to be produced in that year.

7.5.2 O&M Cost

(1) Personnel cost

The number of personnel to be required in the target year of 2005 has been projected based on the volume of water to be produced in that year.

Personnel cost is calculated by multiplying the number of personnel by the average remuneration per employee. The average monthly remuneration in the target year of 2005 is calculated, taking into consideration the current average salaries of the Water Supply Service Office (WSSO), which works out to Nfa 616, and the estimated average yearly growth rate of salaries in real terms, which is 3%.

The estimated number of personnel in 2005 is shown below, and the average remuneration per employee is estimated at Nfa 9,364 at 1997 prices in the same year.

(2) Electricity and fuel cost

All mechanical equipment are operated mainly by electricity. Fuel is also required during emergency. Electricity requirements are calculated based on the volume of water to be produced in 2005.

The electricity cost has been calculated by multiplying electricity requirements in kwh by the unit electricity charge, and by adding 5% of its cost for fuel, in 2005.

The estimated electricity requirements in kwh/day in 2005 are shown below, and the electricity charge per kwh is Nfa 20.16.

(3) Chemical cost

The chemical, hypochlorite or bleaching powder for disinfection to be consumed in 2005 has been projected from the volume of water to be produced in that year.

The chemical cost is calculated by multiplying chemical requirements in kg in 2005 by the unit price of the chemical.

The estimated chemical requirements in 2005 are shown below, and the unit price of the chemical is Nfa 6.5.

(4) Repairing cost

Maintenance and minor repairing works such as replacement of spare parts for pumps and valves, fixing of water leaking locations, checking of water level in the reservoir, etc. are carried out by the staff in the town WSA. Repairing needs are calculated based on the initial cost for mechanical and electrical works as well as on the initial cost for civil works including pipe laying works in 2005.

Repairing cost is estimated at 1% of the initial cost for mechanical and electrical works, and 0.5% of the initial cost for civil works including pipe laying works, in 2005.

(5) Miscellaneous cost

The miscellaneous cost is assumed at 10% of the sum of the preceding four types of costs.

The results of cost calculation are presented below.

(Unit: Nfa)

Item	Year 2005	
1. Personnel Cost	37 persons	346,467
2. Electricity and Fuel Cost	41.10 kwh/day	295,072
3. Chemical Cost	2,610 kg	16,963
4. Repairing Cost	Initial Cost for Pump 1,050,202 Nfa	112,589
	Initial Cost for Others 18,370,357 Nfa	
5. Miscellaneous Cost		77,109
Total		848,201

7.5.3 People's Participation

A key for a successful implementation of water supply/sanitation projects lies in active community involvement. Observed community participation and involvement, as seen from the analysis of the survey, is weak in terms of managing water points, community toilets and overall sanitation activities of the town. People are not encouraged to participate in the management of communal water and sanitation facilities because they take it as part of the Government's/town administration's responsibility.

Another key for a successful implementation of water supply/sanitation projects lies in the active female participation. It appears that female participation is not given adequate attention yet in Mendefera. Therefore, it is necessary to enhance people's participation not only during the execution stage of the project, but most importantly to guarantee their participation in the management and running of the facilities.

To achieve these important project objectives, the following recommendations are forwarded:

- (1) To include a strong component of sensitization and awareness creation program (software) in the project by employing a community agent, organizer and/or adviser during the execution and post execution of the project.
- (2) The need for the continuous and active involvement of beneficiaries should be secured by establishing strong water and sanitation committees who will be assisted by the community agents or organizers mentioned in 1 above.
- (3) Introduce and develop a viable management system for water and sanitation facilities that will be managed by the communities.
- (4) Education and training need to be an in-built system of any program that seeks the active involvement of communities in project planning, implementation and management.

7.5.4 Community Based Management

To lay a solid foundation for community based management in Mendefera during the first phase of the

project, the following recommendations are forwarded:

- (1) Communities must actually own the improved water points, with all that such ownership entails. In addition, such ownership and management should eventually incorporate unimproved water points and water sources into the system.
- (2) If community based management is to function in a sustainable manner, both hardware and software components need to be given equal attention. The complexity of the software tasks should not be underestimated nor the amount of time it takes.
- (3) Failure should be recognized to be part of the process; and if there is failure somewhere in the line, it should be considered part of the learning curve in the water and sanitation sector.
- (4) In community based management, activities should be focused specifically on building self-reliance, self-confidence, and technical and management skills, and helping to solve problems in such a way that water and sanitation facilities are effectively managed locally.
- (5) Frequent participatory appraisal techniques need to supplement committee meetings/contacts with opinion leaders, in the consideration for improvement of software delivery.
- (6) Within the context of affordability, service delivery agents need to recognize that communities are consumers and would like to maximize the returns from the money they pay for the service required.
- (7) The sustainability of community based management for water supply and sanitation facilities may require software interventions up to five year period with multiple visits and strengthening activities taking place over this period. The final measuring rod for empowerment of the community will therefore lie in the commitment of software fund over time, and not simply at the initial stages of service delivery.

7.5.5 Training Plans

Decentralization or regionalization coupled with capacity building is presently a main issue in the world. This trend comes from the bitter experiences accumulated in the past. It has often been the case that expensive and impressive facilities were constructed by the government under loan agreement with an external agency or government without any consultation with the people who were supposedly the beneficiaries, nor with any solid and comprehensive planning over sustainable operation and management of those facilities. The results were disastrous: the government suffering from a mountain of debt and the facilities left to rust having no operating/maintaining personnel and having scanty number of users. These dismal pictures of failures have been repeated many times.

From the above background, one major factor for a successful operation and management of water supply facilities is to have a sufficient number of competent personnel for the town WSA. Especially, such personnel as financial, technical/engineering and legal experts occupy a crucial position in evaluating the overall manpower strength of a WSA.

Training/education of those experts deems to be an essential and urgent matter. It is thus proposed by the study team that a training center be established under the National WSA to meet the requirements of

such experts in the seven towns with the target year set at 2005.

The total training need of experts for WSA's in the seven towns is as follows.

Item	Debar.	Mende.	Adiqu.	Dekem.	Segen.	Adi Ke.	Senaf.
1. Financial/Economic Experts							
Financial Service Head	-	-	1	1	1	-	-
Auditors	-	-	-	-	-	-	-
Budgeting Experts	-	-	-	1	-	-	1
Accountants	1	1	1	1	-	1	1
Financial Analysts	-	1	1	1	-	1	1
Sub-Total	1	2	3	4	1	2	3
2. Technical/Engineering Experts							
Technical Service Head	-	1	1	1	1	1	1
Mechanics	1	1	1	1	-	1	1
Electricians	-	-	-	1	-	-	-
Motor Operators	-	2	1	1	1	2	2
Plumbers	2	-	-	1	1	1	1
Water Meter Technicians	-	-	-	1	-	-	1
Leakage Detectors	-	-	-	-	-	-	-
Water Quality Analysts	-	-	-	-	-	-	-
Designers/Draftsmen	-	-	-	-	-	-	-
Sanitary Technicians/Engineers	-	1	1	1	-	1	1
Sub-Total	3	5	4	7	3	6	7
3. Legal Experts							
Lawyers	-	1	-	1	-	1	-
Contract Experts	-	-	-	-	-	-	-
Sub-Total	-	1	-	1	-	1	-
Total	4	8	7	12	4	9	10

From the above table, there is an urgent need to train 54 experts in total, composed of 16 financial experts, 35 technical/engineering experts and 3 legal experts. Out of them, 2 financial experts, 5 technical experts and 1 legal expert are needed for WSA Mendefera.

Also, on-the-job training of technical experts using the operation manual is essential to elevate their skill as well as to enrich their experience.

7.6 Financial Plan

7.6.1 Willingness-to-Pay

According to the socio-economic survey, the average willingness-to-pay for water came to Nfa 11.7 in monthly amount and 1.5% as the percentage of income. (Refer to the table below.)

Income group wise, the average willingness-to-pay is Nfa 9.0, Nfa 11.8 and Nfa 16.8 in monthly amount in the low, middle and high income groups respectively, while it is 2.4%, 1.5% and 1.1% as the percentage of income in the respective groups.

The table shows that the richer you are, the more you are willing to pay for water. However, it is noticed that there is not so much difference in the willingness to pay in monthly amount as in the size of income between groups. Based on these results, the richer you are the less you are willing to pay for water in terms of the percentage of your income.

Item	Low Income	Middle Income	High Income	Total
1. Average Monthly Income, 1997 (Nfa)	369	769	1,565	774
2. Share (%)	41.8	36.6	21.6	100.0
3. Willingness to Pay for Water (Nfa/m)	9.0	11.8	16.8	11.7
4. Willingness to Pay for Water (%)	2.4	1.5	1.1	1.5

7.6.2 Water Tariff Analysis

The general concept of the water tariff is referred in item 6.8.2 above.

After subsequent mathematical model simulations to attain financial viability and stability for WSA Mendefera and at the same time to fulfill social justice, the study team came up with the proposal for water prices in 2005 as detailed in Table 7.6.1.

The shares and lcd for the three types of water facility users in 2005 were previously determined based on the current water supply and other conditions in Mendefera, which were clarified as a result of the socio-economic survey. The monthly income by type of users was projected based on the existing economic conditions, made clear by the socio-economic survey. In doing so, the annual average growth rate of income in real terms was assumed as 3%.

It is proposed that the water price per cubic meter will be Nfa 9, Nfa 6 and Nfa 2 for house connection, yard connection and communal water point users respectively in the target of 2005.

Then, the monthly payment for water will be Nfa 52, Nfa 21 and Nfa 4 for house connection, yard connection and communal water point users respectively. In terms of the percentage of income, it will be 3%, 2.4% and 0.7% for the respective users.

Table 7.6.1 Payment for Water by Service Mode -Mendefera-

(Unit: Nfa)

Year	House Connection		Yard Connection		Communal Water Point		Total	
	Income/m	Share (%)	Income/m	Share (%)	Income/m	Share (%)	Income/m	Share (%)
2000	1,592	25	840	30	434	45	845	100
2005	1,726	29	874	33	503	38	980	100

(Unit: Nfa)

Year	House Connection		Yard Connection		Communal Water Point	
	lcd	Price/cm	lcd	Price/cm	lcd	Price/cm
2000	30	9	20	6	15	2
2005	35	9	22	6	15	2

(Unit: Nfa)

Year	House Connection		Yard Connection		Communal Water Point	
	Payment/m	Payment %	Payment/m	Payment %	Payment/m	Payment %
2000	44	2.7	19	2.2	4	0.9
2005	52	3	21	2.4	4	0.7

Then, the affordability of low income group (less than 600 Nfa of monthly income) which is the user of communal water points is examined in detail. The group is further divided into four levels based on the income, and the ratio of monthly water tariff to the income is calculated, as shown in the table below.

The table indicates the share (percentage) of monthly expenditure for water to the monthly income, for every income level, is less than their willingness to pay. Further, the ratio of tariff/income is thoroughly less than 4% which is the recommended limit by World Bank. Thus, the proposed water tariff for communal water points (2.0 Nfa/m³), which are mostly utilized by the low income group, shall be reasonable.

Table 7.6.2 Payment for Water as Percentage of Income (Low Income group)

Household Income (Nfa/M)	Payment for Water as Percentage of Income (%)	Willing ness to Pay as % of Income
0-199	2.7	5.0
200-299	1.6	3.4
300-399	1.1	2.5
400-599	0.8	2.1

7.6.3 Revenue Estimation

The revenue sources of WSA Mendefera are water charge, technical service charge, meter rent and miscellaneous revenues.

Water charge is the central revenue source. It is collected from the house connection, yard connection and communal water point users. House connection users include commercial, industrial and institutional clients. The revenue from water charge has been estimated based on proposed water tariffs, future lcd, family size, population projection, future water demand and bill collection efficiency.

The second revenue source is the technical service charge. When WSA Mendefera installs an individual connection for a customer, this technical service charge will be collected in addition to the material cost. It is calculated at Nfa 378 on average. The number of individual connections to be installed is estimated at 2,593 in the target year of 2005.

The third revenue source is the revenue from meter rent. The rental fee is assumed to be Nfa 1 per month per individual connection.

The last revenue source is miscellaneous revenues such as those from the sale of materials, fines, etc. They were not taken into account because they are of an irregular and unpredictable nature on one hand, and not substantial in amount on the other hand.

The revenue deriving from the above-mentioned sources must be sufficient and stable enough to sustain the management of WSA Mendefera in the years to come.

Taking all the above-mentioned into consideration, the future revenue of the WSA is estimated as follows:

(Unit: Nfa thousand)

Year	2001	2002	2003	2004	2005	2006
Revenue	1,386	1,504	1,637	1,786	1,954	1,752

7.6.4 Cost Analysis

(1) Initial cost

Initial cost is composed of construction cost, engineering fee, administration cost and physical contingency. Each of the above-mentioned cost was divided into local and foreign components.

Construction cost was classified into the cost for pumps and other facilities because of the difference in depreciation period between the two categories. The depreciation period is assumed to be 15 years for the pumps and 50 years for other facilities.

Engineering fee, which belongs to foreign components is assumed to be 10% of construction cost, while administration cost, which is usually composed of local currency is estimated at 2% of construction cost. Finally, 10% was added to the sum total of the above-mentioned cost as physical contingency.

Initial cost is estimated at Nfa 23,926 thousand at 1997 prices for the works for the target year of 2005. (Refer to the table below.)

- Year 2005

(Unit: Nfa thousand)

Item	Local Components	Foreign Components	Total
1. Construction Cost			
Pumps	57	993	1,050
Other Facilities	9,614	8,756	18,370
Sub-Total	9,671	9,749	19,420
2. Engineering Fee	-	1,942	1,942
3. Administration Cost	388	-	388
4. Physical Contingency	1,007	1,169	2,176
Total	11,066	12,860	23,926

(2) Implementation schedule

Implementation of the works is scheduled as follows. In the two year works, the first year will be for detail design and the second year for construction as shown below.

1999	2000	2001	2002	2003	2004	2005

(3) O&M cost

Operation and maintenance cost to be incurred annually after the completion of the works is estimated at Nfa 848 thousand.

7.6.5 Projection of Financial Statement

In preparing projected financial statements based on the estimated revenue and cost as explained in sections 7.6.3 and 7.6.4, it was assumed that:

- (1) Initial cost will be totally subsidized by the government, i.e., the people of the town will not be obliged to repay the initial cost.
- (2) The people of the town will shoulder the replacement cost of all facilities.
- (3) No tax will be imposed on the profit from water supply operations.
- (4) Project life will be 20 years from the start of the implementation of the works.

The resultant financial statements including income statement, funds statement and balance sheet are shown in Appendix G, Table-4.

Revenue to Cost Ratio	Cash to Revenue Ratio	Profit to Assets Ratio
124.5%	47.0%	1.2%

As the above table shows, WSA Mendefera will be financially successful and have a stable management in the years to come, if all the conditions mentioned in the preceding sections concerned are met.

7.7 Project Evaluation

7.7.1 Economic Evaluation

(1) Benefits of water

Implementation of the Project will provide a reasonable amount of clean and safe water to the wide ranges of the people of the town. It means that women, girls and boys will be free from the daily water fetching drudgery works. Also, the incidence of water-related diseases such as diarrhea, dysentery, parasitic diseases and skin diseases will be drastically reduced, whereby contributing to the improvement of the health of the people in general.

These economic benefits can be considered to be reflected in the prices of water. Currently, the prices of water in the town is institutionally fixed, ranging from Nfa 1.5 to Nfa 6.25 per cubic meter depending on service modes. Such water prices only partially represents the economic benefits of water, but not fully due to institutional consideration. The economic benefits of water can be regarded to be fully reflected in the prices of the water bought from water vendors. In Debarwa, where the scarcity of piped water is the most severe among the seven towns, water prices from water vendors range Nfa 16 to Nfa 40 per cubic meter according to the socio-economic survey.

The economic benefits of piped water is assumed as Nfa 20 per cubic meter.

(2) Future lcd and population in the without project case

The lcd or the per capita per day piped water consumption in liters under the existing circumstances in the seven towns is calculated at 10.3 on average based on the results of the socio-economic survey. The value is 74% of 13.9, which is an lcd including water from shallow wells, rivers/springs and rain.

In the "without project" case, it is assumed that the lcd will continue to be 10.3 throughout the project life period.

If the Project is not implemented, it is expected that the population of the town will not grow as fast as envisaged in the "with project" case due to constraints in water supply.

In the "without project" case, it is assumed that the growth rate of population will go down to a half of the rate foreseen in the "with project" case.

(3) Other conditions/assumptions

In performing economic analysis, the following conditions/assumptions were presupposed besides the

above ones.

- a) Project life:..... 20 years from the start of the works
- b) Opportunity cost of capital:..... 10%
- c) Cost and implementation schedule:..... (see 7.6.4.)
- d) Standard conversion factor: 0.9, to be applied to local components of initial cost

(4) Results of economic analysis

Cost benefit streams were prepared based on all the above-mentioned conditions and assumptions, as shown in Appendix G, Table-5.

Using the streams, economic analysis of the Project was carried out, producing the economic criteria as shown in the following table.

Economic Criteria	NPV (Nfa thousand)	B/C	EIRR (%)
Value	-1,046	0.95	9.3

The table shows that the EIRR of the Project is 9.3%, which is slightly below 10% or the assumed opportunity cost of capital (OCC). However, the value can be regarded as a reasonable one, considering the social nature of the Project.

(5) Sensitivity analysis

Sensitivity analysis was performed to determine how EIRR will change if cost overrun of 20% happens or if the cost overrun of 20% and the 10% decrease of benefits simultaneously occur. The results are shown below.

EIRR (%)

Case	Base Case	Case 1	Case 2
Conditions	-	Capital Cost: +20% O & M Cost: +20%	Capital Cost: +20% O & M Cost: +20% Benefits: -10%
Value	9.3	6.7	3.3

The table shows that the EIRR stays considerably above the discount rate of zero even under the unfavorable situation of Case 1, and still stays above zero even under the severest assumption of Case 2.

7.7.2 Financial Evaluation

As a result of the evaluation of the Project, the financial internal rate of return (FIRR) cannot be calculated due to the peculiar state of cost benefit streams, characterized by the absence of initial cost in the cost stream.

This financial evaluation was done only for the projected financial statements.

The projected financial statements as shown in Appendix G, Table-4 are summarized in the management indice tabulated below.

(Unit: %)

Management Indice	Revenue to Cost Ratio	Profit Rate	Working Capital to Revenue Ratio	Profit to Total Assets Ratio
Formula	Revenue / Cost x 100	Profit / Revenue x 100	Working Capital / Revenue x 100	Profit / Total Assets x 100
Value	124.5	19.3	47.0	1.2

The table shows that WSA Mendefera will have a substantial extent of profit enough to cushion unpredictable financial turbulences, a thick reserve of working capital to prepare for replacement of facilities and a nominal profit to the assets invested in the years to come.

A trial simulation on FIRR, under the conditions that the initial cost is to be borne by the beneficiaries and the water tariff is to be twice of the proposed one, was conducted as a reference. The result indicated only 7.9% of FIRR under the conditions, which is less than the discount rate of 10%. It means the water tariff must be more than twice of the proposed one to achieve the discount rate of 10%, and it deems to be too heavy burden for the beneficiaries to bear.

7.7.3 Organizational Evaluation

- (1) The skeletal administrative/organizational structures of the PMU and WSA will enable the smooth execution of the first phase of the project and indeed its management latter on. The functions as well as structures will, of course, get more diversified throughout the rest of the Development Program Period as water demand increases and there is more water production.
- (2) The ultimate organizational structure that will be realized in the year 2005 for Mendefera WSA is elucidated in section 7.5.1, and the management of communal water points and toilets will be comprehensive in that it tries to involve all the possible actors or beneficiaries in the town.
- (3) In case of Mendefera WSA, there will be the Town's Water and Sanitation Committee that will also act as the board of WSA. It will have wide powers and responsibilities especially in seeing the efficient management of communal water points and toilets. It can change the members and composition of CWPC and CTC. It will also approve and supervise all planned activities and achievements of the manager of WSA.
- (4) The manager of Mendefera WSA has wide responsibilities and challenges to meet. He will be greatly assisted by the Board and of course the national WSA in all his efforts in managing the office and run the water and sanitation facilities to the satisfaction of the residents. He will have more and better qualified staff.
- (5) The existence of a separate unit in Mendefera WSA charged with sanitation issues will greatly improve the town's sanitation. It is expected that there will be easy access to credit facilities to construct latrines for those who should afford.

7.7.4 Technological Evaluation

The proposed water supply system is composed of relatively simple facilities, those of which are not quite different from the existing ones. Main materials for the project, such as PVC pipe for casing and screen, submersible pump for well pump, ductile cast iron pipe for transmission pipeline and PVC pipe for distribution pipeline, are recently very common in Eritrea. There are a few agents of these materials in Asmara. Although a new material made of fiberglass reinforced plastic is to be introduced for elevated tank, the light material could facilitate the construction work very smoothly. The material is also expected to have a long life span comparing with other conventional materials, thus the long run cost could be reduced for the reservoir.

The construction works are carried out by manual labor at present. Soil features are sometimes fresh rock, and topographical configurations are various and steep. Moreover, the lengths of transmission and distribution pipelines are so long. Therefore, use of construction machinery is recommended to minimize the construction period. Also, the construction works by machinery will be useful and popular in future in Eritrea.

Under the project, several numbers of boreholes are newly required. Their locations are distant from the town and/or distant each other, or sometimes away from others. Therefore, mobilization of these well pumps and boosting pumps is required for periodical or daily operation. In this regard, transportation shall be strengthened by means of vehicle or motorbike.

7.7.5 Social and WID Evaluation

- (1) Both newly constructed and existing communal water points will be managed by the community, 50 percent of whom will be women.
- (2) In order to strengthen good community management in both communal water points and health/sanitation areas, community organizers will be made available by the PMU. Well managed community water and sanitation facilities are expected to minimize current community' frustration with opening hours, breakdowns and repairs, water tariff, etc.
- (3) The community is expected to be financially self-sufficient and will be vested with decision making powers in financial and technical terms as well as personnel.
- (4) The Value-added Related to WID are as follows:
 - The project should result in the shift in the quality of life of all social groups from a lower level to a higher level. It will make Mendefera a more pleasant place to live and will attract house builders, especially from Asmara who wish to commute to Mendefera, thus relieving the demand for land and houses in Asmara.
 - By improving the piped water supply in Mendefera, the intended benefits will include the significant reduction of time and energy spent in the collection of water, for men, women, boys and girls. This will allow, almost every one in Mendefera to have more time for other activities including more leisure time, income generating activities and improved sanitary behaviors. More specifically, it will allow the girl learners and boys to have more time for studying.
 - The construction of latrines and public toilets, will enable women and girls to have more privacy than

they have had in the past for urination, defecation and menstruation. Additionally, improved latrine facilities will benefit all residents of the town, as the bad smell will be substantially reduced.

- The project will allow the community to have a say in the determination of the location and design of the facilities in Mendefera, thereby increasing their sense of empowerment in matters that directly concern them. In addition, it is expected that the project will generate employment opportunities some of which are likely to be for a long term.

7.8 Project Implementation Plan

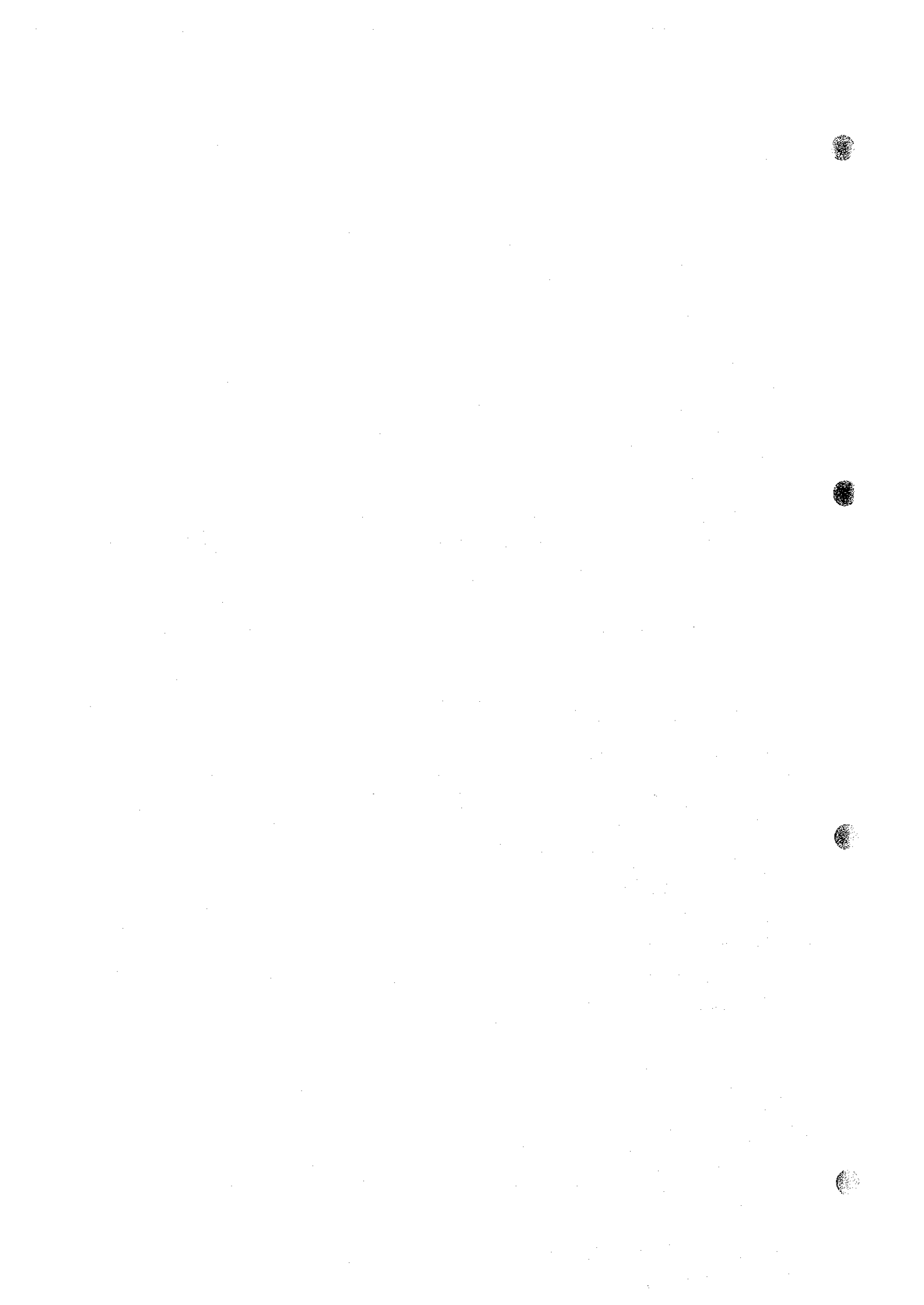
Major works of this project are borehole drilling work, pipe laying work, civil works, mechanical and electrical works, etc. Construction works for the distribution facilities (the reservoir and distribution pipeline) and service facilities (individual connections and communal water points) can be carried out anytime after obtaining work permission. However, borehole drilling, construction of transmission facility and installation of pump are better to be implemented after checking and finding the exact location of well.

Although the existing water supply facilities are obsolete and insufficient, they are kept working during the construction period. Therefore, it shall be careful not to damage the existing water supply facilities during the period.

Implementation schedule is divided into two stages, namely, a) preparation of finance including the foreign currency portion and detail of design together with tender documents, and b) implementation of the project.

Figure 7.8.1 Implementation Schedule

Work Item	Year 1999	Year 2000
Stage I Preparation		
(1) Preparatory Work and Detail Design	████████████████████	
Stage II Construction		
(1) Borehole, Pump and Control house	██████████	
(2) Transmission Pipeline		██████████
(3) Reservoir		██████████
(4) Distribution Pipeline		████████████████████
(5) Communal Water Point		██████████
(6) Temporary Road	██████████	



CHAPTER 8 CONCLUSION AND RECOMMENDATION

8.1 Conclusion

The project of Groundwater Development and Water Supply for Seven Towns in Southern Region is concluded as follows:

8.1.1 Field Survey

- (1) Through the reconnaissance of the town and work shops held in the town, the current poor water supply and sanitary conditions, people's eagerness for water supply development, and inhabitants' well understanding on the importance of sanitary condition were recognized.
- (2) A series of hydrogeological investigation grasped the hydrogeological property of the area and selected out 2 test and 2 observation wells drilling point. MEN-1, thus drilled, indicated fair yield of around 2 lit/sec. An automatic water level recorder has been installed in observation wells and a test well, and the groundwater monitoring is still continued.
- (3) A hydro-meteorological survey collected existing data and set a rain-gauge at each target town, two staff gauges along the Mereb, and a staff gauge at two surface dams. Observations through those gauges are still under way.
- (4) A series of socio-economic survey revealed the actual life-level and willingness of the inhabitants, such as occupation, house income, current water supply means and volume of water consumed willingness to pay, and so forth.

8.1.2 Formulation of Development Plans

- (1) The project for water resources development, water supply and sanitation improvement was formulated as phased plans with horizons of 2005, 2010, and 2015. Water resources development was focused on groundwater, and a domestic water supply was given priority.
- (2) Future population of Mendefera is projected to be 32450, 41630, and 52830 at each target year respectively. While, a domestic water consumption rate is estimated at 23.1, 29.4, and 34.8 l/c/d for the same respective years. Based on those figures, as well as the consideration on the other water uses, extension of service area, etc., the water demand is calculated to be 1001, 2283, and 3761 m³/day for each target year.
- (3) Groundwater development potential around Mendefera is limited because of the major aquifer property. Groundwater in this basin can hardly cover the water demand of 2010 but 2015. To cover the water demand in 2015, a surface water development, of the main Mereb, shall be required.
- (4) Mereb-5 was selected as a proposed damsite. The dam shall have 25.0 MCM of reservoir capacity against 665,000 m³ of embankment volume. Construction cost was estimated as 21.0 million USD.
- (5) Planned water supply facilities comprise of exiting and new boreholes, reservoir tanks, transmission pipelines with max. diameter of 150 mm, distribution pipelines with max. diameter of 200 mm,

booster pumps and pump pits, control houses, etc.

- (6) Planned sanitary facilities are public latrines and school latrines. Besides, sanitation improvement plans such as wastewater and storm water drainage, refused disposal, etc., as well as the educational program on sanitation, were studied and recommended.
- (7) Institutional strengthening plans on MoLWE, MoLG, MoH, WSA, local WSAs and some other local agencies were studied and several recommendations were presented.
- (8) Project costs on water supply and sanitation facilities were estimated as follows:

Target year	Water supply	Sanitation	Total
2005	26,883,400	839,600	27,723,000 Nfa
2010	43,899,700	224,700	43,924,400 Nfa
2015	130,706,500	300,700	131,007,200 Nfa

- (9) O&M cost for the facilities were estimated to be 848200, 2151700, and 4393000 Nfa for the target years of 2005, 2010, and 2015 respectively.
- (10) Through the financial analysis, water tariffs of 9.0 – 12.0 Nfa for house connection, 6 - 9 Nfa for yard connection, and 2 Nfa for communal water points were proposed.
- (11) Economic evaluation figured out –18,825 thousand Nfa of NPV, 0.75 of B/C, and 6.2% of EIRR, lower than OCC but it may be tolerable considering the social nature of the Project. Sensitive analysis indicated the EIRR stays above the discount rate of zero even under the unfavorable situation.
- (12) While, financial evaluation suggested a reasonable extent of profit to make a provision for unpredictable financial turbulence, a thick reverse of working capital to prepare for replacement of facilities and nominal profit to the assets invest in the years to come.
- (13) The project was, thus, tolerable for economic and financial evaluation, and withstanding for organizational, technological, social and WID, and environmental evaluations.
- (14) Project implementation plan is formulated as follows: from 1999 for the first, from 2003 for the second, and from 2008 for the third phase implementation. Each phase shall have around one year of preparatory work period and following one year of actual implementation period.

8.1.3 Feasibility Study

- (1) Project feasibility was studied for the priority projects targeting the year of 2005.
- (2) The first phase implementation for the priority projects is feasible on the condition that the initial cost will be subsidized by the government, and to be promoted by the Ministry of Local Government with appropriate foreign assistance.
- (3) Projected water demand in 2005 is 1,001 m³/day. To cover the demand, two new boreholes shall be drilled as additional water sources besides the existing BH-4, BH-5 and MEN-1.

- (4) Designed facilities to be constructed under the Project are well pumps, transmission pipeline, booster pump and pumping pits, reservoir, distribution pipeline, communal water points, temporary access roads, control houses, school latrines, and public latrines.
- (5) Project cost for water supply is estimated at 26,883,400 Nfa, while for sanitation 839,600 Nfa. The O&M cost for the first phase is estimated to be 848,200 Nfa.
- (6) For smooth implementation and effective O&M of the facilities, a capacity building of local WSA as well as the establishment of local sanitary committees, is required.
- (7) Water tariff to be applied under the Project is estimated at 9, 6, and 2 Nfa/m³ for house connection, yard connection, and communal water points users, respectively. Revenue estimation based on the tariff suggested sufficient sound management of WSA.
- (8) Cost benefit streams analyzed were -1,046 thousand Nfa of NPV, 0.95 of B/C, and 9.3% of EIRR, slightly below OCC but tolerable from its social nature. Sensitive analysis figured out that EIRR stays considerably above the discount rate even under the unfavorable situation.
- (9) Financial evaluation figured out 124.5% of revenue to cost ratio, 19.3% of profit rate, 47.0% of working capital to revenue ratio, and 1.2% of profit to total assets ratio. The figures show the WSA will have a reasonable profit, a thick reserve of working capital, and a nominal profit to assets invested in the year to come.
- (10) The Project is tolerable for organizational, technological, social and WID aspects evaluations.
- (11) Implementation schedule is to be divided into two stages: a preparatory stage and an construction stage.
- (12) The Project is, thus, feasible.

8.2 Recommendation

- (1) The Government of Eritrea is recommended to consider financing of the Project of Groundwater Development and Water Supply for Seven Towns in Southern Region to implement the first phase of the phased plans targeting 2005.
- (2) Institutional strengthening of RAD of MoLG, WD of MoLWE, EHU of MoH are quite important, not only for the Project but also for all other national development programs.
- (3) Smooth and complete establishments of WSA both of national and local levels, as well as the associated local committees based on autonomous management, are highly recommended.
- (4) PMU of the Project, under RAD of MoLG, shall be established as soon as possible.
- (5) Establishment of a training center under the national level WSA, for financial, technical, and legal personnel of local WSA, is recommended.
- (6) The concept of community based management and people's participation shall be taken into the

consideration throughout the project implementation and O&M after construction.

- (7) Besides the provision of public/school latrines under the Project, provision of on-site drainage system for sewerage, and refuse truck/containers for refuse disposal, are recommended.
- (8) Educational program is also of vital importance for sanitation improvement, against the construction of sanitary facilities. Thus, carrying out this educational program formulated under the Project is recommended.
- (9) Monitoring of groundwater, observation of rainfall, and measuring of river runoff are essential for the Project and for future water resources development programs. To continue those measurement is highly recommended.

APPENDICES

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A. Scope of Work

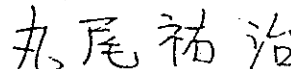
SCOPE OF WORK
FOR
THE STUDY
ON
GROUNDWATER DEVELOPMENT AND WATER SUPPLY
FOR
THE SEVEN TOWNS IN SOUTHERN REGION
OF
ERITREA

AGREED UPON BETWEEN
THE MINISTRY OF LAND, WATER AND ENVIRONMENT
AND
THE JAPAN INTERNATIONAL COOPERATION AGENCY

Asmara, April 22, 1997



TESFAI GHERMAZIEN, Ph.D.
Minister for Land, Water and Environment



Dr. Yuji MARUO
Leader of the Preparatory Study Team,
Japan International Cooperation
Agency (JICA)

I . INTRODUCTION

In response to the official request of the Government of State of Eritrea (hereinafter referred to as "the Government of Eritrea"), the Government of Japan decided to conduct a Study on Groundwater Development and Water Supply for the Seven Towns in Southern Region of Eritrea (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of Eritrea.

The present document sets forth the Scope of Work for the Study.

II . OBJECTIVES OF THE STUDY

The objectives of the Study are:

- (1) to evaluate potential of water resources, focusing on groundwater
- (2) to formulate a development plan for water supply and sanitation
- (3) to conduct feasibility study for water supply project
- (4) to pursue technology transfer to counterpart personnel in the course of the Study.

III . STUDY AREA

The Study will cover following 7 towns in Southern Region.

- Adiquala, Segeneiti, Adi Keyih, Senafe, Mendefera, Dekemhare, Debarwa

IV . SCOPE OF THE STUDY

Stage I: Data Collection and Evaluation of Present Condition

1. Collection, review and analysis of related data and information
 - a. social and economic conditions
 - b. natural conditions (topographical maps, hydrogeological maps, meteorological data, hydrological data, geological data, aerial photo, etc.)
 - c. other projects relevant to the Study
 - d. existing well data and existing water supply services
 - e. sanitary conditions
 - f. present conditions and policies related to "Women in Development (WID)"
 - g. laws, regulations and policies on water resource development, water supply and sanitation
 - h. other relevant data and information
2. Topographic surveying
3. Diagnostic survey of existing water supply facilities
4. Water quality analysis for existing water supply facilities

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5. Survey on actual conditions of seven towns
 - a. condition of water use and sanitation
 - b. social and economic aspects
 - c. people's awareness on health and hygiene and their willingness to pay for better water supply services
 - d. cultures and habits on water supply and sanitation
 - e. women's social situation
6. Initial Environmental Evaluation (IEE)

Stage II: Water Resources Potential Survey

1. Field reconnaissance
 - a. topographical and geological investigation
 - b. rivers and springs
 - c. hydrogeological investigation
2. Preparation of inventory of existing wells
3. Geophysical exploration
4. Test well construction, well logging, pumping test and water quality analysis
5. Leveling survey for observation wells
6. Observation of groundwater level
7. Observation of river flow and water quality analysis
8. Water balance analysis and preparation of hydrogeological map
9. Evaluation of water resources potential

Stage III: Development Plan for Water Supply and Sanitation

1. Water demand projection and confirmation of planning framework
2. Formulation of water sources development plan
3. Formulation of water supply facility plan
4. Formulation of operation and maintenance plan and institutional development plan
5. Sanitation development plan
6. Cost Estimation
7. Evaluation
 - a. socio-economic evaluation
 - b. institutional and technical evaluation

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- c. environmental impact
- 8. Formulation of implementation program
- 9. Selection of projects for feasibility study

Stage IV: Feasibility Study on Development Projects

- 1. Supplementary investigation
- 2. Water demand projection and confirmation of planning framework
- 3. Formulation of groundwater development plan
- 4. Formulation of water supply facility plan
- 5. Preliminary design of facilities
- 6. Cost Estimation
- 7. Formulation of operation and maintenance plan and institutional development plan
- 8. Evaluation
 - a. financial plan and evaluation
 - b. institutional and technical evaluation
 - c. socio-economic evaluation
 - d. environmental impact assessment (EIA)
- 9. Formulation of implementation program

V. SCHEDULE OF THE STUDY

The Study will be carried out in accordance with the tentative schedule as attached in the appendix. The schedule is tentative and subject to modification if such necessity should arise during the course of the Study and mutually agreed to by both parties.

VI. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Eritrea.

1. Inception Report:

Ten(10) copies at the commencement of the first work period in Eritrea. This report will contain the schedule and methodology of the Study as well as outline of the field survey.

2. Progress Report :

Ten (10) copies about three(3) months after the commencement of the first work period in

MAM

T.G

Eritrea.

3. Interim Report:

Ten (10) copies at the end of the first work period in Eritrea. This report will summarize the findings of the first field survey.

4. Draft Final Report:

Ten (10) copies at the third work period in Eritrea. The Government of Eritrea shall submit its comments within one (1) month after the receipt of the Draft Final Report.

5. Final Report:

Ten (10) copies within two (2) months after the receipt of the comments on the Draft Final Report.

VII. UNDERTAKINGS OF THE GOVERNMENT OF ERITREA

1. To facilitate the smooth conduct of the Study, the Government of Eritrea will take the following necessary measures:

- (1) To secure the safety of the Japanese study team (hereinafter referred to as "the Team")
- (2) To permit the members of the Team to enter, leave and sojourn in Eritrea for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees
- (3) To exempt the members of the Team from taxes, duties, fees and any other charges on equipment, machinery and other materials brought into Eritrea for the conduct of the Study
- (4) To exempt the members of the Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study
- (5) To provide necessary facilities to the Team for remittance as well as utilization of the funds introduced into Eritrea from Japan in connection with the implementation of the Study
- (6) To secure permission for the Team to enter into private properties or restricted areas for the implementation of the Study
- (7) To secure permission for the Team to take all data and documents (including photographs and maps) related to the Study out of Eritrea to Japan
- (8) To provide medical services as needed, expenses for which will be chargeable to the members of the Team.

2. The Government of Eritrea shall bear claims, if any arise, against the members of the Team resulting from, occurring in the course of, or otherwise connected with, the discharge of

their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the member of the Team.

3. The Ministry of Land, Water and Environment shall act as a counterpart agency to the Japanese Study Team and also as a coordinating body in relation with other governmental and non-governmental organizations for the smooth implementation of the Study. The Ministry of Land, Water and Environment shall, at its own expense, provide the Team with the followings, in cooperation with other organizations concerned:

- (1) available data and information related to the Study
- (2) counterpart personnel
- (3) suitable office space with necessary equipment in Asmara
- (4) credentials or identification cards
- (5) appropriate number of vehicles with drivers.

VIII. UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures:

1. to dispatch, at its own expense, study teams to Eritrea
2. to pursue technology transfer to the Government of Eritrea counterpart personnel in the course of the Study.

IX. CONSULTATION

JICA and the Ministry of Land, Water and Environment shall consult with each other in respect of any matter that may arise from or in connection with the Study.

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TENTATIVE STUDY SCHEDULE

APPENDIX

MONTH DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
WORK IN ERITREA																	
WORK IN JAPAN																	
STAGE OF THE STUDY			STAGE I	STAGE II							STAGE III, IV						
REPORT PRESENTATION	▲ IC/R			▲ P/R				▲ IT/R							▲ DF/R		▲ F/R

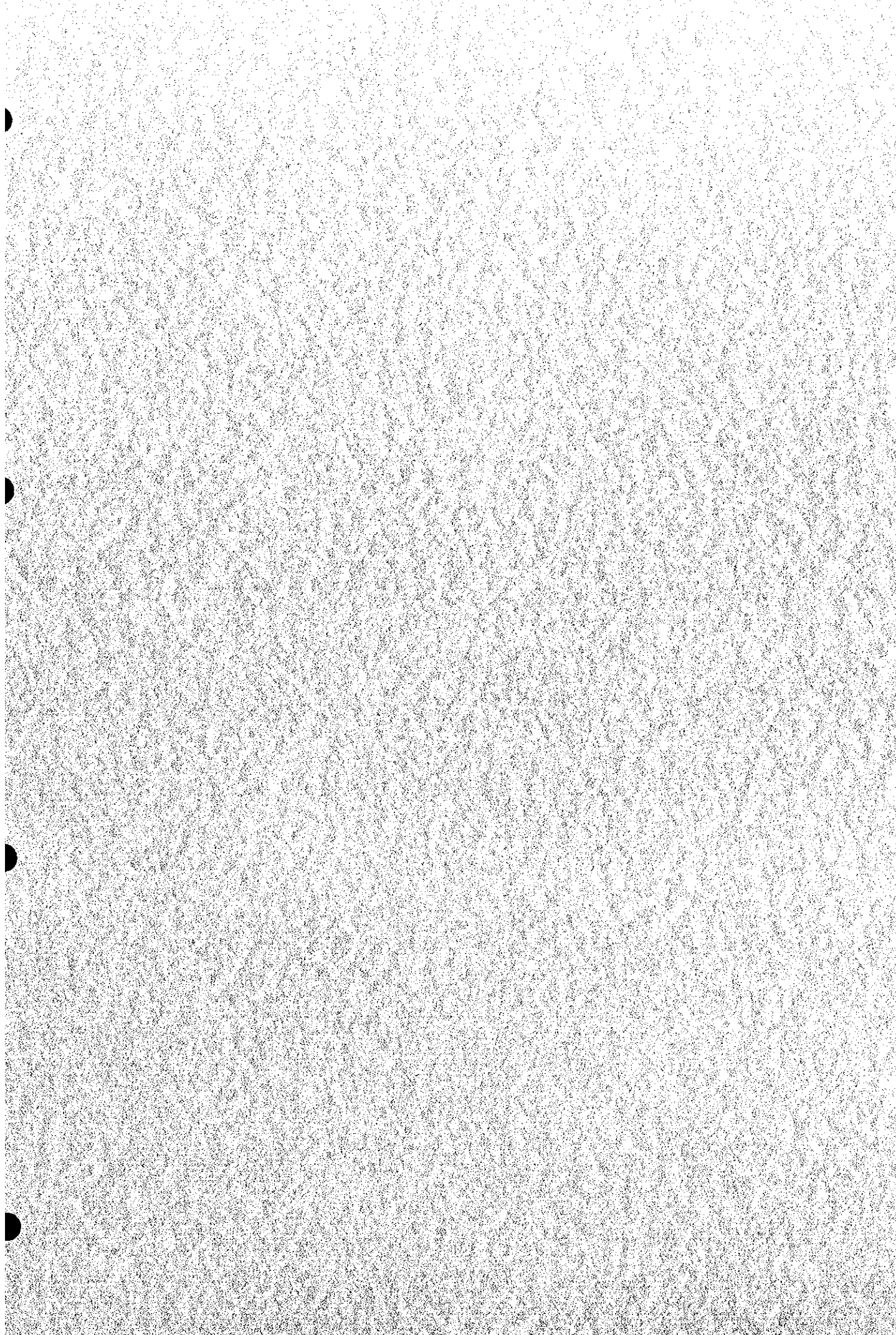
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B. Member of the Study Team

KUME Takao	Team Leader / Water Supply
KAWASAKI Ryoichi	Hydrogeology (A) / Groundwater Development
HIGUCHI Masao	Hydrogeology (B)
Mahbub A.K.M. REZA	Hydrology / Environment
TAKAHASHI Naoyoshi	Geophysics
HASE Masahiro	Drilling Supervisor
ISHIBASHI Naomichi	Financial Planning / O&M
Haregu GEBRESILASSIE	Sanitary / Hygiene Improvement Planning
KIMATA Noriyasu	Facility Planning / O&M
TANAKA Etsuji	Design / Cost Estimation
Tesfa Mariam TEKIE	Socio-economy / People's Participation
SHIBATA Eichi	Coordinator

C. Name of Counterpart Personnel

Mr. Ghebremichael Temnewo	Acting General Manager
Mr. Michael Negash	Chief Hydrologist
Mr. Tewelde Solomon	Chief Hydrogeologist
Mr. Fikremariam Kahsai	Head, Water Quality Test Laboratory



JICA