Chapter IV ESTABLISHMENT OF MASTER PLAN OF STUDY AREA

4.1 Water Demand Projection of the Study Area

The preliminary population projection carried out in the previous Study reports were elaborated on the basis of the census survey executed in September 1994 and socio-economic survey made in this Master Plan Study. Further, the unit water consumption established previously in the course of the Study as a preliminary level was also scrutinized on the basis of the real condition of water consumption in the model areas.

(1) Existing Water Production and Consumption

The water production records at the Ain Gdah and Mekansa water treatment plant through 1993 to 1994 are addressed in Table 4.1.1 to 4.1.2. The maximum, minimum and average daily water production are given by 3,300 m^3/d, 700 m^3/d and 1,779 m^3/d at Ain Gdah and 990 m^3/d, 471 m^3/d and 704 m^3/d at Mekansa, respectively.

The seasonal fluctuation of water production at the treatment plants are given in Figures 4.1.1 and 4.1.2. At Ain Gdah, the seasonal fluctuation is much larger than the case at Mekansa having a relative peak factor in the former case at 1.9 and 1.4 in the latter case.

Causes of these fluctuation are assessed that firstly the Ain Gdah water supply system has several high pressure zones due to topographic configurations in which water leakage is often observed resulting in a large amount of additional water production to compensate for water loss. Secondly, the water production at the treatment plant is not constant due to having excess capacities in the facilities against the actual demand, namely, water is supplied mostly by stand pipes, although it was initially designed by house connection system, bringing about less consumption.

While, the fluctuation of water production in the Mekansa water supply system is comparatively steady compared to the case of Ain Gdah due to moderate topographic conditions and having less leakage problems. However, excess capacity against the demand still remain by the same reason.

The relationship between the total production, distribution and consumption at Ain Gdah and Mekansa are given in Table 4.1.3.

The rate of water consumption to water production at Ain Gdah is computed by 47 percent and 45 percent in 1993 and 1994, respectively. This implicate that the efficiency of water consumption is considerably low or otherwise unaccounted for water is very

large. The cause of this high rate of unaccounted for water might have been brought from the constraints on distribution network as above described. Whereas, the rate of unaccounted for water at Mekansa is counted at 37 percent and 35 percent, and they are in general comparatively good condition.

Table 4.1.3 Water Production and Consumption

Water Usage	Ain Gdah System				Mekansa System			
	1993		1994		1993		1994	
	(m^3)	%	(m3)	%	(m^3)	%	(m^3)	%
Water Production	290,287	100	310,471	100	118,003	100	131,569	100
Water Distribution	199,278	69	302,425	97	112,839	96	126,219	96
Water Consumption	137,649	47	140,645	45	78,027	66	85,723	65

Source: ONEP Fes
Note: The data in 1994 is from January to November

As was given in Table 4.1.4 and 4.1.5, the 'relative' unit water consumption (total water consumption/total population in the rural center) including unaccounted for water in the existing rural centers of the Taounate province can be seen as comparatively high as 64 l/c/d at Karia Ba Mohamed followed by 57 l/c/d at Taounate. While, much less unit water consumption is at the same time seen at Mouly Bouchta and Ain Aicha. This is because the supply pervasion (served population/total population) in the former case is comparatively high, whereas the one in the latter case is very small.

Table 4.1.6 gives the water consumption record and projection in the rural center of Taounate from 1982 to 1989. The net water consumption as defined by the ONEP including unaccounted for water varies from 52 l/c/d to 89 l/c/d. Similarly, the net water consumption from 1991 to 2020 is projected such at 88 l/c/d in 1991 to 111 l/c/d in 2010 and 2020.

Meanwhile, it should be kept in mind that the existing ongoing projects under the ONEP North Regional Center for the Ain Gdah and Karia Ba Mohamed systems which mainly supply water by stand pipes adopted the unit water demand at 15 l/c/d on average for domestic and livestock use. Needless to say that these systems as described in detail in the previous reports were originally established by adopting unit water demand at 30 l/c/s with the plan of house connections for the entire supply area.

The water consumption records in the rural areas controlled by communal authorities or individuals have not ever been compiled due to lack of actual data. Their consumption may be in the order of around 15 l/c/d as described in Section 3.4.2 in Chapter III.

(2) Unaccounted for Water

Unaccounted for water is generally found in two categories. The one is found in the non-effective water represented by water leakage from the facilities, meter reading errors and hydraulic losses in the system. The other one is found in the non-revenue water out of effective water, which is represented by non-detected water by water meters and the water use for operation and maintenance of water supply systems.

As was given in Table 4.1.4 and 4.1.5, the rate of unaccounted for water in a broad sense varies from 20 to 60 percent in the rural centers of the Taounate province. In the definition of design criteria by the ONEP, the word 'efficiency' is used in place of unaccounted for water as is given in Table 4.1.6. In the table, the rate of consumed water against produced water is defined as the 'efficiency' varying from 48 percent to 77 percent or inversely corresponding to 52 percent to 23 percent of unaccounted for water. Further, as previously descried, the efficiency at Ain Gdah and Mekansa systems are 47 percent and 66 percent in 1993 and 45 percent and 65 percent in 1995, respectively. They inversely correspond to the unaccounted for water of 53 percent and 34 percent in 1993 and 55 percent and 35 percent in 1995.

As a conclusion, the rate of unaccounted for water in the current water supply system under the ONEP can be evaluated approximately at 40 percent and this rate will provably decrease by 3 percent annually resulting in 26 percent in the year 2010.

(3) Set up of Unit Water Demand

The unit water demand fundamentally differ with life style, customs and traditions in urban and rural areas, water supply facilities provided or to be provided in the area concerned and availability of water sources near by. In addition, it should be noted that the actual water consumption measured up today does not necessarily show the real water demand, but the suppressed demand.

The water demand in the Study Area, in general, is classified in two categories: the one is the demand in urban areas and the other is in rural areas. The existing typical urban areas are indeed provided with house connection facilities depending on the scale of the town and subsequent water consumption is occasionally seen at the level of more than 70 l/c/d including unaccounted for water. Average net water consumption in these urban areas including their out skirts is still in the order of 30 to 40 l/c/d as a whole.

It should be pointed out that existing rural areas may turn into urban areas in the future due to natural increase of population or governmental policies. However, future conversion is unpredictable at this stage of the Study other than considering natural population increase on the basis of past trend. Therefore, the existing demarcation of urban and rural areas shall in a conventional view point remain as it is in the water demand projection in this Study.

The strategy for establishing unit water demand in this Master Plan Study is fundamentally set taking into account of the National Master Plan of Water Supply for Rural Population in parallel with referring the current actual water consumption records in the Study Area and socio-economic survey carried out in this Study. The parameters constituting unit water demand are considered to be basically domestic and livestock feeding only, since industrial water demand is found to be considerably small or negligible in the Study Area. Further, administrative water demand is considered to be included in the domestic water demand.

Consequent to the consideration of above strategies, the unit water demand is set up as follows. It should be noted that the unit water demand given in Table 4.1.7 does not include unaccounted for water.

Table 4.1.7 Unit Water Demand

		1995	2000	2005	2010
Urban Area	Domestic (l/c/d)	30	35	43	52
	(Rate of Increase)	(3%)	(4%)	(4%)	
	Livestock (l/c/d)	20	20	20	20
	Unaccounted for Water	40%	35%	30%	26%
Rural Area	Domestic (l/c/d)	20	23	27	31
	(Rate of Increase)	(3%)	(3%)	(3%)	
	Livestock (l/c/d)	20	20	20	20
	Unaccounted for Water	40%	35%	30%	26%

Note: Unaccounted for water in the rural area shall be applied only to the areas currently being controlled by ONEP.

(4) Water Demand Projection and Water Balance in the Study Area

The water demand projection in the Study Area and supply capacities based on the existing water sources are given in Table 5.8 to 5.10 of Supporting Report for respective commune.

For provision of the table, the following conditions are taken into account:

i) The served population shall be 80 percent and 90 percent in rural and urban areas, respectively. This presentation is based on the assumption that approximately 20 percent and 10 percent of the population in the respective area may depend upon private water sources exploited by themselves, and these percentages shall not vary up to 2010.

ii) Unaccounted for water is applied to communes defined as urban, and also rural communes in which pipeline network with house connections or stand pipes have already been provided by the ONEP.

iii) Total groundwater production is diminished by 10 percent due to inclusion of salt water in the existing dugholes. Further, some of the wells, dugholes and springs are almost dry in the dry season resulting less water production in average in a year.

iv) The water to livestock is in general given at streams and rivers nearby during winter time, and 10 to 50 percent out of water consumption is given in houses during summer time. Therefore, weighted average consumption shall be at 15 percent for convenience of computation.

v) Private wells and dugholes are neglected in the amount of groundwater potential due to lack of data. However, this concept is included in supply pervasion as aforementioned.

vi) The total groundwater and surface water production shall remain in a conventional view point as it is in the future till the year 2010, and the balance made in the table shall be subject to the condition of 'without further development'.

Consequent to the computation of water demand in parallel with supply capacity, the followings are resulted.

In the present condition as of 1995, 15 out of 48 communes which equivalent to 31 percent in the Taounate province are seen to be suffered from water deficit. Of 4 circles, only Tissa is sufficient in quantity in the balance having only one water-deficit commune. As a matter of course, this does not necessarily mean that almost all the population in the circle of Tissa is provided with sufficient amount of water.

In the Sidi Kacem province, 18 out of 26 communes which equivalent to 72 percent are suffering from water deficit giving much larger ratio than the Taounate province. Especially, the circle of Had Kouart containing 12 water-deficit communes has water

deficit of 1,840 m^3/d in total. Whereas, the circle of Ouazzane is rich in source water due to having a large water source at Bouagba, although it is located out of the Study Area.

12 out of 14 communes in the Taza province which equivalent to 86 percent are currently suffered from water deficit. Of three circles, Tainaste and Taza having 8 and 2 water deficit-communes, respectively, namely all the communes contain the deficit of 1,840 m^3/d. The total deficit after the balance in this province amounts to 1,672 m^3/d.

Meanwhile, in the year 2010, the number of communes with water deficit in the Taounate province increases up to 19 which equivalent to 40 percent. The overall balance in this province is still in surplus by 19,539 m^3/d. In other words, this implicate the large water potential still underlies even in the future in this province. In like manner, the number of water deficit-commune increases up to 77 percent in the Sidi Kacem province, but still in surplus with the amount of 1,672 m^3/d.

However, the Taza province turn into a water-deficit province in the balance by 2010 having 14 water-deficit communes which is equivalent to 100 percent bringing about the deficit of 1,672 m^3/d.

Conclusion in water balance analysis for 2010 is summarized as follows:

i) The Taounate province still has a surplus in water balance with an amount of 19,539 m^3/d. However, the potential is not well balanced to all the areas due to partial allocation of water sources. Further, groundwater yield is not necessarily expectable through years due to climatic conditions.

ii) The Sidi Kacem and Taza provinces are in water-deficit condition in almost all the communes, therefore, new water sources required in these provinces.

4.2 Assessment of Future Water Resource

4.2.1 Surface Water

(1) General

The surface water resource development in the Sebou river system is being proceeded with the SBO Master Plan as a framework. The SBO Master Plan was formulated to satisfy the future water demand of the six sub-basins of the Sebou river system and the regions of the Atlantic coast. The several number of dams have been planned and constructed for development of the surface water resource. In the SBO Master Plan, the water balance study on the sub-basin basis shows that the water demand in the Sebou river basin including the Study Area will be satisfied by the said dam construction until 2020. The succeeding development plan will be therefore discussed for water use at specific locations or areas with consideration to future availability of water resource. The following discusses the possible development plans for potable water supply in the Study Area with reference to the ongoing and proposed surface water development plan in the Sebou river basin.

(2) Middle Sebou

In the middle Sebou Area, the mainstream of the Sebou river is the stable surface water source. The development locations will be specified on the mainstream.

The expansion of the existing two water supply system has been planned by the ONEP. Available water resource of the Sebou river was estimated at 10.9 m^3/sec at the Mekansa intake and 7.5 m^3/sec at the Karia Ba Mohamed intake on the basis of the 95 percent dependable discharge under the present condition, while the planned supply capacity is 0.056 m^3/sec for Mekansa and 0.030 m^3/sec for Karia Ba Mohamed.

Water resource of the Sebou river will make it possible a water supply system covering Lolja, Sidi El Abed, Bouchabel and Jbabra communes with a total potable water demand of 1,770 m^3/day (0.020 m^3/sec) in the year 2010. Available water resource of the Sebou river was estimated at 7.4 m^3/sec at the Loulja town on the basis of the 95 percent dependable discharge under the present condition.

(3) Lebene River

The existing water supply system of the city of Tissa was established using groundwater resource and the future expansion or enlargement of the system will be expected by

means of developing the groundwater potential area identified. Water supply by surface water resource is expected to be an alternative plan for the city of Tissa and the neighboring areas. Surface water resource will meet with further increase of potable water demand or expansion of the water supply system covering a wider area .

The Sidi Abbou dam is planned on the Lebene river with a storage capacity of 60 million m^3. This dam is expected to be a future water source for the said system. By this dam, the water resource will be developed at 58 million m^3/year which will mainly contribute to the irrigation water demand of 30 million m^3/year. The rest of water resource will be used for potable water demand in the area along the Lebene river and for the other downstream uses. When the supply area will cover the circle of Tissa, the potable water demand is estimated at 1.78 million m^3/year in the year 2010. Accordingly, the surface water source will be sufficient to meet with the potable water demand.

(3) Inaouen River Basin

The surface water development in the Inaouen river basin will be formulated by the water resource of the Idriss No.1 dam and the Touahar dam which is planned around 10 km downstream of the city of Taza.

The expansion of the Ain Gdah water supply system is planned by the ONEP. Available water resource of the Inaouen river was estimated at 0.34 m^3/sec at the Ain Gdah intake on the basis of the 95 percent dependable discharge under the present condition, while the planned supply capacity is 0.064 m^3/sec. The baseflow of the river is still larger than the planned supply capacity. However, it is anticipated that the water extraction might be forced to stop by severe drought as experienced in 1995. In order to avoid such case, it will be necessary to increase the baseflow regulated by the Touahar reservoir or introduction of water from the Idriss No.1 reservoir.

(4) Lower Ouergha and Rdat Basin

Since possible surface water resource is not identified in these areas, surface water development for these areas will depend on introducing water from the Al Wahda reservoir or the Sebou river. The ten communes located along the Ouergha river are expected to be covered by water supply system using water release from the Al Wahda reservoir for a total water potable demand of 1.57 million m^3/year, and the five communes with a total potable water demand of 0.78 million m^3/year may be supplied by the Sebou river.

Even though use of surface water in the lower Sebou river should be carefully studied for the various water demand, the surface water resource to be developed will be basically sufficient for satisfying the potable water demand within the Sebou river basin including the above-mentioned areas.

(5) Upper Ouergha Basin

Surface water development in the upper Ouergha basin requires construction of storage dam to regulate river discharge with a large fluctuation by season. In addition to the SBO Master Plan, the surface water development is implemented by constructing medium and small scale dams. The construction of these dams generally aims at enhancing development of rural area by use of water for agricultural development. Meanwhile, the medium scale dam with a sufficient storage capacity for regulating the river discharge will be utilized for a source of water supply system. Considering an expected scale of water supply system by surface water, possible supply area may be at some limited locations due to topographic constraints even though the development potential of surface water is quite large in the upper Ouergha basin.

1) Taounate Area

According to the Ouergha River Master Plan, the area along the Ouergha river near Taounate has the highest potential for agricultural development. The Ouergha River Master Plan proposed the agricultural development in this area as the priority project using water to be developed by construction of the Zrizer dam and the Oued Sra headwork on the Sra river and the El Mekabline dam on the Sahela river. Construction of the El Mekabline dam was completed in 1994. Other than these dam plans, construction of the Bouhouda dam located on the Sra river was commenced in 1995. Purposes of this project are the said agriculture and potable water supply.

Water use in this area was assessed by a preliminary water balance study considering the water requirement of agriculture development of 6,730 ha and the potable water demand for the communes around the objective area. The results shows that the surface water resource to be developed by the above-mentioned dam construction will meet with both potable water demand of 1.33 million m^3/year for the six communes and irrigation requirement of 73.4 million m^3/year.

2) Thar Souk and Beni Oulid Area

The Asfalou dam is proposed by the SBO Master Plan with the planned storage capacity of 97 million m^3. The site of Asfalou is most favorable for constructing a large scale dam for developing water resource of the basin. Main purpose of constructing the Asfalou dam is hydroelectric power generation. Meanwhile, the surface water resource will be developed at 75 million m^3/year. This amount of water is sufficient for covering the water demand in the basin so that it may contribute to future potable water supply for this area as well as for the downstream reaches. The medium scale dams, the Thar Souk dam and the Ain Abadon dam, are also planned mainly for irrigation in the Beni Oulid area.

3) Rhafsai and Galez Area

The two medium scale dams are planned, the Ratba dam on the Aoulai river and the Sidi Mokfi dam on the Amzaz river. The amount of surface water expected to be developed by these dams was approximately estimated at 54 million m^3/year by the Ratba and 44 million m^3/year by the Sidi Mokfi.

(6) Small Scale Dam

Construction of small scale dams is an effective water resource development with consideration to the characteristics of the basin, project cost and construction period. The small scale dams are expected to supply water for use of domestic, livestock and irrigation for the scattered population in the mountainous areas.

Use of surface water for potable water supply requires a system including water purification plant, pipeline, pumping and storage facilities. Per capita investment cost of such system will be much higher than the existing water supply system using surface water because population covered by small scale dam ranges from 100 to 3,000 in number which is much smaller than those of the existing systems. The approximate number of population supplied by the existing systems are 21,000 by Mekansa, 16,000 by Karia Ba Mohamed and 29,000 by Ain Gdah, respectively.

Meanwhile, a storage capacity of small scale dam is around 2 million m^3 in the maximum. Such capacity may be too small to regulate river discharge fluctuating by season for serving potable water constantly through a year.

Consequently, it is concluded that future potable water supply system by surface water will be planned to cover the urban area with a reltively large water demand and to be a component of a multi purpose project based on construction of medium or large scale

dams. On the other hand, a role of small scale dam is still important for the above-mentioned purposes. It is also helpful as supplemental or alternative water source for a case of drought.

4.2.2 Groundwater

The geological and hydrogeological studies carried out during the first two Phases of the Study in Morocco succeeded in identifying a number of promising groundwater supply sources distributed among the various geographical regions of the Study Area. Following field reconnaissance and analysis of satellite images and aero photos the identified sources shown in Figure 4.2.1 were selected according to their geological structures, their lithological characteristics and ability for water accumulation, taking into consideration the following criteria:

i) Type and area of the geological structure

ii) Size of catchment area

iii) Physical character of stratigraphical units

iv) Presence of fault activities

v) Underground water reserves

vi) Absence of Triassic formations

The general hydrogeological features of the Study Area classify the identified possible future sources into the three following categories:

(1) Sources of Fair to Good Water Potential

The hydrogeological structures of this category include the following structures:

1) Taineste Flexure

The structure is of an allochton origin located to the southeast of Taineste. It consists of the outcropping Lias formations of the Jurassic period. The flexure covers an area of 3 km^2 and is marked with fissures and fault activities where water bearing formations can be located at about 125 m deep. The expected yield of the structure ranges from 2 to 7 l/sec and its estimated water reserve is in the order of 1.1×10^6 m^3.

2) Jbel Khamise Monocline

The structure is an allochton flysch with the outcropping Lias formations of the Jurassic period and covers an area of 8.5 km^2. Water bearing formations located along fissures and faults of the monocline can be found at about 150 m deep with an expected in the order of 3 to 10 l/sec and an estimated water reserve of about 2.8 x 10^6 m^3.

3) Jbel Keil Monocline

The monocline is an allochton flysch with the outcropping Lias formations of the Jurassic period and extends over a total area of 40 km^2. Water bearing strata are located along fissures and fault lines of the structure at a depth of 150 m with an expected yield of 2 to 15 l/sec and an estimated water reserve of 9.3 x 10^6 m^3.

4) Thar Souk Syncline

The structure is an allochton of the Miocene epoch with massive formations of the Quaternary conglomerate overlaying impervious marl layers. The syncline has an area of about 12 km^2 and encloses water bearing formations at about 30 to 150 m below ground level with an expected yield of 1 to 5 l/sec and an estimated water reserve of about 9 x 10^6 m^3.

5) Ourtzagh Syncline

Located in the valley of the Ouergha river, the structure encloses the Quaternary conglomerate deposits overlaying the upper Tortonian Miocene formations marked with well developed fissures and faults. Water bearing formations can be located along the flanks of the valley at a depth of 300 m with an expected yield of 5 to 10 l/sec. The area of the structure is about 15 km^2 and the estimated water reserve is around 9.4 x 10^6 m^3.

6) Ain Saddine Syncline

The structure has the Quaternary formation and Miocene formations with conglomerate outcropping along the edge of the syncline. The area of the structure is about 10 km^2. Water accumulations can be found in the Quaternary and in the Miocene layers at depths of 30 and 150 m respectively with expected yields of 1 to 5 l/sec and a water reserve of 6.7 x 10^6 m^3.

7) Taounate Syncline

Located in the valley of the Sra river, the structure consists of the outcropping Quaternary formations overlaying the middle Miocene formations of solidified conglomerate and fractured marlstone. Water accumulations are found in the upper and lower formations at depths of 30 and 250 m respectively with expected yields of 5 to 15 l/sec. The area of the syncline is about 4 km^2 and the estimated water reserve of about 8.2 x 10^6 m^3.

8) Tissa Syncline

The structure is located in the valley of the Lebene river. It is marked with the outcropping Quaternary formations overlaying the Oligocene formations of fractured marly limestone. Water accumulations can be found in the upper Quaternary and lower limestone layers at depths of 30 to 150 m respectively with expected yields of 3 to 7 l/sec. The area of the syncline is about 5 km^2 and the estimated water reserve of 2.7 x 10^6 m^3

9) Jorf El Melha Syncline

Located in the flat plain of the Quergha river, the syncline consists of the outcropping Quaternary formations with recent alluvium and conglomerate deposits followed by a lower layer of silt, marl and conglomerate of Miocene. Water accumulations can be found in these formations at depths of 30 and 150 m respectively with estimated yields of 2 to 7 l/sec. The area of the structure is about 10 km^2 and the estimated water reserve is around 4 x 10^6 m^3.

10) Had Kourt Basin

The structure is a depression of the Miocene epoch and is marked with the outcropping Quaternary formations followed by the Tortonian conglomerate with marl matrix. Water accumulations can be found in these formations at depths of 30 and 150 m respectively with estimated yields of 1 to 3 l/sec. The area of the structure is 6 km^2 with an estimated water reserve is 3 x 10^6 m^3.

Some of these identified groundwater supply sources, namely Jbel Keil, Ourtzagh, Taounate and Jorf El Melha, were surveyed by geophysical prospecting during Phase 1 of the Study and consequently their water potential can be reasonably be estimated from the survey results presented in Figure 4.2.3 of Supporting Report. The hydrogeological details of the 10 structures are presented in Table 2.1.5.

(2) Sources of Fair to Low Water Potential

The structures of this category of groundwater sources are widely spread around the Study area and cover the three types of the geographical configurations of mountainous, hilly and flat plain areas. The hydrogeological characteristics of these structures are summarized in Table 4.2.1.

(3) Sources of Low Water Potential

The majority or 70 percent of these groundwater sources belongs to flat plain and valleys of major river crossing the Study Area in the north west direction and the remaining 30 percent are located in the hilly areas. The hydrogeological details of these structures are presented in Table 4.2.2.

The hydrogeological evaluation of the fair and low groundwater potential structures was carried to a preliminary level and should be complemented with geophysical prospecting and exploratory well drilling in order to determine the exact water reserves of each groundwater source.

(4) Preliminary Evaluation of Possible Development Yield

The possible development yield of groundwater was evaluated by the water balance analysis and the groundwater simulation for the potential structures in the three model areas, respectively. With reference to the results for the model areas, the possible development yield was estimated approximately for the other ten potential structures.

The possible development yield discussed here was defined to be equivalent to groundwater recharge. It corresponds with a total yield of spring and groundwater extraction on the assumption that it is possible to product a yield of groundwater equivalent to a balance between groundwater recharge and spring yield in a potential structure. This amount of production can be made theoretically when the optimum arrangement of production wells are provided.

For the model areas, a ratio of groundwater recharge to rainfall was obtained as shown in Table 4.2.3.

Table 4.2.3 Ratio of Groundwater Recharge to Rainfall

Type of Topography	Name	Ratio	
		Average	10-Year Drought
Mountain	J. Berda	12 %	8 %
Hill	Teroual	9 %	6 %
Flat Plain	Ain Defali	9 %	6 %

With reference to the table, the possible development yield was estimated for the other ten potential structures. The ratio by type of topography was applied for each potential structure with a corresponding topography. The estimated yield is tabulated on Table 4.2.4.

4.3 Establishment of Future Water Supply System

4.3.1 Groundwater Supply System

(1) Groundwater Potential

Great many dugholes, springs and wells have been developed by the AH up to date. The number of dugholes drilled and registered by the AH amounts to 410 according to the records as of 1994. The amount of groundwater yield by dugholes are 21,581 m^3/d, 11,354 m^3/d and 428 m^3/d in the Taounate, Sidi Kacem and Taza province, respectively as is given in Table 5.8 in Supporting Report. A large number of springs have also been developed in the Study Area. The existing number of springs and estimated amount of production in each province are 523 and 16,186 m^3/d, 1,764 m^3/d and 846 m^3/d in the Taounate, Sidi Kacem and Taza provinces, respectively. Whereas, the number of wells drilled and registered by the AH in the Study Area amounts to 118 with the yields of 760 m^3/d and 2,437 m^3/d in the Taounate and Sidi Kacem provinces, respectively, and no well is recorded in the Taza province.

The total volume of the existing groundwater yield in the entire Study Area therefore comes to approximately 55,400 m^3/d. However, it should be noted that the great many of the groundwater sources are laid in a position without water in dry season for several months in a year. Especially, those wells exploited by the AH have not been working in these years due to dry up in the wells. Further, some of the wells are suffering from the problem of salt water content which is reported above drinking water standard of Morocco.

Groundwater potential expected and to be exploited in the future are such as groundwater already exploited in the model areas, other 10 high potential areas, medium and low potential areas along rivers. The expected groundwater from these high potential areas including model areas amounts to approximately 29,894 m^3/d in an average year and 14,056 m^3/d in ten-year drought period.

In the course of development of groundwater sources, caution must be given to the fact that potential areas resulted from geological and hydrogeological analysis are not necessarily reliable to yield certain amount of water unless given by verification with geophysical prospecting and subsequent test drilling. Thus, allowance in the expected yield should be kept in mind in planning and designing purpose. The estimated groundwater yield under these high potential areas are summarized in the sub-section 4.2.2.

(2) Establishment of Groundwater Supply System

For the establishment of groundwater supply system, the following implementation program is proposed.

i) In compliance with drilling of test wells, pumping tests and subsequent analysis, reliability of groundwater yield for potable water use in the model areas is confirmed. Due to urgent necessity of increasing of production capacity and provision of water distribution facilities, the groundwater development program is recommended as an urgent scheme.

ii) The water supply system recommended in the model areas is classified into two groups; the one is supply by gravity and the other is by pumping. The gravity supply system is to be laid on the first priority and the pumping supply system is on the second in the implementation program.

iii) Establishment of water supply system including both of gravity and pumping system in the model area as well as rehabilitation programs for the existing facilities shall be completed within five years.

iv) Development of ten high potential areas comprising planning, physical inspecting, test drilling, detail designing and construction works is proposed to be completed within ten years in parallel with the development of three model areas.

v) Medium and low potential areas shall be developed thereafter in compliance with the progress and/or results of the development of 10 potential areas. At the same time, development condition of surface water supply system should also be taken into consideration.

vi) Extremely low potential areas for groundwater development, such as north-west of Had Kourt, north of El Bibane commune and far east regions, and where surface water potential is also poor shall be developed based on the transmission of water from other provinces.

4.3.2 Surface Water Supply System

(1) Surface Water Potential

Surface water supply system in the future will be divided into three systems; the one is dependent upon the Sebou river, the second is the Inaouen river and the third is the Ouergha river.

In the case of the Sebou river, the flow rate for water supply is so large that enlargement of the treatment capacities such as Karia Ba Mohamed and Mekansa are readily accomplished. According to the analysis of hydrology, the low flow rates at the sites of Karia Ba Mohamed and Mekansa treatment plants with the 95 percent dependability are 7.5 m^3/s and 10.9 m^3/s or approximately equivalent to 648,000 m^3/d and 942,000 m^3/s, respectively .

In compliance with this potential, the ONEP is currently carrying out improvement and expansion program as addressed in Table 2.5.10 in the previous section. The proposed supply capacity of Karia Ba Mohamed under this program for instance will be 30 l/s which equivalent to 2,600 m^3/d. (The current capacity of treatment plant is 1,300 m^3/d as given in Table 2.5.2.)

Whereas, the flow rate estimated simultaneously at the Ain Gdah treatment plant is 0.34 m^3/s or approximately 29,000 m^3/d and this amount will be critical when encountered with heavy draught like in the summer of 1995. During the Study period in July 1995, the operation of the Ain Gdah water treatment plant was stopped for six days due to shortage of source water in the Inaouen river. In the numerical point of view, the existing Ain Gdah treatment plant is readily enlarged to a larger size, however, flow rate itself is duly limited.

The city of Taza is progressing the surface water development program based on the tributary of the Inaouen river. However, the potential of this tributary as well as the Inaouen main river is not large. In this respect, the Touahar dam water will cover the shortage of the flow rate of the Inaouen river bringing about sufficient water to the southern part of the Taza province extending along the Inaouen river.

The Ouergha river, the other major surface water source in the Study Area, has also abundant potential. A program of constructing a huge dam which is the so called Al Wahda dam construction scheme is currently ongoing, and its scheduled completion day is set in the middle of 1996. When this huge dam which has the total reservoir capacity of 3,800 million m^3 has been completed, potable water after treatment will be available, although this reservoir was not originally planned to utilize for water supply to the

neighboring communes, but for the Atlantic coast, flood control and irrigation purpose in the down stream reaches.

Several dam construction schemes have been implemented and ongoing in the Study Area. The water of these dams will be utilized for portable purpose, however, construction of treatment plant, pumping stations, transmission lines and distribution tanks for rural water supply will not be feasible in the financial view point, management aspects and efficiency if compared with the development of groundwater sources.

(2) Establishment of Surface Water Supply System

For the establishment of surface water supply system, the following implementation program is proposed:

i) According to urgent needs for exploitation of surface water sources and subsequent development of water supply facilities, the first stage implementation will be dependent upon the ongoing program being carried out by the ONEP. According to enlargement of treatment plant capacities to a double size or more, the supply area could be extended to several communes along the Sebou river.

ii) As for future water resources to meet requirement by the target year, the Al Wahda dam which is supposed to be completed within 1996 will be realized, however, there is no plan for water supply to the Pre-Rif region. Substantial planning for utilization of the Al Wahda reservoir shall be commenced around the year 2000.

iii) By the time of commencement of planning for water supply based on the Al Wahda reservoir, review work of groundwater development programs and their progress as addressed previously shall be carried out in parallel with the programs currently being carried out by the ONEP.

iv) The surface water supply system based on the Al Wahda reservoir may be first of all applied to the flat plain areas in the Sidi Kacem province where easily supplied by gravity system.

v) Southern part of the Taza province will be developed by the water from the Touahar dam in the future.

4.3.3 Covering Area by Supply System

Figure 4.3.1 shows the covering area by supply system distinctively given for the respective item as follows.

(1) Existing surface water supply area

The area has already been provided with major surface water supply systems under the control of the ONEP. The systems comprising Ain Gdah, Karia Ba Mohamed and Mekausa water supply systems located from the east to the west in order contain water treatment plants, clear water reservoirs, pumping stations and relevant facilities to transmission.

In the Ain Gdah water supply system (south-east of the map), extension line and distribution reservoirs are currently under construction in the commune of Sidi Mohamed Beni Lahcen.

In the Karia Ba Mohamed water supply system (central-south of the map), extension line to Moulay Bouchta and supply douars to be connected are planned. A branch line from the said extension line to Bouchabel is also planned to be constructed.

Mekansa water supply system has a small scale of extension plan to Beni Senouss commune.

(2) Ongoing and proposed surface water supply area

Extension programs for the existing treatment plants have already been committed by the ONEP for effective extension for the future surface water supply system. The areas along the course of the Sebou river have topographical advantages to provide extension lines and relevant facilities, since the features of these areas are comparatively flat.

In the course of establishing a new surface water supply systems in these areas, consideration should be given to demarcation between surface water supply areas and groundwater supply areas.

(3) Proposed future groundwater supply area

The area is proposed to be basically supplied by groundwater sources. The area contains existing groundwater supply system under the ONEP, namely 10 systems, and 10 high groundwater potential areas identified in this Master Plan Study. Medium and low groundwater potential areas are also included.

(3) Model area (as proposed future groundwater supply area)

The model areas are selected as the representatives from three types of topographic configuration where suffered from severe drought in resent years and from areas where economic and social impacts due to development are highly expected. Details are referred in the previous section.

(4) Proposed future groundwater supply area from Bouagba

The communes in the northwest of the Study Area except Mzefroun, Sidi Ameur El Hadi and Sidi Ahmed Ben Sissa communes are currently supplied with water from Bouaguba fountain located in the westward out of the Study Area. The water supply in the future of these communes will be supplied from the said Bouaguba fountain including extension of current facilities provided in Masmouda and Ouazzane.

(5) Proposed future supply area by Al Wahda reservoir

Al Wahada dam water has already been planned to utilize for irrigation, flood protection in the downstream reaches and water supply in the Atlantic coast, but not for water supply in the surrounding areas of the dams.

If the reservoir is found to be applicable for water supply in the surrounding areas after an appropriate study has been completed and government commission has been obtained, the proposed area for water supply from the reservoir will be such as given in Figure 4.3.1.

It should be noted that the demarcation of supply area based on the Sebou river surface water, high potential groundwater and the Al Wahda reservoir shall be re-arranged in the future.

(6) Future supply area by other water sources

The areas located in the north central and east of the Study Area are pointed out as poor water resource areas.

It is fortunate that there is not much population in these communes concerned, and water with moderate amount is obtainable for the current population. If the population in these areas increases in the future, transmission of water from the neighboring areas will be necessary. Use of surface water by constructing medium and small scale dams will also be taken into consideration.

4.4 Establishment of Guidelines

4.4.1 Guidelines for Operation and Maintenance for Rural Water Supply System

(1) Standard and Monitoring of O&M

The rural water supply projects will be operated and maintained by either ONEP or communes themselves. In the latter case, an importance would be attached to work quality and sustain ability of operation and maintenance. In order to sustain the acceptable works of operation and maintenance should be established and executed respectively.

(2) Operation Management

The operation of rural water supply would not require implementing bodies (communes) to get the high standard of technical knowledge unlike maintenance works. The only exception may be operation of motorized facilities driven by electricity, diesel and petrol. The management will be necessary for power supply, procurement of fuel, and technical control and maintenance of such facilities. In this respect, communes are to be responsible for training staffs to manage technical matters.

(3) Maintenance Policies

The AH is the government agency which is liable for formulation of maintenance policies. The scope of works for which the AH is responsible should be spelled out in respect of maintenance works, organization, staffs and budget appropriation.

(4) Operation and Maintenance Costs

As made clear in financial analysis of rural water supply projects in the model areas, operation and maintenance costs would be financed by project revenues. Nevertheless, low rate of revenue collection and cost increase associated with price escalation would make it difficult for communes to manage operation and maintenance costs out of project revenues. If necessary, the budget support will be given to communes.

4.4.2 Guidelines for Environmental Aspects

(1) Environmental Consideration Necessary for the Study Area

Based on the IEE and the EIA for planning the water supply system in the model areas, environmental considerations for potable water supply in the Study Area are summarized as follows.

1) Natural Environment

Since a scale of water supply facility is not so large in the case of rural water supply, impacts on natural environment by constructing the facility are not to be significant. Consideration should be provided for construction of dam planned as a source of water supply system.

For groundwater resources, it is necessary to forecast impacts on existing groundwater sources, groundwater potential and quality after groundwater extraction is newly implemented. An intensive hydrogeological study should be carried out for this purpose.

The Sebou river is a perennial river in the Study Area. The baseflow of the river is abundant and has not been affected seriously by water extraction in the current condition. When water demand increases in the future, a water management plan will be required for control of water extraction and maintain the baseflow for environmental purposes.

2) Social Environment

As described before, implementation of rural water supply project will bring to rural people the positive effects including reduction of hard works for water collection and improvement of sanitary conditions as well as other indirect socio-economic effects.

Attention should be paid for development of water resources concerning with water rights. Under the Moroccan law, all the water is owned by the government. While some traditional springs in rural area have been actually managed by local people. Proper coordination is required for water resource development and water supply plan in such areas, especially for the case that water supply plan includes water transfer to the neighborinng areas. It is reported that the AH has experienced the difficulties of such coordination in the Study Area.

3) Water Quality and Sanitation

It is reported that water pollution in the Sebou and Inaouen river is caused by industrial and domestic wastewater from urban areas. These rivers are important water resources in

the Pre-Rif region and should be preserved in order to sustain the existing water supply systems as well as the future extension. It is necessary to implement a plan of wastewater disposal as soon as possible for Fes and other urban areas.

Wastewater disposal in rural area will be provided in view of water quality preservation of water sources as well as improvement of health and sanitation. It is expected that appropriate measures for wastewater disposal will be provided and spread over rural communities in line with the sanitary education to be implemented by the government.

(2) Implementation of Environmental Considerations

In general, plan and implementation of environmental considerations area is carried out corresponding with project preparation as shown below.

Stage of Project	Environmental Considerations
Master Plan	Initial Environmental Examination (IEE)
Feasibility Study	Environmental Impact Assessment (EIA)
Detailed Design	Preparation of Environmental Preservation Measures
Construction	Implementation of Environmental Preservation Measures
Operation	Environmental Monitoring

In parallel with establishing a plan of water supply system in the Study Area, the environmental preservation plan shall be prepared based on EIA for the above-mentioned environmental aspects and others particular for the objective water supply system. The environmental preservation plan shall be established with the definitive plan of the objective project. Implementation of the environmental preservation measures shall be commenced at construction stage. After commencement of project operation, the monitoring shall be carried out for evaluating actual impacts by the projects and effects of the preservation measures.

The AH and ONEP will be in charge of the environmental considerations for water supply projects. In addition, cooperative works with the Ministry of Public Health and other related agencies will also be required for improvement of health and sanitary conditions in rural areas.

4.4.3 Guideline for Women in Development (WID)

The strategy for women in development is virtually different by douar being provided with basic infrastructure and not being. The provision of basic human need such as water supply facilities is regarded as the necessary condition of WID for douras where basic infrastructure is not provided.

The issue of WID needs a wide range of programs to fulfill a positive integration of local women into social and economic development. Programs should be carefully designed in order to realize various kind of WID effects, WID should not be taken into account as the fashionable issue, but as the essential one since WID is regarded as the significant field of socio-economic development in the country of Morocco. This concept is also true of the Study area. Because of the different types of programs for fulfillment of WID effects discussed in 3.10, the cooperative actions shall be required to be taken by the concerned government agencies.

The careful approach to establish the guideline for WID is necessary for implementation of programs.

(1) Organizational set-up

The implementation of programs for WID effects requires the inter-governmental organization. The concerned agencies are:

i) Ministry of Agriculture and Agricultural Development
ii) Ministry of Interior
iii) Ministry of Public Works
iv) Ministry of Public Health
v) Ministry of Education
vi) Ministry of Industry
vii) Ministry of Finance
viii) Local Government

Representative staffs from the respective agency should be selected to organize the inter-agency working committee whose purpose is specifically oriented to WID. The role of the working committee would be as follows:

i) Establishment of strategies for WID,
ii) Preparation of programs for WID effects,
iii) Determination of the role of respective agency for implementation of programs,
iv) Budget estimation for implementation of programs,
v) Monitoring works of programs, and
vi) Evaluation of programs.

Until the function of such a committee becomes well-organized, the Ministry of Agriculture and Agricultural Development would perhaps be requested to be the lead executing agency for WID because of the agency's experience in WID programs in the past.

(2) Strategy

The country of Morocco is characterized by the diversified socio-cultural aspects as well as traditional customs. The multi-cultural aspects are also envisaged in the Study area. If possible, local consultants or researchers are to be employed for establishment of strategies for formation of programs. The strategy for WID is obviously different by commune and local women with the different economic status. The following aspects would be fully surveyed by area (commune).

i) Present conditions of basic infrastructure,
ii) Social status of local women in the framework of traditional customs,
iii) Classification of households by income class, and
iv) Economic activities of communes in the Study area.

The Study area is characterized by insufficient level of basic infrastructure as a whole. So the strategy for WID by commune would be different depending on socio-economic conditions of communes.

(3) Preparation of programs for WID effects

The procedure of program formation would be as follows:

i) Analysis of current conditions of women's activities
ii) Determination of potential benefits
iii) Identification of social and economic constraints
iv) Program formation

Potential benefits are defined as WID effects to be expected as a result of analysis of current women's activities. potential benefits are not subject to socio-economic constraints prevailing in the Study area. Such constraints are represented by social status of women, low rate of literacy, the budget constraint of local government and economic condition of women in terms of household income. The formation of programs to realize potential benefits should be carefully designed by taking into account various constraints.

Perhaps it is desirable that the formation of programs should be subject to time frame (the short through long-term) and constraints.

(4) Monitoring

The monitoring is the basic work for assessment of program effects on WID. To monitor socio-economic impacts is the essential task to evaluate potential benefits brought about by programs. The fields to be monitored would be the same as proposed in 3.10.

i) Utilization of training facilities and credit system
ii) Budget allocation or disbursement to poor families
iii) Participation of women in rural water supply projects
iv) Effect of public hygiene dissemination program on women
v) Effect of guidance for children's education on parents

The Working committee is basically responsible for implementation of such a monitoring work. Thanks to a continuous monitoring work, the viability of program is certain to be enhanced on the long-term basis.

4.4.4 Guidelines for Sanitary Education

The government of Morocco has prepared the sanitary education program for rural area. By implementation of the program with the potable water supply project, it is expected that rural people will be aware of health and sanitation and water borne diseases will decrease as a result of improvement of sanitary conditions in rural areas.

1) Objectives

i) To induce the population to get supplied from disinfected water points.
ii) To make the population participate in the disinfection of private water points.

2) Target population

i) Family heads (mother / father)
ii) Authorities
iii) Elected representatives
iv) Teachers
v) Fkihs (wise, religious men)

3) Methodology

i) Interpersonal communication

- Interviews
- Discussions
- Round table conversations

ii) Mass Media

- Advertisements
- Megaphone
- Public address system

4) Main topics

i) Seriousness of water-related diseases
ii) Importance of water points disinfection
iii) Personal (and hand) hygiene

5) Human means

i) Elected representatives
ii) Chiokhs and Makadems
iii) Teachers
iv) B.M.H and B.C.H personnel

6) Communication means

i) Advertisements
ii) View masters
iii) Folders (Brochures)
iv) Stickers
v) Cassettes

4.5 Implementation Program of Project

4.5.1 Project Screening for Urgency

On the basis of establishment of future water supply system addressed in the Section 4.3, implementation schedule has been scrutinized by the category of 1) urgency of project (short term, medium term, and long term), 2) economic effect , and 3) ease of implementation and establishment of organization, 4) coordination and cooperation with the ongoing and already planned programs, and 5) regional contribution in socio-economic aspects in rural areas.

Out of the schemes proposed to be implemented by the target year of 2010, the following programs have been screened:

(1) Establishment of water supply system in model areas
   1) Development by gravity system
   2) Development by pumping system
(2) Exploitation of groundwater resources
   1) High potential structures (10 structures)
   2) Medium potential structures
(3) Rehabilitation of existing facilities of groundwater sources
   1) Model areas
   2) Others in the Study Area
(4) Development of surface water supply system
   1) Rehabilitation and improvement of ONEP facilities
   2) New water supply system based on Al Wahda reservoir

4.5.2 Scope of Programs

In compliance with the schemes screened, the following programs in three terms have been proposed. The implementation plan for these programs are shown in Figure 4.5.1.

(1) Short Term Program (1996 - 1998)

1) Construction of Water Supply Facilities in the Mode Areas (by Gravity System)

(Ain Defali)

- Submersible Pump	Model	BS - MF Type
	Diameter	80 mm
	Stage	5 No. of impeller
	Frequency	50 Hz
	Power	11 kW
	Discharge	0.69 m^3/min
	No. of pump	3 units
	Head	48 m
- Pipe line installation	D=200 mm	L= 600 m
	D=150 mm	L= 1,500 m
	D=125 mm	L= 4,700 m
	D=100 mm	L= 13,600 m
	D= 89 mm	L= 11,750 m
	D= 75 mm	L= 12,530 m
	Total	L= 44,880 m
- Distribution tank (RC)		
	V= 600 m^3 x 1	
	V= 400 m^3 x 1	
	V= 100 m^3 x 6	
- Stand pipes	25 units	
- Appurtenant facilities	LS	

(Teroual)

- Submersible Pump	Model	BS - MF Type
	Diameter	65 mm
	Stage	10 No. of impeller
	Frequency	50 Hz
	Power	5.5 kW
	Discharge	0.33 m^3/min
	No. of pump	2 units
	Head	46 m
- Pipe line installation	D=125 mm	L= 500 m
	D=100 mm	L= 250 m
	D= 89 mm	L= 11,300 m
	Total	L= 12,050 m
- Distribution tank (RC)		
	V= 280 m^3 x 1	
	V= 140 m^3 x 2	
- Stand pipes	9 units	
- Appurtenant facilities	LS	

(Ain Berda)

- Submersible Pump	Model	BS - MF Type
	Diameter	50 mm
	Stage	10 No. of impeller
	Frequency	50 Hz
	Power	5.5 kW
	Discharge	0.18 m^3/min
	No. of pump	2 units
	Head	65 m
- Pipe line installation	D= 75 mm	L= 900 m
	D= 64 mm	L= 1,300 m
	D= 50 mm	L= 4,800 m
	D= 25 mm	L= 4,100 m
	Total	L= 11,100 m
- Distribution tank (RC)		
	V= 120 m^3 x 1	
	V= 30 m^3 x 1	
	V= 10 m^3 x 1	
- Stand pipes	4 units	
- Appurtenant facilities	LS	

2) Rehabilitation of Existing Water Supply Facilities

Dugholes

i) repair of wall
ii) provision of roof on dughole
iii) provision of cover on dughole
iv) provision of hand pump
v) provision of concrete stage for sanitary purpose
vi) provision of drain

Springs

i) provision of water tank
ii) provision of conduction pipe from spring to tank
iii) provision of roof
iv) provision of concrete stage for sanitary purpose
v) provision of drain

(Ain Defali)	Dughole	7 location
	Spring	19 location
(Teroual)	Dughole	1 location
	Spring	23 location
(Ain Berda)	Dughole	0 location
	Spring	7 location

3) Exploitation of High Potential Groundwater Sources

(Mountainous Area)		No. of Well	Depth
i)	Taineste	1	125 m
		1	100 m
		1	75 m
ii)	Khamise	1	150 m
		1	125 m
iii)	Lakdar (Keil)	1	150 m
		1	150 m
		1	100 m
iv)	Thar Souk	2	150 m each
		3	30 m each

(Hilly Area)		No. of Well	Depth
v)	Ourtzarh	2	300 m
vi)	Ain Saddine	3	30 m each
		1	100 m
		1	150 m
vii)	Taounate	3	30 m each
		1	250 m
viii)	Tissa	3	30 m each
		1	75 m
		1	100 m

(Plain Area)		No. of Well	Depth
ix)	Jofl El Melha	3	30 m each
		1	125 m
x)	Had Kourt	3	30 m each
		1	125 m

4) Rehabilitation and Improvement of ONEP Facilities as given in Table 5.5 in Supporting Report.

(2) Medium Term Program (1999 - 2005)

1) Construction of Water Supply Facilities in the Mode Areas (by Pumping System)

(Ain Defali)

- Pipe line installation	D=125 mm	L=	800 m
	D=100 mm	L=	7,800 m
	D= 89 mm	L=	6,300 m
	Total	L=	14,900 m
- Pumping Facilities	18.5 kW	h=100 m	4 unit
	1.5 kW	h= 13 m	2 unit
- Distribution tank (R.C)	V= 100 m^3 x 2		
- Stand pipes	5 units		
- Appurtenant facilities	LS		

(Teroual)

- Pipe line installation	D= 89 mm	L= 8,700 m	
- Pumping Facilities	30 kW	h=130 m	4 unit
	7.5 kW	h= 70 m	2 unit
	7.5 kW	h= 60 m	2 unit
- Distribution tank (R.C)	V= 140 m^3 x 2		
- Stand pipes	6 units		
- Appurtenant facilities	LS		

(Ain Berda)

No facilities to be installed

2) Rehabilitation of Existing Water Supply Facilities

Same items as above to the entire Study Areas other than model areas

3) Exploitation of High Potential Groundwater Sources

Same as above

4) Rehabilitation and Improvement of ONEP Facilities

Same as above

5) Development of Surface Water Supply System (Al Wahda dam)

Planning, detail designing and construction of facilities in accordance with the progress of groundwater resources development program shall be implemented.

- intake
- water treatment plant
- pumping facilities
- transmission lines
- distribution lines
- distribution reservoirs

(3) Long Term Program (2006 - 2010)

1) Development of medium and low potential groundwater resources

2) Continuation of establishment of water supply system by Al Wahda dam

4.5.3 Financial Plan

(1) Financial Strategy

As shown in Figure 4.5.1, the implementation plan of water supply system in the Study area consists of the following components:

i) Water supply system in model areas
ii) Exploitation of groundwater resources
   - high potential structures (10)
   - Medium potential structure
iii) Rehabilitation of existing facilities of groundwater sources
iv) Development of surface water supply system

1) Model areas

First of all, the government is advised to prepare for a plan of fund mobilization to finance project costs. FIRR are estimated for various cases based on water supply scheme, the coverage of costs to finance and the model areas.

Table 4.5.1 FIRR for Water Supply Scheme

Unit: %

	Schedule	Ain Defali	Teroual	El Bibane
1.	Gravity			
1.1	Direct Cost Only	5.1	-	-
1.2	All project Costs	0.7	-	-
2.	Gravity + Pumping			
2.1	Direct Cost Only	5.2	-	
2.2	All Project Costs	0.9	-	

Note: (-) means negative value of FIRR

The application of loan to communes can be financially possible for both cases (Gravity, Gravity + Pumping) with direct cost only in Ain Defali. Loan repayment by the commune office of Ain Defali would not entail financial problem such as cash shortage. The results of financial analysis identifies that if water supply projects in the model areas to be implemented as planned in Figure 4.5.1. The government should appropriate for the budget to finance the following project costs.

Scheme	Ain Defali	Teroual	El Bibane
Gravity	Engineering Services Administration Expenses	All Project Costs	All Project Costs
Gravity + Pumping	Engineering Services Administration Expenses	All Project Costs	-

The sources of fund to finance the above project costs would be:

i) Government Funds (internal revenue, insurance of bonds)

ii) Domestic Funds

iii) International Funds

Except for internal revenue from taxes, the government is basically responsible for borrow and repayment of funds as a guarantor. The AH and the Ministry of Finance are advised to coordinate to determine the appropriate sources of fund to finance project costs.

2) Study area

Unlike the model areas, projects are not physically formed for the other components. The exploration cost of the ten (10) high potential structures for groundwater was only estimated as follows.

Table 4.5.2 Groundwater Exploration Cost

Location geological structures	Number of well (no.)	well's depth (m)	Exploration cost (DH)
Mountainous water potential structures			
01) J. Tainaste	3	75-125	1,440,000
02 J. Khamise	2	125-150	1,320,000
03) J. Lakhdar (Keil mountain)	3	100-150	1,920,000
04) Dhar-Souk	5	30-150	1,872,000
Sub total	13		6,552,000
Hilly water potential structures			
05) Ourtzarh	2	300	2,580,000
06) Ain Saddine (Rdat valley)	5	30-150	1,462,000
07) Taunate (Sra valley)	4	30-250	1,462,000
08) Tissa (Leben valley)	5	30-100	1,139,500
Sub total	16		6,643,500
Flat plan water potential structures			
09) Jorf El Malha	4	30-125	838,500
10) Had Kourt	4	30-125	838,500
Sub total	8		1,677,000
Total	37		14,872,500
(US$ equivalent, US$ 1.0=DH8.6)			(US$ 1,729,360)

The exploration cost is estimated to be about DH14.9 million. The financial plan of groundwater development in the Study area is contemplated to be as follows.

i) The rehabilitation cost of existing groundwater source would be costless, which is within payable capacity of local people. For example, the per capita cost of rehabilitation in the model areas are estimated to be less than DH100. Accordingly the rehabilitation of existing groundwater sources should be implemented by communes themselves.

ii) There are some areas where the proposed potential structure and the existing ONEP's groundwater supply system co-exists. It is desirable that the ONEP should be the implementation body of groundwater development in those areas. Accordingly the ONEP will be in a position of financing exploration and distribution costs.

iii) For areas where new water supply system is confined to the proposed structure only, it is recommended that the AH should prepare for the budget for exploration and a part of distribution cost. Projects would be operated by communes themselves. The government finance is certain to contribute to improvement of financial viability.

iv) The AH is recommended to prepare for the budget for execution of Pre-F/S or F/S for groundwater development projects in the study area.

(2) Financial Plan

The results of financial analysis in the model areas conclude that FIRRs estimated result in non-feasible value except for those of Ain Defali. The negative FIRRs (Teroual and El Bibane) are primarily ascribed to low demand associated with small scale of beneficiary population and high initial investment costs.

There is not the marked difference of FIRRs between Gravity and Pumping scheme and Gravity scheme in the case of Ain Defali. The less-cost scheme (Gravity) is expected to yield higher FIRR, but the results show no positive rate of return in Teroual and El Bibane. The implementation of either Gravity Scheme only or Gravity and Pumping scheme depends on not financial viability but project costs which the government is able to guarantee as the borrower.

In the light of financial viability (FIRR), the projects of Teroual and El Bibane basically need financial support to finance all project costs, whereas the loan scheme to finance direct construction costs would be financially manageable in terms of loan repayment condition for the project of Ain Defali. The loan repayment by the implementing body (commune of Ain Defali) would be financially sustainable.

Based on the results of financial analysis in the model areas, the following financial plan shall be taken into consideration for the Study Area.

1) Grant

Grant is specially designed to relieve the communes such as Teroual and El Bibane who are considered difficult to implement water supply project with even subsidiary or soft loan. The fund will be provided from either the Official Development Assistance (ODA) or the government budget. In case the government commits itself to borrow loan funds

from ODA, the government is responsible for repayment of such loans in place of communes.

i) Qualification
Communes showing that financial viability (FIRR) is negative or no positive rate of return.

ii) Project costs to be covered by grant
All project costs are basically financed by grant.

2) Subsidiary loan

This financial support intends to extend soft loans to assist the commune like Ain Defali whose financial viability (FIRR) is marginally viable.

i) Qualification
Communes showing that the prospect for loan repayment is financially sustainable.

ii) Coverage to finance costs by loan
Coverage to fiancee costs by subsidiary loan depends on the results of financial viability (FIRR). The project of Ain Defali shows that the financial rate of return on all project costs results in merely marginal, which makes it difficult for the commune to repay any subsidiary loans under the prevailing loan conditions. Thus the loan coverage is confined to direct construction costs.

iii) Source of fund
The financial sources of fund are the existing external loan lent from the bilateral financial institution and domestic loan from the FEC under the Ministry of Interior.

3) Financial Support

i) Tax reduction
This arrangement is intended to relieve or exempt income tax, import tax and value added tax (VAT) imposed on implementing bodies. The Ministry of Finance is responsible for issuance of special decree to enforce exemption of income tax and VAT to be executed for rural water supply projects. The AH is responsible for rendering necessary arrangements with agencies concerned including custom office on behalf of the commune offices.

ii) Foreign exchange risk

In the case of loan procurement from foreing countries, foreign exchange risk arises. Such a risk should be basically borne by the government and not to be imposed on implementing bodies.

iii) Establishment of financial intermediary

Financial channeling system is necessary for supply of funds to implementing bodies. It is preferable that intermediary banks do not act as executing bank but as channel ones. Accordingly the premium would not be imposed on implementing bodies.