Part II Feasibility Study

PART II FEASIBILITY STUDY

CHAPTER 7 NATURAL AND SOCIAL CONDITIONS OF THE PRIORITY PROJECTS

7.1 Natural Conditions

7.1.1 Physiography and Geology

(1) No.5 N'Fifikh

N'Fifikh Dam Site is located almost at the border between the tablelands on the Atlantic Ocean side and the mountainous land. Altitude of riverbed at the dam site is 212 m, and the highest peak of the river basin is a little higher than 800 m. The catchment area topographically features a lot of dense gullies and stream courses having round hill peaks of 500 to 700 m in height of elevation due to long time erosion of old rocks.

Unconsolidated deposits distributing in the area are Alluvial deposits, Colluvial deposits, and Terrace deposits. Alluvial deposits consist of River deposits, Alluvial Cone deposits, and Alluvial Terrace deposits. Their composition is mainly gravels and silts. Colluvial deposits consist of the mixture of fine soil and angular rock fragments, while Terrace deposits is of mainly silty to clayey layers with some rounded gravelly layers. Bedrock consists mainly of the alternation of Sandstone and Pelitic Stone, intercalated with some Quartzite boudin and Limestone mass. Sandstone has various types such as Quartzitic, Arkosic, ore mineralized, and partly schistose. The type of Pelitic Stone also ranges widely such as Argillite, Slate, Phyllite, or partly Pelitic to Green Schist. Structurally, the area can be divided mainly into Sandstone dominant area and Pelitic Stone dominant area, both of which belong to Devonian to Carboniferous. Overfolds and faults (thrusts) develop very much in the area, and zones of Pelitic Stone layers are sometimes sheared, phyllitizate, and schistose. Furthermore, very hard rocks such as Quartzite separate into some blocks forming boudin. Depth to sound rock at dam foundation is relatively deep. Surface zone is commonly developing many fissures. Due to this condition,it is dfficult to construct a concrete type of dam on the foundation. Geological profile of N'Fifikh is shown in Figure 7.1.1.

(2) No.9 Taskourt

Taskourt Dam Site is located on the northern slope of Haute Atlas Occidental. Altitude of riverbed at the dam site is 943 m, and the river basin has peaks ranging over 3000 m. The highest one is Jbel Igdet (3615 m). River Assif el Ma has perennial flow provided by snow-melting water from those mountains, and pours itself into Hauz plain around Marrakech.

Unconsolidated deposits in the area are Alluvial deposits, Colluvial or Talus deposits, and Terrace deposits. Alluvial deposits and Terrace deposits consist of very hard gravels, cobbles and boulders, while Colluvial or Talus deposits is of many brittle rock fragments and rock blocks in matrixes of silty soil. Bedrock around reservoir area can be divided into 6 zones that are mainly orienting from north to south. They are the following from western to eastern side.

i- Quartzite, Quartzitic Schist, Quartz-Chlorite Schist, and Chlorite Schist (Lower Cambrian)

ii- Pelitic or Biotite Schist intercalated with Psammitic Schist (Cambro- Ordovician)

iii- Phyllitize Rocks, Graphite Schist, and Meta-Quartzite layer (boudin) with many Quartz vein, Calcite vein, and Igneous material intrusion (Silurian)

iv- Alteration zone (Brittle Graphite Schist altered by sulphate, gypsum, and other igneous material)

v- Pelitic Schist, Psammitic Schist, or Biotite or Black Schist (partly phyllitize)
(Cambro-Ordovician)

vi- Psammitic Schist or Quartz-Biotite Schist (black and hard, partly Pelitic or Biotite Schist)
(Ordovician)

The foundation at dam site consists of the rocks of zone (vi) above mentioned. Those are slightly folded and their schistosity and bedding are usually dipping to downstream. Faults may exist along riverbed and in the right abutment directing their strike mainly parallel to river course and dipping to both riverside and mountainside. Foundation at dam site may probably be hard and massive but some faults may exist and covered with thick alluvial deposits along riverbed and talus deposit in the right abutment. Geological Profile of Taskourt dam axis is shown on Figure 7.1.2

(3) No.10 Timkit

Timkit Dam Site is located on the southern border of Haute Atlas Central limited by the cliff formed by the so called South Atlasic Faults. Altitude of riverbed at the dam site is 1211 m, and the highest peak of river basin is 2921 m of Ylalla Rejdet situated NE of the dam site. River basin is prolonged to ENE to WSW due to mountain ranging direction. Mountains in this area range usually ENE to WSW having cliffs in the southern side and sloping sometimes gentle and sometimes steep to the northward forming like Questa.

Unconsolidated deposits in the area are Alluvial deposits, Flood deposits, Talus deposits, and Travertine. Alluvial and Flood deposits is mainly composed of sands and gravels. Bedrock around reservoir area consists of Limestone, Dolomite, and Marl of Jurassic and Cretaceous. Foundation at dam site consists of the rocks as the followings from upstream side to downstream side. Those are all Liassic formations.

i- Limestone and Dolomite

ii- Black to brown ore (iron-manganese) mineralized Dolomite

iii- Alternation of (ii) strata intercalated with marl and (vi) strata

iv- White to bluish gray thinly layered (or laminating) stromatolitic or cherty strata.

Every stratum is dipping 20° to 30° to upstream side. Partial anticlinal folding can be observed in the downstream side. Stratum (i) in the upstream develops many karsts so that it may be loose, porous, and highly permeable. Stratum (ii) also develops large karst and many cavities exist inside. In case of strata (iii), they are interbedded with slightly cataclastic and nodular layers so that partly develops small karsts between these layers and limestone. On the other hand, strata (vi) have no karsts, well-layered, well contact each other, and relatively hard. Foundation rocks are usually relatively hard, but strata (i) and (ii) have a lot of leakage. Strata (iii) also has some leakage. To prevent leakage, strata (vi) should be utilized effectively. Geological profile of the dam axis is shown on Figure 7.1.3

(4) No.17 Azghar

Azghar Dam Site is located western side of Moyen Atlas whose peak altitude is more than 3000 m. Altitude of riverbed at the dam site is 821 m, and the highest peak of river basin is around 2100 m. Both banks around dam site and the following watershed consist of continuous hills, however the central area around reservoir and the land situating in the rear consist of relatively gentle sloping area. Unconsolidated deposits in the area are Colluvial deposits, Alluvial deposits, Terrace deposits, Travertine, and Residual soils with some wind transported soil and sheet erosion deposits. Bedrock in the area consists of two formations, namely:

i- Rhythmical alternation of laminated and fissile Marl and black Limestone.

ii- Laminated and fissile black Marl or Shale.

Both of them are Lower Liassic, and continuing from lower (ii) formation to upper (i) formation conformably. Large regionally, they form gently undulating Anticline and Syncline with axes NNE-SSW plunging to south. However, small regionally, they are monoclinic structure dipping 10° to 20° to downstream side at dam site with their strike almost parallel to dam axes.

Formation (ii) extends in relatively flat or gently sloping reservoir area, and Formation (i) forms hilly area around the dam site. Foundation at dam site is generally massive and strong enough as a foundation except weathered portion of surface layer. Strength of dam foundation may be enough even for concrete type of dam. Thickness of surface weathered layer is ranging from 3 to 5 m.

Up to 7～8 m depth in right abutment, 1～2 m at valley bottom, and around 20 m in left abutment from the rock surface, Lugeon value is rather high, usually more than 10. Deeper than above-mentioned depth, bedrock is commonly watertight. Bedrock is covered by colluvial material and travertine with around 10m in thickness at the foot in the right abutment, and by terrace deposits (sand and gravel with boulder) and fine colluvial material with 4 to 5 m in thickness at valley bottom. Left abutment usually has no overburden. Geological profile of the dam axis is shown on Figure 7.1.4.

7.1.2 Construction Materials

(1) No. 5 N'Fifikh

N'Fifikh dam and its appurtenant structures proposed by this study will require the following embankment volumes of each construction material:

- Impervious soil zone; 140,000 m^3
- Filter and semi-pervious sand and gravel zone; 60,000+300,000=360,000 m^3
- Pervious rock zone ; 160,000 m^3
- Rip rap ; 20,000 m^3
- Concrete aggregate; 60,000 m^3

Test pitting, sampling and laboratory testing were carried out for soil material and sand & gravel materials. Also, sub-surface exploration was performed for rock and rip rap materials without laboratory test.

(2) No. 9 Taskourt

Taskourt dam is proposed to be a concrete gravity type. According to JICA Study Team recommendation, the concrete volume is estimated as 415,000 m^3. Test pitting, sampling and laboratory tests were carried out for concrete aggregates as construction material. There is a large amount of river sand and gravel deposit observations in the proposed reservoir area. Also sand and gravel deposits are observed in the riverbed near downstream of the dam site. Prospecting volumes of deposits are estimated as 2,250,000 m^3 for the reservoir area and 150,000 m^3 for downstream dam site. Their boulder size content is not high. Silt contents are low, less than 3%. Gravel has excellent quality with 0.7 % of water absorption, 2.68 of specific gravity, 27% loss of abrasion test and non-reaction of alkali reaction.

Therefore, these materials are judged to be suitable for concrete aggregate. However, it should be noted that gravels have flat shape that will be causing less consistency of mixing concrete and will sometimes require increment of cement content. To obtain a proper condition of mixing, various kinds of concrete mixing tests are necessary.

(3) No. 10 Timkit

Timkit dam is proposed to be a concrete gravity type with concrete volume estimated as 230,000 m^3. There are sand and gravel deposits observed on the riverbed around upstream and downstream of the dam site. Prospecting volumes of deposits are estimated as 450,000 m^3. In the alluvium plain of downstream of Ifegh village, an enormous volume of sand and gravel are also observed.

Although no laboratory test on sand and gravel as construction material was performed, those materials are considered to have hard and of high durability to be suitable from their appearance. Natural sand and gravel have wide range of gradation, depending on the deposit condition and the depth.

Using sand and gravel with the natural gradation as concrete aggregate may affect the concrete qualities, for example, showing uneven concrete strength.

It is important to clarify the tendency or relation between the gradation of material and concrete qualities such as strength, workability, etc., through the survey and concrete mixing test in the next stage.

(4) No. 17 Azghar

Azghar dam and its appurtenant structures proposed by this study will require the following embankment volumes of each construction material:

- Impervious soil zone; 130,900 m^3
- Filter and pervious sand and gravel zone; 61,500+531,100=592,600 m^3
- Pervious rock zone; 23,200 m^3
- Rip rap; 23,100 m^3
- Concrete aggregate; 30,000 m^3

Test pitting, sampling and laboratory testing were carried out for soil material and sand & gravel materials. Also, sub-surface exploration was performed for rock and rip rap materials without laboratory test.

The results and the detailed assessments and construction materials are described in the Supporting Report X.

7.1.3 Hydrology and Groundwater

(1) River Basin

General location maps of the four dam sites and their related river basins are shown in Figures 7.1.5 to 7.1.8 for N'Fifkh, Taskourt, Timkit, and Azghar, respectively. Basin area, river system and managing office relevant to each dam are summarized below.

Principal Basin Features

Dam	BA (km^2)	River system	Managing office
N'Fifikh	323	Daliya/N'Fifikh	DRH/DPE Ben Slimane
Taskourt	419	Al Mal/Tensift	DRH/DPE Marrakech
Timkit	572	Iffer/Ferkla/Rerhis	DRH/DPE Er Rachidia
Azghar	263	Zloul/Sebou	DRH/DPE Fes

(Note) BA: Basin area at dam site

(2) Climate

Temperature of the Study area is low around the month of January (winter) and high around July/August (summer). The winter is generally wet and the summer is dry. The climatic features of N'Fifikh, Taskourt and Azghar sites are similarly located on the western side of the Atlas Mountains, but Timkit shows different features from other three sites located on the eastern side of the Atlas adjacent to the arid Sahara. The climatic features of these sites are outlined below.

General Climatic Features

Dam	Temperature (℃)	Humidity (%)	Ann.rainfall (mm/yr)
N'Fifikh	19.8 (12.0/28.0)	55.2 (45.5/63.2)	323
Taskourt	20.0 (12.1/28.7)	55.2 (45.5/63.2)	366
Timkit	19.4 (8.3/31.3)	41.0 (23.2/58.2)	186
Azghar	16.8 (9.0/25.8)	61.4 (46.3/70.8)	447

(Note) Temperature and humidity: Average (min./max.)

(3) Hydrology

Monthly inflows to the proposed dams were estimated based on flow records at reference stations as shown in Tables 7.1.1 to 7.1.4 for N'Fifikh, Taskourt, Timkit and Azghar Respectively. The average annual inflows are as shown below.

Inflow to Dam

Dam	Reference station	Period of data		Ann. inflow (Mm^3/yr)	
		(yr)	From - to	Average	Range
N'Fifikh	Feddane Taba	58	1939/40-1996/97	13.32	0.15-41.57
Taskourt	S. Bouathmane	62	1935/36-1996/97	44.65	6.41-125.37
Timkit	Tadighoust	36	1961/62-1996/97	10.11 (11.71)*	0.22-86.71 (1.83-88.27)*
Azghar	Dar Hamra	44	1955/56-1998/99	53.21	9.06-125.96

(Note) * : Annual inflow including subsurface flow.

Probable flood discharges proposed by DGH were verified to be acceptable by examining the latest flood records and the probable discharges of other dams in the similar hydraulic conditions. The flood peak discharges of various return periods are shown in Table 7.1.5.

Design values of annual reservoir sedimentation proposed by DGH were verified to be acceptable after comparative studies on reservoir sedimentation of other dams in similar hydraulic conditions (Table 7.1.6). Specific annual reservoir sedimentation (Ds) and the annual reservoir sedimentation (Vs) of the proposed dam are as follows:

Annual Reservoir Sedimentation

Dam	Basin area (km^2)	Ds($m^3/km^2/yr$)	Vs (m^3/yr)
N'Fifikh	323	93	30,000
Taskourt	419	280	120,000
Timkit	572	350	200,000
Azghar	263	490	130,000

(4) Groundwater

The groundwater study was carried out for No. 5 N'Fifikh and No. 10 Timkit considering the significant impacts of groundwater to the project development plans in these sites.

- No. 5 N'Fifikh

The N'Fifikh is located along the Atlantic Ocean Coastal zone. Approximately 25km southeast of Ben Slimene town in linear distance, and 45 km upstream from the estuary of the Daliya River near Mohammadia town. The elevation of the riverbed in the barrage site is around 240m. In the vicinity of the site, quartzite and alternation of silicious sandstone and schistosed shale are developed. These basement rocks are categorized into "Socle Orogenique Caledono-Hercynien" in Triassic, Mesozoic period. The downstream area of the River of Daliya is widely developed with the alternation of sandstone and shale in "Zone Caledono-Hercynian Cratonique". Both areas of the barrage site and the downstream area are geotechnically judged to have good water tightness. Details of the study are shown in Supporting Report XI.

- No. 10 Timkit

The Timkit Dam site is located in the vicinity of Tinejdad that has suffered from serious groundwater lowering by drought in several years and increase of demands. The surface flow is not reliable due to very limited floods. Basement rocks in the flat land is composed of hard sandstone, shale and conglomerate in Cretaceous. The formation of this rocks dips slightly to the north (the barrage Timkit side) with 5 ° or less. Due to high groundwater potential in Cretaceous sandstone and conglomerate formations, several deep tube wells are scattered.

Basement in the south area of Tinejdad and right side of the barrage Chitam are composed of igneous and sedimentary rocks in Paleozoic. They are nearly impervious. The formation of Paleozoic sedimentary rocks dips at rather steep angle of 20 ° to 30 ° to the north in the east and south area of Tinejdad. The alluvial deposits are developed in the flat land. The groundwater exists mostly in the alluvial deposits of boulders, gravel, pebbles and coarse sand along the main river courses such as the River of Ferkla (River of Todrha, River of Ifegh and River of Tanguerfa), the River of Rheris and the River of Izilf. Due to its high permeablility average of 1 x 10^{-1} cm/s in the deposits, most of the existing wells vary from 10 - 12 m (the north area) to 20 - 30m (the south area)deep. The depth depends on the thickness of the alluvial deposits. Calibration of groundwater basin is made to estimate groundwater size and hydrogeological parameters. The results in Todrha and Timkit are as follows:

Calibration Results of the Todrha and Timkit Basins

Basin	Width (m)	Length (km)	Thickness (m)	Porosity	Permeability (=1 x 10^{-1} cm/s)
Todrha	2,000	30	18.0	0.1	3m/day
Timkit	2,000	10	8.5	0.1	6m/day

The model of the Todrha is approximately 90km in linear distance from Tinehir to Tinejdad. It is matching the 1/3 of distance (=30 km) with 2,000 m width and 18.0 m deep. The result of calibration shows that GWL is continuously and constantly. The same trend has been observed in the lowering of the groundwater level lowering since 1973. The model along the River of Ifegh (Timkit) is approximately 30 km in linear distance from the barrage Timkit to Tinejdad. It is matching the 1/3 of distance (=10 km) with 2,000 m width and 8.5 m deep. The result of the calibration shows that GWL curve is lowering by 2 m, which is consistent with the actual GWL. Details results of the hydrogeological study are shown in Supporting Report XI.

7.1.4 Soils

(1) No.5 N'Fifikh

a) N'Fifikh Upstream

The soils of this area develop on the low and middle terraces in the large valley of the N'Fifikh River. Three types of soils lie on the area:

- Soils developing from alluvial deposits are situated on the low terrace along the N'Fifikh River. They are very deep with silty texture without any significant constraints for agriculture.
- Soils affecting isohumic condition extensively occupy on the right bank of the river. The soils are very deep, reddish color and clayey texture without any constraints for agriculture.

- Soils formed from Vertisols occupy large extent on the left bank of the river. These soils are characterized by very deep, clayey texture and low permeability. Locally, the soils present a stony load in middle surface. The area covering from these soils have a constraint on the slope.

b) N'Fifikh Downstream

The soils of this area develop on the low trays of the coastal plains as follows:

- Hydromorphic soils are dominant in this area. These soils are formed from old deposits of the Quaternary. They are characterized by a discontinuity of very clear textures. The surface soils from 30 to 50 cm in depth are coarse texture with high content in ferruginous concretions. The horizon lies on the accurate transition and subsurface soils are very clayey and compact horizon of impervious layer. These soils present major constraints of texture, discontinuity texture and internal drainage.
- Red soils lie on the east borders of the area. The soils are deep (from 80 to 120 cm) and locally fairly deep (40 to 60 cm). Their textures are slightly sandy in surface and become clayey in depth. These soils are generally good for agriculture, but there are constraints in topographical conditions.

(2) No.9 Taskourt

The Taskourt area has the following types of soils:

- Alluvial soils are situated on the low terraces of the Asif El Mal River and downstream area. They are very deep with silty textures. These soils are apt to inundate in the low terraces locally. They are capable in any kind of cultivation.
- Brown calcareous soils as well occupy large extent in strand on the left bank of the river. These soils are characterized by their shallow layer that are rarely 40 cm of surface soil and stony in surface.
- Fersialitic soils occupy large surface in the area and are concentrated completely on the left bank of the river. They are characterized by their red color and fine texture. The soils generally have constraints in the slope. The shallow soil depth and stony on surface are recognized partly.

(3) No.10 Timkit

a) Ifegh Area

The area is just located downstream the proposed Timkit dam site situated on the south of the High Atlas Mountains. Soils contain plenty of stones and gravels in surface and in depth. Terracing farmlands, which were graded and leveled by farmers, have been artificially developed in this area. In parts of the area dominated by the seguia, soil becomes very shallow and farmers brought earth there to enable cultivation. The soils of this area are characterized the stony and shallow soil.

b) Tinejdad Area

The area occupies a low alluvial terrace of the Todrha River. Soils are homogeneous. They are very deep alluvial soils with silty texture. The soils of this area do not present any considerable constraints for intensification of irrigation.

c) Chitam Area

The area was occupied by many farmlands but it was affected strongly by sand shifting that has invaded more than half of farmlands. Soils in this area are relatively sandy. It is difficult to irrigate part of the area.

(4) No.17 Azghar

This area is occuppies a large terrace of the Zloul River shaped in the tender schistose marls of the Jurrassique in the north edges of the Middle Atlas. Dominant soils are:

- Isohumic red soils occupy terraces where the slope ranges between 2 and 4%. They are very deep, clayey texture, and locally stony. The soils have high fertility with wide cultivation.
- The soils facing erosion situate in the area relatively steep slope of 4 to 8%. The soils are little deep (less than 40 cm). The area has topographic constraint.

(5) Land Suitability of the Each Project Areas

The classification of Land Suitability in Morocco basically follows the French system, which is for the operation of large scale in irrigation scheme. However, the irrigation plan has been proposed in consideration of small-scale network in this project, which is applicable to the high slope area. Therefore, the application of the classification of this land suitability will be considered based on the irrigation scheme proposed in the Project.

7.1.5 Natural Environment

Present status of fauna (terrestrial and aquatic) and flora (terrestrial) around the four dam literature was also reviewed. Field investigation was focused mainly on the submerging areas upstream, but ecosystems downstream reaches were also surveyed. Two endangered mammal species, *Felis caracal* and *Ammotragus levia* were distributed around some of the dam sites. *Felis caracal* was found in N'Fifikh and Azghar, and *Ammotragus levia* was also found around Taskourt, Timkit and Azghar sites. However, mobility of those species (cat and ungulate) is quite high so that the population size is unlikely seriously reduced unless there is a significant loss of their habitats. However, critical habitats of those species in the study areas have not been identified and that the impact is unlikely to be significant.

For to the status of fauna, any endangered or rare species of plant species have not been found with the field investigations during the course of the Study. Distribution of the plants is generally limited due to low precipitation.

Present status of natural environment is shown in XVI 3.1 of Supporting Report XVI.

7.2 Social Conditions

7.2.1 Socio-economic Conditions (downstream areas)

(1) Administrative Conditions

The beneficial areas of the four projects cover two municipalities, 13 rural and urban communes consist of more than 180 villages (Douars). Administrative conditions of the beneficial areas of each Project site are as shown in Table 7.2.1. More than 120,000 people will be directly or indirectly benefited from the Projects.

(2) Population

Population in the Beneficial Area (as of the year 2000)

Project	Population	Family Numbers	Household Numbers
No. 5 N'Fifikh	4,360	650	1,040
No. 9 Taskourt	51,030	7,850*	10,630*
No. 10 Timkit	17,560	2,140	3,200
	(59,700)	(4,500)	(10,190)
No. 17 Azghar	6,080	580	870

Notes: * : Estimated from Samples, ( ): including beneficiary by groundwater recharge

(3) Socioeconomic Survey

The Study Team conducted a socioeconomic survey in order to grasp the present condition of the people' s livelihood in the beneficial areas. The survey has been carried out in two different ways.

One is group survey and another is household interview survey. Summary of the survey results is shown in Table 7.2.2 and details are given in Supporting Report XII.

a) No. 5 N'Fifikh

- Social Organization

In N'Fifikh, an irrigation water association and some associations for fresh water supply exist but they are not operational at present. The organizations that are still operational are those entrusted with the management of mosques.

- Education

The school attendance rates are relatively high both among boys and girls. They are 96% for boys and 89% for girls. This is due to the proximity of large urban centers, availability of school and junior high school within reasonable distance from the villages. The literacy rates are low at 55% for men and 24% for women. Of the villages, 2/3 have a school in their villages and the remaining 1/3 are located 0.1 to 3 km away from schools.

b) No. 9 Taskourt

- Social Organization

The rural society at the downstream area of Taskourt is very well structured. The local population manages all the collective goods. The management of koranic schools and mosques, collective lands and irrigation water are revealing indicators of how well people are informally organized. These informal organizations have credibility among people. The most important formal (institutional) organizations at the downstream areas are the six milk cooperatives. Four of them are located in the rural communes of Guemmassa and Assif El Mal (two in each commune rural) and two are located in the rural communes of Mejjat and Mzouda (one in each).

- Migratory Movement

The migratory movements concern mainly the men's temporarily emigration. Of active men's population, 50% is concerned with emigration. They go to big cities where they stay and work for two to three months. They work in bakeries, cafes, public bathrooms (hammam), etc. Only 4 % of women are concerned by emigration. They go to big cities to work as housekeepers, employees in restaurants or cafes. The main reason of people's emigration is the lack of employment in villages accentuated by the severe drought of the last few years.

- Education

The school attendance rates are relatively high in the studied villages. They are of 78% for boys and 65% for girls. This situation could be partially explained by the schools' availability, which is located at an average distance of 0.4 km. On the other hand, the literacy rates are very low at 21% for men and 3% for women. Out of the eight sample villages, except in Aazib, primary schools exist in all other villages.

c) No. 10 Timkit

- Social Organization

In this site, social organization is still very active although it has reduced some of its functions. The most significant example is the irrigation community. Every unit has its Jmaa and does not avoid the implications of hierarchy and social stratification.

- Education

The schooling rate is also high among boys and girls. On average, it reaches 81% for boys and 76% for girls. In fact, all the villages have a school. The literacy rate is almost average for males (47%) and low for females (10%). All the douars have a primary school in their village. Two or three neighboring qsours commonly use one school. Junior- senior high schools are located in Tinejdad.

d) No. 17 Azghar

- Social Organization

Organizations that still exist are those entrusted with the mosque management.

- Education

The schooling attendance rate is high both for boys (88%) and girls (78%). This is due to the proximity of schools to the villages. The literacy rate is low at 44% for men and very low at 9% for women. Of the villages, 86% are less than 2 km away from school.

(4) Results of Household Interview Survey

The household interview survey was conducted in the beneficial areas. Number of households surveyed for each site is 63 for N' Fikh, 75 for Taskourt, 77 for Timkit and 44 for Azghar. Results of the survey are summarized below:

a) Family Structure

In many houses in the Project areas, more than one household live in the same house. Average family size in the Project areas is 8.9 persons and this is larger than average family size in rural area of Morocco, 6.6 persons. The average family sizes at N'Fifikh, Taskourt, Timkit, and Azghar are 8.4, 7.6,11.4, and 7.4, respectively.

b) Economic Activities

Almost all the households are engaged in agriculture, but many of them are also involved in other businesses. Especially in Timkit, the households engaged in agriculture and other economic activities make up account for 77 percent of the total households. Likewise, the farm families involved in other businesses are large at 48 percent for N' Fifikh, 63 percent for Taskourt, and 57 percent for Azghar. Probably this occurred due to drought in recent years and the need for cash income.

Family budget of the households in the Project areas is largely depending on remittance from migrant workers. Approximately 40 percent of the family income is coveted by remittance from migrant workers on average as shown below:

Average family income and expenditure (DH/house/year)

	N'Fifikh	Taskourt	Timkit	Azghar	Total
Excl. migrant workers remittance	32,800	20,800	12,600	16,500	20,551
Incl. migrant workers remittance	47,900	27,000	32,400	23,700	33,129
Family expenditure	15,600	17,100	16,100	16,300	16,300

According to many respondents, actual income and expenditure are almost balanced so they cannot afford to save money.

c) Influence of Flood and Erosion

In Timkit, a serious flood occurred in 1979. About 73% of the sample households answered that they have suffered from flood inundation in their farmlands. The damaged crops were dates, alfalfa, and wheat.

In N' Fifikh, a serious flood occurred in 1996. About 41% of the sample households suffered from flood damage in their farmland. Wheat, beans, and vegetables were damaged.

In Taskourt, a serious flood occurred in 1999. The ratios of suffered households are relatively small at 24%, but they are concentrated in Assif El mal commune. In the commune, 55% of households suffered from flood damage. The major damaged crops were barley, olive, and alfalfa.

In Azghar, flood inundation is not significant. The ratios of suffered households are small at seven percent.

7.2.2 Agriculture

(1) Present Agricultural Conditions

(a) No. 5 N'Fifikh

The Project area is separated into two, upstream area and downstream area. The Upstream area is located at the northwest of Ben slimane City and the downstream area is located at the west of Mohamedia City.

- N'Fifikh Upstream

The area of N'Fifikh upstream is typically single cultivated area of cereals under rain-fed condition. Main cereals are soft wheat and hard wheat. Vegetables are cultivated in the irrigated areas situated near the N'Fifikh River for self-consumption and cash income. Irrigation water is collected from groundwater by traditional methods, but irrigated areas are very limited.

Legumes (broad bean and green bean), forages (barley and oat) and tree crops (grape and olive) are cultivated in small areas. Present land occupancy of crops in the N'Fifikh upstream area is as follows (fallow or open Land = 9% and irrigated ratio = 3%):

Crops	Cereals	Legumes	Vegetable	Fodder	Fruits
(%)	85-90	5±	2±	5±	5±

There are no large-scale agricultural processing facilities. Agricultural machinery is widely utilized for cereal cultivation, and also cultivation by means of animals and manpower are also widely practiced. Fertilizers and chemicals are utilized but these amounts are small. Drip irrigation systems are used to cultivate grapes and potato.

- N'Fifikh Downstream

Single cultivation of cereals under rain-fed condition is also predominant in the area of N'Fifikh downstream. Main cereals are soft wheat and barley. Grapes are famous in this are, though their cultivated areas are not so large.

SBarley and oat are cultivated as fodder production. Vegetables and legumes are cultivated in very limited areas for self-consumption and cash income.

Fallow land in the downstream area occupies larger area compared with the upstream area. Farmers in this area have good knowledge and technique of cultivation methods. In the N'Fifikh downstream area, it is difficult to collect irrigation water. Irrigation water is only available as groundwater and natural ponds in the rainy season. Present land occupancy of crops in the N'Fifikh downstream area is as follows (fallow or open land = 22% and irrigated ratio = 5%):

Crops	Cereals	Legumes	Vegetable	Fodder	Fruits
(%)	80-85	1±	2-5	4-8	7±

There are some large-scale agricultural processing facilities. Agricultural machinery is widely utilized for cereal cultivation. Fertilizers and chemicals are utilized but these amounts are small. Both the upstream and downstream areas in N'Fifikh are located near Rabat and Casablanca. These areas have, therefore, high potential for future development in view of marketing condition.

(b) No. 9 Taskourt

The Taskourt area is located at the typical agricultural zone in the southeast Moroccan climate, which is relatively warm and has low precipitation. There are some constraints in farming due to the steep topographical condition and gravely soils.Main cereals consist of barley and soft wheat. Fodder cultivation (alfalfa) is practiced along the Assif El Mar River. Fruits including olive and almond are commonly cultivated. Olives are grown in flat lands and almonds relatively in sloppy areas.

Main vegetables are potato and melons. Present land occupancy of crops in this area is as follows (fallow or open land = 4% and irrigated ratio = 32% with permanent, seasonal and flood irrigation)

Crops	Cereals	Legumes	Vegetable	Fodder	Fruits
(%)	> 80	< 2	5±	5±	7±

There are no large-scale agricultural processing facilities except traditional ones. Most olives are sent to the factories in Agadir. Agricultural machinery is commonly operated for cereal cultivation, and animal cultivation is also practiced. Fertilizers and chemicals are utilized nevertheless these amounts are small.

Since the area is located near Marrakech, its marketing situation is favorable.

(c) No. 10 Timkit

- Ifegh

Agriculture in this area is an oasis type (high temperature and no precipitation) with traditional cultivation and small-scale farming. The area consists of two lots; traditional farmland located near proposed dam site and newly extended area situated downstream the traditional farmland. The farmers themselves consume most of the present productions. Main crops are cereals (hard and soft wheat, barley and maize), fodder (alfalfa) and tree crops (dates, olive and almond). Vegetables including potatoes, melons and onions are cultivated in small area. Most of the farmlands are under irrigation and the cultivation has been restricted by traditional water rights. Present land occupancy of crops in this area is as follows (fallow or open land = 4% and irrigated ratio = 95%):

Crops	Cereals	Legumes	Vegetable	Fodder	Fruits
(%)	75±	3±		12±	10±

- Tinejdad

In this area, typical oasis agriculture (high temperature and no precipitation) is practiced by small landholders. The area has been faced with serious situation for agricultural activities because the groundwater has been exhausted. Main crops are cereals (hard wheat), fodder (alfalfa) and fruits (dates and olive). Vegetable cultivation is also commonly practiced. Main vegetables are melons, tomatoes and potatoes. The farmers have good experience and know-how of irrigated agriculture. Rate of irrigation is high and cultivation is restricted by traditional water rights. Occupancy of fallow land is relatively high. Fallow lands have been increasing year by year due to droughts mentioned above. Present land occupancy of crops in this area is as follows (fallow or open Land = 16% and irrigated ratio = 75%):

Crops	Cereals	Legumes	Vegetable	Fodder	Fruits
(%)	55-60	2±	5±	15±	20±

- Chitam

In this area, the authority is trying to develop a farming area, which was ruined in the 1970's due to exhausting of groundwater. Small farms are scattered in the area and most of them are still left as fallow lands (86% of potential land). Traditional cultivation has been practiced in small lands under high temperature and no precipitation. Main crops are cereals and fodder (alfalfa). Farmers come from surrounding areas such as Tinejdad and Goulmima. They have high-level cultivation technique. Present land occupancy of crops in this area is as follows (fallow or open land = 86% and irrigated ratio = 100%):

Crops	Cereals	Legumes	Vegetable	Fodder	Fruits
(%)	50	10	10	30	0

(d) No. 17 Azghar

The Azghar area is located in the typical agricultural zone in the northern Moroccan climate that is relatively cool and high in precipitation. Irrigated area is very limited and most of the crops are cultivated under the rain-fed condition. Main crops in this area are cereals and olive.

Olive cultivation is commonly practiced in the southeast part of potential area, where topography is undulating. Main cereals are hard wheat and barley. Legumes are also commonly cultivated. Vegetables and other crops are only cultivated for self-consumption. Barley and oat are produced for animal breeding. Present land occupancy of crops is as follows (fallow or open land = 18% ,irrigated ratio = 6%):

Crops	Cereals	Legumes	Vegetables	Fodder	Fruits
(%)	75±	5±	< 2	2-5	15±

There are no large-scale agricultural processing facilities except traditional ones for olives. Agricultural machines and animal traction are utilized for various cultivations. Fertilizers and chemicals are utilized although their amounts are small.

(2) Existing Conditions of Irrigation and Water Rights

(a) No. 5 N'Fifikh

- Upstream Area

In the upstream area of N'Fifikh, there were a few irrigation channels diverted from the Dir and Daliya Rivers in the past. However, the diversion structures and channels are severely deteriorated and damaged, and none of them are functioning at present. Along the river, irrigation is practiced for only twenty to thirty hectares by pumping up river water and groundwater. Regarding the water right, several persons made application for it in the past, nonetheless most of them were rejected due to insufficient qualification.

- Downstream Area

In the downstream area of N'Fifikh, no river water is used except for only a few hectares located in the riverbed of the N'Fifikh River. There exists no agricultural water users' association (AUEA) in these areas. Water from the river and the wells is managed individually.

(b) No. 9 Taskourt

In the Taskourt area, the network of irrigation channels originating from the Assif El Mar consists of 18 principal irrigation channels of traditional type. Length and capacity of the respective channels, and their command areas and type of irrigation are shown in Table 7.2.3. It should be noted that the network is joined and that the water taken by the upstream channels can arrive to the downstream ones by the set of successive cascades of irrigation channels to others. It is seen from the table that the total irrigation area is 18,750 ha consisting of perennial irrigation with an area of 1,180 ha, seasonal irrigation of 5,520 ha and flood irrigation of 12,050 ha.

Surface irrigation method is predominant in the area such as furrow, border and basin irrigation. When the river water is scarce, the enjoyment of the water rights is generally made according to the priority of the upstream on the downstream. Distribution of water from the river to the channels, and from the channels to the villages is made based on the rights as indicated in the table. The inter-villager distribution is complicated but in principle proportional to the owned surface from the upstream towards the downstream. AUEA manages irrigation water there.

In the flood period, when the flows is not controlled anymore, each intake and irrigation channel will convey the flow without regulation to the downstream areas, and as far as the flood continues, flood irrigation is practiced.

(c) No. 10 Timkit

The Study area of Timkit consists of three separate areas, Ifegh, Tinejdad and Chitam, of which irrigation areas and water rights are referred to Table 7.2.4.

In the Ifegh area, irrigation is conducted for an area of 200 ha with the underground water and flood taken from the Ifegh River. The water right of the area with a discharge volume of 0.035 m^3/sec is authorized. Water is conveyed to individual farms through concrete channels. Irrigation method of the area is gravity such as furrow, border and basin. Irrigation water in this area is managed by the AUEA.

In the Tinejdad area, floods from the Tanguerfa and the Todrha Rivers are conveyed to the field. Three channels diverted from the Chaaba cover the fields with an area of 175 ha, two channels diverted from the Tanguerfa River cover the fields with an area of 215 ha and four channels diverted from the Todrha River cover 720 ha, totaling 1,110 ha. Volume of floods to be conveyed to these areas is more or less proportional to each acreage.

Irrigation in this area is practiced by means of border method. It should be noted that the prefectural commission in charge of water right authorization (groundwater) suspended any requests in this zone until the present situation is improved. The reason is that the regression of groundwater aggravated by years of drought and intensive pumping caused serious constraints of the development of this region.

In the Chitam area, floods from the Felkla River will be supplied to the fields covering an area of 690 ha through the newly constructed diversion weir and concrete channel. Volume of flood to be conveyed is designed as 1.0 m^3/sec.

(d) No. 17 Azghar

In the Azghar area, there is no irrigation channel diverted from the Wad Zloul. However, pump-up irrigation is practiced at seven locations, five in the right bank of the river and two in the left. Irrigation area is only 42.5 ha in total. Drip irrigation for tree crops is predominant in this area. Water right for these irrigation areas in using the river water is authorized. It should be note that the areas located in the right bank would be covered with the proposed irrigation network, but the areas located in the left bank would not. In addition, there are four areas where irrigation is practiced by using groundwater and/or spring water at present within the Study area. There is no AUEA in this area, therefore, river and well water is managed on an individual basis.

(3) Agricultural Extension and Supporting Services

(a) Extension Related Institutions in the Study Area

- No. 5 N'Fifikh

There are two Work Centers (CT) responsible for the extension activities in the Study Area i.e., the CT of Ben Slimane for the upstream area and the CT of Bouznika for the downstream area, respectively. The CT of Ben Slimane has four Sub-Centers of which one is in Ben Slimane with seven technicians and the CT of Bouznika has three Sub-Centers of which one is in Ben Yakhlef with four technicians and one staff for feminine animation are responsible for the extension activities in these areas. There are about 400 farm households per extension worker.

- No. 9 Taskourt

The extension activities in the area are the responsibility of Work Center in Chichaoua. There are six Sub-Centers under it of which three are in the area, i.e., Guemassa, Assif El Mal and Mzouda respectively. These Sub Centers are staffed by one extension worker each. The average farm households per extension workers exceed more than 2,000 households.

- No. 10 Timkit

Two CMV, one in Tinejdad and the other in Aghbalou under ORMVA/TF are responsible for the extension activities in the area. ORMVA/TF has one Sub-Division in Goulmima that supervises the activities of the above CMV. There are altogether five Sub-Divisions and 21 CMVs under ORMVA/TF.

In the CMV of Tinejdad there are two extension workers for general agriculture and one for livestock production. In Aghbalou there is only one extension worker specialized in livestock.

- No. 17 Azghar

There are four Work Centers (CT) in the province of Sefrou. The Work Center (CT) located at Ribot Al khayr is responsible for the extension activities in the area. There are six technicians for extension activities and one is in charge of agricultural materials. There are about 500 farm households per extension worker.

(b) Agricultural Marketing

- No. 5 N'Fifkh

Owing to the good excess to the big cities as Casablanca, Mohammedia and Rabat, it is estimated that about 95% of the farmers buy agricultural inputs from private traders rather than from the sales points of CT. It is estimated that the prices of inputs in private shops are cheaper by 10% on average. Farmers in the area sale their products either to the wholesalers from the big markets from Casablanca, Mohammedia, Rabat etc. or sale in the local markets called Souks. There are five Souks used by the farmers namely, Tlet Zaida, Arba Ben Slimane, Jemaa Fedalette, Khemisse Bouznika and Ahade de Beni Yakhlef.

- No. 9 Taskourt

Farmers of the area procure agricultural inputs from the sales point of CT in Chichaoua. Chemical fertilizers and traditional seeds are also available in weekly markets (Souks) or private shops, but certified seeds are only available in the sales point of CT. There are four Souks Had M'jjate, Arba Frougma (Guemassa), Sebt Mzouda (Mzouda) Arba Assif El Mal in the area. Agricultural products, livestock, daily use commodities etc. are sold in these weekly markets. Traders from other areas or big markets from Marrakech, usually used those Souks for the procurement of agricultural and livestock products.

- No. 10 Timkit

Farmers of the area buy agricultural inputs from the sales point of CMV or from private shops. SONACOS has a sales point and FERTIMA has four sales points in Errachida of which one is in Goulmima. Prices are rather low at private shops, so the share of agricultural input supply of private traders is an increasing trend.

Two Souks, Had Tinejdad and Tlet Goulmima were the main Souks used by the farmers.

- No. 17 Azghar

Agricultural inputs, such as seeds, fertilizers, pesticides, etc., are available at the sales point of CT at Ribat Al Khayr, which is about 4 km from the area. Fertilizers and seeds of traditional varieties are also available in the weekly market at Al Ribat Al Khayr or in private shops. The major destination of the agricultural products in the Study Area is the Souk of Tinin Ribat Al Khayr.

(c) Cooperatives and Farmers' Organizations

- No. 5 N'Fifikh

There are several cooperatives in and around the area and most of them are milk collection and marketing cooperatives. There are three farmers' associations, N'fifikh River Water Users' Association (Association des Usagers d'eau d'Oued N'fifikh), Red Meat Producers' Association (Association des Producteurs de Viande Rouge) and Young Farmers' Provincial Association (Association Provinciale des Jeunes Agriculteurs ; APJA).

- No. 9 Taskourt

In this area, there are four Water Users' Associations, two in Assif El Mal one in Guemassa and one in M'jjate respectively. Those associations were established after 1996 and have altogether 650 households as members. Thee are eight cooperatives in the area, three in the commune of M'jjet, three in Assif El Mal, one each in Guemassa and Mzouda respectively. All but two cooperatives are milk collection and marketing cooperatives.

- No. 10 Timkit

In the Study Area there are six cooperatives of which five are in the Commune of Tinejdad and one in Aghbalou. Four cooperatives are active in sheep breeding and one in apiculture.

- No. 17 Azghar

There are no cooperatives and farmers' organizations in this area, however some farmers are the members of provincial comparatively large cooperative and association called ASSAS (Association ds Arboriculture de Sefrou) and Red Met producers' Association.

(d) Household Economy

- No. 5 N'Fifikh

According to the household interview survey, 52% households were engaged only in agriculture and livestock keeping, whereas the other 48% were engaged in agriculture and other activities as labor, small business etc.

Owing to the proximity to the big cities, like Casablanca, Mohammedia, Rabat etc., there were more opportunities for employment. The total average annual family income was estimated at 47,900 Dh. The annual family expenditure was 15,600 Dh (Table 7.2.5).

- No. 9 Taskourt

The major economic activities were agriculture, livestock rearing, small business, seasonal labor, etc., that generated annual average family income of 27,000 Dh. According to the household interview survey, 50% of the active men labor force found employment in big towns like Marrakech, Agadhir etc., for two to three months during a year. The annual family expenditure was 17,100 Dh (Table 7.2.5).

- No. 10 Timkit

In the area of Timkit, 47% of the respondent households were engaged in agriculture cum labor, whereas 19% were engaged only in agriculture and livestock rearing. Because of the drought during recent years, majority of the households were forced to get some source of alternative income. According to the household interview survey, nearly two third of the young labor force goes to the cities for seasonal employment. The average annual family income was 32,400 Dh and the annual average family expenditure was 16,100 Dh (Table 7.2.5).

- No. 17 Azghar

In the Study Area, the important source of income is agriculture and animal husbandry. According to the household interview survey 43% households were engaged only in agriculture and animal husbandry whereas another 57% were engaged in agriculture/animal husbandry cum other activities like small business, labor etc. The annual average family income in Azghar was estimated at 23,700 Dh and the average annual expenditure was 16,300 Dh (Table 7.2.5).

7.2.3 Rural Water Supply

Existing water supply systems at downstream reach of the dams are controlled and managed by the ONEP, communes, villager's associations or individuals.

(1) No.5 N'Fifikh

The beneficiary irrigation area of the N'Fifikh dam (upstream) extends within the communes of Ziaida, Mellila, Moualine El Ghaba, Oulad Yahya Louta, in Ben Slimane province. The local population in and around the irrigation area exists in dispersed condition, and mainly depends on wells or springs for drinking water supply. Major springs are located in Lakdamra village in Ziaida commune (Sidi Amar) and Ouled Tarfaya village in Moualine El Ghaba commune (Ain Marsid).

Public wells are located in Ouled Jialili village in Ziaida commune and Ouled Chaoui village in Mellila commune.

Private wells are constructed not only beside the river, but also on side of hills at both banks. For the latter, however, high salinity and/or scarcity of water quantity during drought seasons are observed in some locations. There is no plan for intervention by the ONEP in this area at this moment. According to site survey, daily domestic water consumption (drinking, cooking, washing, bathing and etc.) per capita is 8 to 12 liter/capita/day (9.4 in average). Meanwhile, willingness to pay by local habitants for water supply service varies between 20 and 70 DH per month per one household.

In Mellila center, which is located around 9km westward of the dam site, the commune manages a water supply network that serves some 200 recipient households. Water source is a spring (Ain Oum Laknabech) of which discharge is 2 liter/sec, and there exists three storage tanks ($120m^3$, $30m^3$ and $27m^3$). High salinity is observed. The ONEP is planning to intervene in this center by extending distribution pipe from Fedalate center to which the water is supplied from the Sidi Mohamed Ben Abdallah (SMBA) dam.

(2) No.9 Taskourt

The beneficiary irrigation area of the Taskourt dam extends within the communes of Assif El Mal, Majjat and Mzouda in Chichaoua province. The local population depends on wells, springs or "Mattfias" (storage tank) for drinking water. As a rule, springs are major sources of water for villages in the mountainous area such as Taskourt, Anebdour, Zilawt, Sidi Bou Otmane, etc. in Assif El Mal commune. Quality of water taken from such springs is comparatively better and accepted by the local population. Meanwhile "Mattfias" is widely used at many villages in flat area, such as Dar Akimakh, Dar Al Jorf, etc. in Assif El Mal commune and Tiguemi Oumrhar, Tamatoust, etc. in Mzouda commune, to store surface water in the river taken through "Seguia" (canal). Quality of water from "Mattfias" is regarded as one of the causes for water-borne disease occurrence. Quantity of water in these villages becomes insufficient notably during dry seasons. There is no plan for intervention by the ONEP in this area at this moment.

Daily domestic water consumption per capita is 14.8 to 16.2 liter/capita/day (15.7 in average). Meanwhile, willingness to pay by local habitants for water supply service varies between 10 and 30 DH per month per household. Monthly expenditure for water transportation is 5 to 50 DH (21 in average) per month per household. In Majjat center (Souq Al Had Majjat), which is also located within the irrigation area, the commune manages a water supply network that serves some 200 recipient households and 10 standpipes. There exists two wells equipped with two storage tanks ($100m^3$ and $25m^3$), and its daily production is about 120 m^3/day. There is a possibility that the ONEP will intervene with this system in the future.

(3) No.10 Timkit

The beneficiary irrigation area of the Timkit dam extends within the communes of Aghbalou-N'kerdous, Ferkla El Oulia and Ferkla Es Soufla in Errachidia province. At the immediate downstream of the dam (Ifegh village), there exists a water supply system that serves some 400 recipient households under management by a villager's association. There is one drilled well (168m deep, water surface at some 40m deep) equipped with a pump ($21m^3/h$) and a storage tank ($72m^3$). Monthly production is about 2,500 to 3,000 m^3.

Tinejdad, the municipality that is located downstream of the dam, is served by the ONEP's water supply system (Goulmima-Tinejdad) of which main source are three drilled wells. Existing water supply capacity is 96 liter/sec. Several villages around Tinejdad such as Ait Labzem, Ait Assem, Ait Hamou, etc. in Ferkla El Oulia commune are already connected with the Goumima-Tinejdad system. The remaining villages in Ferkla El Oulia and Ferkla Es Soufla communes currently depend on "Khettara" (traditional water supply system) or private wells. However, extension programs of conduits of the Goulmima-Tinejdad system to cover such villages are already committed by the ONEP.

(4) No.17 Azghar

The beneficiary irrigation area of the Azghar dam extends within the communes of Ighzrane and Oulad Mkoudou in Sefrou province. Ribat El Kheir, the nearest municipality from the dam, is served by the ONEP's water supply system of which source are two wells (Ain Ajri and Ifrah). Existing water supply capacity is 25 l/sec.

Several villages around Ribat El Kheir such as Ikharouane, Tsaout Ou Araar, Taghza Lamrouj, etc., in Ighazrane commune are already connected with the above Ribat El Kheir system. The remaining villages in the irrigation area currently depend on springs and wells. At the most downstream irrigation area (Mghila village in Ouled Mkoudou commune), there exists a water supply system that is managed by the commune.

This system is in severely poor condition due to scarcity of water quantity at its source (Ain Jorf spring).

Extension programs of conduits to cover villages in and around the irrigation areas, including Mghila village, are already committed by the ONEP.

7.2.4 Rural Electrification

Among the Projects, the Taskourt and Azghar dams are selected for the study of power generation, because of rather ample water resources with respect to annual inflow, storage volume and/or dam height, compared to the other two dams, that is, the N'Fifikh and Timkit dams.

A survey found that there are concrete programs for rural electrification by the National Office of Electricity (ONE) to extend its 22 kV distribution lines around the sites of the Taskourt and Azghar dams in the framework of Global Rural Electrification Program (PERG), as shown in Table 7.2.6.

(1) No.9 Taskourt

Villages downstream of the dam such as Imin Ouassif, Zilawt, Sidi Bou Otmane and Dar Akimakh in Assif El Mal commune, and upstream of the reservoir such as Adassil, Mejdid, Quiadat in Adassil commune are already connected to the grid. ONE is implementing PERG2 (2000-2002) to electrify major villages in irrigation areas such as Taloutint, Tigourar, Dar N'mes etc., in Assif El Mal commune. Villages immediate downstream of the dam such as Taskourt, Anebdour, in Assif El Mal commune and in reservoir area such as Zawyat Hemti, Talat Nemti, Imin Eikha, Kerni, Talborjt, Tiliwa, Assais, etc., in Adassil commune are also to be electrified in PERG 3 (2002-2004).

(2) No. 17 Azghar

Villages located around Ribat Al Khayr such as Ifrah and Sidi Bonaza are already electrified. ONE is implementing PERG2 (2000-2002) to electrify villages in irrigation area such as Tsaout Ou Araar, Tichout Tamalalet, Nass Said Jbel, Taghza Lamrouj, Ekarbousse. Villages upstream of the reservoir or outside of the irrigation area are also programmed to be electrified in PERG4 and 5.

7.2.5 Social Environmental Conditions (upstream areas)

- Population

The population data in the downstream beneficial areas of the priority dam sites was evaluated as shown in Section 7.2.1. In order to evaluate the resettlement plans of the upstream dam sites, the Study Team investigated the actual population and households for upstream of the four priority dams. The population survey was made based on the social maps. According to the demographic data obtained at the four sites, the number of households, families and population were as follows:

Population at the Priority Dam Sites

Site	Household Numbers	Family Numbers	Population
Azghar	6	10	42
N'Fifikh	31	38	178
Timkit	39	64	342
Taskourt	301	410	2,306

Azghar has the lowest population and Taskourt is the most populated site. Numbers of destitute, disabled (entirely or partially) families were 22, 2, and 2 in Taskourt, Timkit, and N'Fifikh, respectively. It should be noted that many young couples (families) live currently with their parents in the same house.

- Socio-demographic:

The education level in the four sites is low for both men and women. Literacy of the men is low and almost all the women are illiterate. This low literacy rate is not conducive to empowering the populations quickly to take care of themselves during the resettlement process. Access to health services is possible only in emergency cases. Family planning and birth control exist in very rare cases. Even in the absence of the husbands, the women are not recognized to head the households.

In all sites except Azghar, more than 60 % of men leave their homes to other regions of Morocco or foreign counties in search for temporary work. With absence of men, the numbers of women heads households were found as 31, 3 and 1 in Taskourt, Timkit and N'Fifikh respectively.

- Social organization:

Timkit has the most organized population where the traditional association (e.g, Jamaa Soulalia: inherited group) exists. The group settles the conflicts among people and seeks to develop relations with other communities. It also directs collective work in the community, such as irrigation and water rights, and manage irrigation/agriculture schedule such harvesting dates. Also, the community grants building plots for extending the dwellings of applicants. One of the other tasks, which the Jmaa has, is to appoint "community employees", such as waterman (aiguadier), islamic teachers (Fakih) and guard to monitor farm plots. In Taskourt some individuals (as assaîs Fakih) possess the moral power amongst the population and therefore can organize people. These types of social cohesion can be supportive to facilitate population resettlement. In the N'Fifikh and Azghar there are no social organizations.

- Women conditions:

The women participate in all the activities without any decisional role. Their practical conditions are very unfavorable and do not insure comfort. They don't take any advantage of the strategic conditions of Moroccan women.

This situation is the result of the isolation of the sites, the general illiteracy of women, the willingness of men and resignation of women to maintain their position, respecting customs and traditions. Only the elder women are allowed to go to markets (souks). Woman cannot check the family budget and they rarely have their own income. Many women are ignorant in accounting money.

To cope with this, monitoring is necessary during the resettlement so that women can have all their rights. Besides, a lot of conflicts happen between people especially between man and women from the same family.

- Infrastructure and Equipment:

The four sites have a very low social infrastructure with no economic infrastructure. Tourist, cultural and archaeological sites do not exist. All the equipment and infrastructures whatever their status (public, collective or private) is counted and their prices are estimated.

- Land Ownership:

There are different types of landowners in the dam sites. Private farms (Melk) represented by ownership with or without certificate by a notary or court justifying, Islamic properties (Habous) and public lands. The rate of each status was approximately evaluated.

Outside the dam sites and near the river, the structure and the nature of soil are poor and the yield is very low. The water right exists only in Timkit. This right was established more than century of years ago. The population wants to recover it downstream. The forest area is the most important source of animals grazing in tree sites (except Timkit). The population is developing livestock breeding of small animals (ovines and caprines).

- Economical activities and Revenues:

People income is estimated by PRA and by household questionnaire. The source of income mainly comes from migrant workers remittances, livestock breeding, farming. The participation rates of each activity revenues are share (%) in the annual average income was estimated. It is understood that in all the sites, the livelihood gained by activities outside are more important than that obtained by the activities performed within the sites. For example, in Azghar the incomes from outside constitute 72% from the global annual revenue to the family. This rate is 58%, 54% and 60% in N'Fifikh, Timkit and Taskourt. This shows how the dam construction can have an incidence upon population's income.

- Perception of populations:

The population of the four sites agrees to the dam implementation and construction. They participated in counting of their goods, which were estimated beneficiaries residents or non-residents illegible. Global average income of 20% is added to entitled beneficiaries residents to be compensated for the 1st year of the resettlement.

Detail results of social environmental survey are given in Supporting Report XVI.

CHAPTER 8 DEVELOPMENT PLAN OF THE PRIORITY PROJECTS

8.1 Agriculture and Irrigation

8.1.1 General

Irrigation area has increased to approximately 1.0 million ha as of 1999. It is classified into three categories in terms of irrigated conditions. 1) Perennial irrigation with an equipped area of approximately 670,000 ha of the large-scale irrigation system (GH) and 330,000 ha of the small-scale irrigation system (PMH). In addition, 2) seasonal irrigation, and 3) flooding irrigation cover a total area of 300,000 ha.

PMH represents a potential of 510,000 ha of perennial irrigation and 300,000 ha of seasonal irrigation. Increasing attention has been given since the mid-1980s to improving PMH through rehabilitation and betterment, some 330,000 ha have been developed, and hence approximately 180,000 ha are to be developed.

According to the action plan concerning the rural development and irrigation in the Five Year National Development Plan, new irrigation development of 27,000 ha are proposed to be conducted under PMH, and an integrated rehabilitation program involving an area of 134,000 ha of PMH is scheduled to be implemented.

8.1.2 The Scope of PMH

PMH has a great potential for perennial irrigation as discussed above. They are scattered all over the country and developed by mobilizing water resources. A significant interest has been taken in PMH owing to the following reasons:

- It accounts for 38% of perennial irrigation potential and mobilizes 35 to 40% of water resources of the country;
- From the viewpoint of social equity in terms of its investment and distribution, PMH irrigation can take advantage of consented investments by the Government;
- The sector is promising because of its diversity of favorable ecological conditions to practice a variety of farming such as arboriculture, cereal, vegetable, etc.;
- It is possible to enhance water value difficult to regularize and improve water use efficiency;
- The immediate return of investment is expected due to the experiences of traditional irrigated farming;
- Social and economic effects will create job opportunity during and after the implementation and management of the system;

- It incurs limited intervention costs;
- There will be no serious negative impacts on environment; and
- The new system can be operated and maintained in many cases by the existing water users' association.

The Administration has set up a participatory approach with the beneficiaries from the design to the achievement of the project to successfully implement the project and to continue its investment. In addition to these efforts, it encourages the beneficiaries grouped with the framework of the agricultural water users' association (AUEA) to take responsibilities for the management of the perimeters.

8.1.3 Alternative Studies for each Project

In order to examine the irrigation extent and economic feasibility of the respective projects, alternative studies were conducted for the following 14 cases. The cropping patterns, water demands, irrigation areas, costs incurred, benefits derived, results of economic analyses are detailed in the Supporting Report.

(a) No.5 N'Fifikh

i- Upstream

1) Gravity irrigation for the cropping pattern proposed by the JICA Study Team that seems to be most appropriate in view of farming practices (Alternative NU1);
2) Gravity irrigation for the present cropping pattern to estimate the utmost extent of irrigation area (Alternative NU2);
3) Gravity irrigation for the cropping pattern proposed by the DPA Ben Slimane that seems to be most profitable in view of cash income, though it is risky due to large share of vegetables, with which most of the farmers are not familiar with their farming practices (Alternative NU3);
4) Mechanical irrigation (50%) together with gravity irrigation (50%) for the cropping pattern proposed 1) above for the examination of the feasibility of the introduction of the irrigation methods, such as sprinkler, drip, etc. (Alternative NU4); and
5) Gravity irrigation for the highland areas located at the left bank of the N'Fifikh river to evaluate economic efficiency (Alternative NU5).

ii- Downstream

6) Mechanical irrigation for the cropping pattern proposed by the JICA Study Team by lifting water from the N'Fifikh river for the examination of the irrigation extent and economic feasibility (Alternative ND1); and

7) Mechanical irrigation for the cropping pattern proposed 1) above by lifting water from a dam/reservoir to be constructed at N'Fifikh river near Rahal for the examination of the effect of the dam on irrigation area and economic feasibility (Alternative ND2).

(b) No.9 Taskourt

8) Gravity irrigation for the cropping pattern proposed by the JICA Study Team through the dam with a capacity of 34 Mm^3, which seems to be most appropriate in view of the scale of the reservoir (Alternative TA1);

9) Mechanical irrigation (50%) and gravity irrigation (50%) for the cropping pattern proposed 1) above through the dam with a capacity of 34 Mm^3 to examine economic feasibility of mechanical irrigation (Alternative TA2);

10) Gravity irrigation for the cropping pattern proposed 1) above through the dam with a capacity of 24 Mm^3,which seems to reduce economic and financial costs (Alternative TA3); and

11) Mechanical irrigation (50%) and gravity irrigation (50%) for the cropping pattern proposed 1) above through the dam with a capacity of 24 Mm^3 to examine economic feasibility of mechanical irrigation (Alternative TA4).

(c) No.10 Timkit

12) Gravity irrigation by means of surface water from the Timkit dam and subsurface water recharged with floods through pump wells except the Ifegh area where is irrigated by surface water (Alternative TI1); and

13) Gravity irrigation by means of subsurface water recharged with floods through pump wells except the Ifegh area, which is irrigated by surface water (Alternative TI2).

(d) No.17 Azghar

14) Gravity irrigation for the cropping pattern proposed by the JICA Study Team that seems to be most appropriate in view of farming practices (Alternative AZ1).

8.1.4 Agricultural Development Plan

(1) Basic Consideration

The agricultural development plan was formulated in consideration of the present land use, actual farming practices, intentions of local authorities and farmers, and the strategies of the Moroccan Government. The development plan has to contribute to the improvement of farmers' living condition and be appropriate and sustainable. For the formulation of the agricultural development plan (Target Year 2020), the following basic strategies have been adopted as the general methodologies.

a) Consideration of present land occupancy and farming practices

- To introduce crops that farmers have sufficient experience and farming techniques
- To formulate a plan based on the present cropping occupancy
- To promote cereal cultivation that is most important for increasing stable income of farmers
- To introduce crops in due consideration of marketing condition
- To apply the most suitable crop rotation for annual cultivation
- To formulate a land use plan with full assistance of the related authorities in view of technical support and marketing arrangement

b) Consideration of agro-climatic condition and soil condition

- To introduce crops that farmers have good experience in cultivation and formulation of a land use plan based on the agro-climatic condition
- To formulate a land use plan to adopt soil conditions in sites

c) Consideration of high value income under appropriate development

- To introduce improved seeds of cereals
- To introduce transplantation for some vegetable cultivation
- To formulate a plan based on the most appropriate managements of irrigation, fertilization and chemical control
- To introduce the crops those are considered sustainable for increasing farmers' income
- To formulate a plan with fodders that are able to increase income from animal breeding

d) Consideration of the national food security and governmental policy strategy

- To formulate cropping pattern aiming at production of staple food, especially cereals for national food security, which is one of the most important strategies of the Moroccan Government
- To target small and medium scale farmers as beneficiaries
- To alleviate poverty, to mitigate rural differentials, and particularly to create job opportunities in the outskirts of main cities
- To harmonize with other development sectors
- To formulate land use plans from the economic and financial viewpoints of the project.

(2) The Project Area

Study areas of priority projects are 17,125ha, which are used as agricultural land. The total acreage of the project area is 13,755ha of which 10,860ha is cultivable. The acreages of each project area are shown below.

Project Acreage Areas (Unit:ha)

Project Area		Potential Area	Study Area	Gross Area	Net Irrigation Area
N'Fifikh	Upstream	1,250	1,250	1,000	590
Taskourt	Taskourt	8,000	6,000	4,500	2,500
Timkit	Ifegh	300	300	240	240
	Tinejdad	2,835	2,835	2,298	888
	Chitam	690	690	522	222
Azghar	Azghar	2,350	2,350	2,350	2,000
Total		15,425	13,425	10,910	6,440

Details are shown in Supporting Report XIII. According to the above results, four priority project areas have enough potential acreage for irrigation. In Tinejdad, the areas that are not included in soil mapping are located in the present cultivated areas. Hence, there are no doubts to develop for 2,298ha. In Azghar, the areas that are not included in the soil mapping are mostly utilized as natural pasturelands located in the sloped areas with good soil conditions according to the field observations.

(3) Proposed Cropping Pattern

Proposed cropping patterns of each project area in consideration of the basic strategies mentioned have been proposed and formulated. Selection of crops for adapting the proposed cropping patterns to have been carried out in consideration of the present cultivated crops, agro-meteorological condition, technical level of farmers and social conditions of each project area. As principals of selection of crops, cereals, fodders, legumes, vegetables and fruits (tree crops) have been considered. Basic principals for the crops selection are summarized in Supporting Report V. According to the field survey and the analysis of statistical data in the each project areas, these crops are widely grown, and the farmers in and/or around the project areas have long experience in cultivation. Profitability and marketability for extended crops such as fruits and vegetables has been carefully considered, hence their introduction into the cropping pattern with a large area is decided in consideration with the present cultivated area. Their production as cash crops will require comprehensive development measures such as additional farming technologies, development of new markets including foreign countries, etc.

In addition to technical background, the creation of job opportunities by proposed cropping pattern should be also considered. Unemployed people who mainly are living in the outskirt of the urban area such as Casablanca, Fes and Marrakech, which has enough capacity to supply labor power.

To achieve optimum development, the technical support of the related authorities and their managing support for marketing should carefully conducted.

8.1.5 Irrigation Water Demand

(1) Basic Considerations

Estimate of the water demand with project is based on the meteorological information of five stations of Fes (for Zone I), Marrakech and data on temperature recorded at the Sidi Jaber Station (for Zone II), Marrakech (for Zone III), Ouarzazate (for Zone IV) and Errachidia (for Zone V). Reference crop evapotranspiration (ET_0) was worked out by the modified Penman method.

The effect of the crop characteristics on crop water requirement is given by the crop coefficient (kc) which represents the relationship between reference crop evapotranspiration (ET_0) and crop evapotranspiration (ETcrop) or ETcrop = kc・ET_0.

The effective rainfall (Pe) was calculated by analyzing rainfall records and rainfall probabilities.

In the Study, the effective rainfall was estimated by the evapotranspiration/precipitation ratio method (FAO Irrigation and Drainage Paper No. 25, Effective Rainfall, 1975) at dependable rainfall of 4 out of 5 years. The net irrigation requirement (In) was calculated using the field water balance. The variables include crop evapotranspiration (ETcrop), rainfall (Pe), groundwater contribution (Ge) and stored soil water (Wb), or In = ETcrop – (Pe + Ge + Wb). In the Study, Ge and Wb were disregarded, and hence, In = ETcrop – Pe.

The calculation of the project water requirement (V) required for a given cropping pattern and intensity includes the net irrigation requirement (In) and other water needs including conveyance, distribution and application efficiencies of the system. These are calculated on a monthly basis. Using average supply, the total project acreage can then be determined from the available water resources.

(2) Project Water Requirements

a) N'Fifikh Upstream

(Gravity Irrigation of the Upstream Area, Alternative NU3)

The project water requirements for the proposed cropping pattern by means of gravity irrigation for the N'Fifikh upstream area are calculated to examine the irrigation extent as well as economic feasibility (to be discussed in Chapter 10) as shown in Tables 8.1.1. Data and information used and procedures are as follows:

- The reference crop evapotranspiration (ET_0) is estimated by the meteorological data observed at the Marrakech Station and modified by using temperature recorded at the Sidi Jaber Station;
- The crop coefficient (kc) references the standard figures given in the Irrigation and Drainage Paper No. 56. The monthly average kc was calculated based on the cropping pattern proposed by the ADP Ben Slimane for the N'Fifikh upstream area, which is shown in Figure 8.1.1.
- The dependable rainfall 4 out of 5 years or 80% probability was estimated using the rainfall data observed at the Feddan Taba Station;
- The project water requirement (V) for the upstream area was estimated on the assumption that the overall irrigation efficiency is 52% (conveyance efficiency, water released to the river – concrete lined canal – feeder canal: 80%, and distribution and application efficiencies of furrow, border and basin irrigation: 65%);
- Studies on water balance and/or optimization of dam scale indicate that net irrigation area of 590 and 740 ha have 80 and 20% probability, respectively.

b) No.9 Taskourt

(Gravity Irrigation through the Dam with a Capacity of 34 Mm^3, Alternative TA1)

The project water requirements for the proposed cropping pattern by means of gravity irrigation for the Taskourt area were calculated to examine the irrigation extent as well as economic feasibility as shown in Tables 8.1.2. In this calculation, data and information used and procedures are as follows:

- The monthly average kc was calculated based on the cropping pattern proposed by the Study Team for the Taskourt area, which is shown in Figure 8.1.2;
- The dependable rainfall 4 out of 5 years or 80% probability was estimated using the rainfall data observed at the Amezmiz Station;
- The project water requirement (V) was estimated on the assumption that the overall irrigation efficiency is 52% (conveyance efficiency, water released to the river - main canal – feeder canal: 80%, and distribution and application efficiencies of furrow, border and basin irrigation: 65%); and
- Studies on water balance and/or optimization of dam scale indicate that the net irrigation area is 3,530 ha with 80% probability, and 4,500 ha with 20% probability.

c) No.10 Timkit

(Gravity Irrigation by means of Surface Water from the Timkit Dam and Subsurface Water Recharged with Floods, Alternative TI1)

The project water requirements for the proposed cropping pattern by means of gravity irrigation using surface water from Timkit Dam and subsurface water recharged with floods were calculated.

This is to examine the irrigation extent as well as economic feasibility as shown in Tables 8.1.3, 8.1.4, and 8.1.5 for Ifegh, Tinejdada and Chitam areas, respectively. Data, procedures and information used are as follows:

- The reference crop evapotranspiration (ET_0) was estimated by the meteorological data observed at the Errachidia Station;
- The monthly average kc was calculated based on the cropping pattern proposed for the Timkit area, which is shown in Figure 8.1.3 for the Ifegh, Tinejdad, and Chitam areas.
- The dependable rainfall 4 out of 5 years or 80% probability was estimated using the rainfall data observed at the Errachidia Station;
- The project water requirement (V) for the Ifegh area was estimated on the assumption that the overall irrigation efficiency is 58% (conveyance efficiency of concrete lining canal: 90%, and distribution and application efficiencies of basin irrigation: 65%)
- The project water requirements (V) for the Tinejdad and Chtam areas by means of subsurface water were estimated on the assumption that the overall irrigation efficiency is 60% (conveyance efficiency: 90%, and application efficiency: 65%).
- The project water requirements (V) for the Tinejdad and Chtam areas by means of surface water from the Timkit Dam were estimated on the assumption that the overall irrigation efficiency is 46% (conveyance efficiency along the river and canal: 72%, and application efficiency: 65%).
- Studies on water balance and/or optimization of dam scale indicate that the net irrigation area is 1,110 ha plus 240 ha for the Ifegh area.

d) No.17 Azghar

(Gravity Irrigation, Alternative AZ1)

The project water requirements by means of gravity for the Azghar area were calculated as shown in Table 8.1.6. In this calculation, data and information used and procedures are as follows:

- The reference crop evapotranspiration, (ET_0) was estimated by the meteorological data observed at the Fes-Sais Station;
- The monthly average kc was calculated based on the cropping pattern proposed for the Azghar area, which is shown in Figure 8.1.4;

- The dependable rainfall 4 out of 5 years or 80% probability was estimated using the rainfall data observed at the Ribat Al Kheir Station;
- The project water requirement (V) was estimated on the assumption that the overall irrigation efficiency is 52% (conveyance efficiency of concrete lining canal: 80%, and distribution and application efficiencies of furrow, border and basin irrigation: 65%).
- Studies on water balance and/or optimization of dam scale indicate that the net irrigation area is 2,000 ha with 80% probability of rainfall.

(3) Net and Gross Irrigation Areas

The area that is determined by the water balance study made between the available water resources and the project water requirements estimated based on the dependable rainfall of 80% probability is defined as the net irrigation area which is commonly used for economic evaluation. However, it is preferable to increase the cultivation area as large as possible in a dry region such is the case in this country where the available water resources are much less to meet the land toresources, as the farmers intend to utilize the land to the maximum extent. To cope with this, another project water requirement is calculated on the basis of the dependable rainfall of 20% probability as shown in the lower part of Tables 8.1.1, 8.1.2, 8.15 and 8.1.6 for N'Fifkh, Taskourt, Timkit (Ifegh), and Azghar respectively. It is proposed to determine the project area adopting the latter water requirements instead of the former. It is expected that incremental benefits may be gained when the rainfall exceeds that of of 80% probability.

The water demand worked out on the basis of the dependable rainfall of 20% probability is lower than that calculated on the basis of the 80% dependability by 20% to 35%. In other words, the irrigation area estimated by the former will be larger than that estimated by the latter by 20% to 35% except for Timkit area, where the rainfall is too little to be effective.

It is necessary to determine the area required for infrastructures i.e., canals, ditches, roads, etc, as well as buildings for storage, farming, accommodation, etc. It is a common practice to add 10 to 15% to the net irrigation area for such structures.

So the gross area should be as large as 1.5 to 1.6 times the net irrigation area with some allowance. In the future the irrigation area will be increased by adopting water saving mechanical irrigation method such as sprinkler, drip, etc. The increased area, which was estimated at approximately 30%, can be accommodated in the gross area thus determined. Thus, the irrigation facilities and structures alignment was proposed to cover the entire gross areas.

Summary of the respective areas stated above for each project is shown in Table 8.1.7.

8.1.6 Examination of Soil Salinity

Salinity problems encountered in irrigated agriculture are often associated with an uncontrolled water table. In most soils with a shallow water table, water rises into the active root zone by capillary action and, if the water table contains salts, it becomes a continual source of salts to the root zone as water is used by the crop or evaporates at the soil surface.

The rate of soil salinity accumulation from an uncontrolled water table depends on salt concentration of irrigation water, depth of the groundwater, soil type, climatic condition and topography.

When the build-up of soluble salts in the soil is expected to become excessive, the salts can be leached by applying more water than that needed by the crop during the growing season. This extra water moves at least a portion of the salts below the root zone by deep percolation (leaching)[(1)].

No serious salinity problem is observed in such area as Taskourt and Timkit despite the fact that these lands had been used for a long time without controlling groundwater table, nonetheless a small amount of excess water had been applied. This indicates that the water applied moves a portion of the salt by deep percolation and that part of the water is returned to the rivers as groundwater naturally. This trend is prominent if the irrigation area is small and soil is permeable. Since the other areas proposed for irrigation, N'fifikh and Azghar schemes are much smaller than the above, ratio of return flow as groundwater might be higher. Assuming that LF is only 0.15 or 15% of the irrigation water to be applied are used as leaching water, salinity of soils will be as follows:

project	Leaching fraction (LF)	Salinity of applied water (ECw) in dS/m	Soil salinity (ECe) in dS/m
N'Fifikh	0.15	1.6[(2)]	2.4
Taskourt	0.15	0.5	0.8
Timkit	0.15	1.8	2.7
Azghar	0.15	0.3	0.5

(1) The terms 'leaching fraction (LF)' and 'leaching requirement (LR)' are used interchangeably. They both refer to that portion of the irrigation water which should pass through the root zone to control salts at a specific level. While LF indicates that the value be expressed as a fraction, LR can be expressed either as a fraction or percentage of irrigation water.

(2) Average of salinity of surface water and rain water, Supporting Report 2 (XVI2.1.2).

This table suggests that there is no serious salinity hazard for the moderately salinity tolerant crops such as wheat, barley, date palm, olive, pomegranate, and fig., however, there may be a slight hazard for such salinity sensitive crops as vegetables, alfalfa, etc., for the areas of N'Fifikh and Timkit.

8.1.7 Irrigation Development Plan

(1) No. 5 N'Fifikh

In this area, only a few irrigation channels had been diverted from the Daliya River in the past. However, the diversion structures and channels are severely damaged and deteriorated, and none of them are functioning at present. While several persons had applied for water right in the past, most of them were rejected due to insufficient qualification.

To cope with this, a storage dam is proposed to be located in the hilly area, 25 km southwest from Ben Slimane. The dam site was selected at just upstream side of the narrow valley on the Daliya River.

The irrigation area is divided into two, upstream and downstream areas. For the upstream area, water will be released from the intake structure installed at the dam, and conveyed to the field through two feeder canals for both right and left banks. For the downstream area, water released to the river will be taken at an intake weir located 16 km downstream of the dam. The irrigation water will be diverted from the intake structure to the fields situated on both banks of the river. All the irrigation facilities, consisting of feeder canals, intake weir, main canals, branch canals, supply canals and related structures as well as terminal systems, will be newly constructed as no existing structures are functioning.

An agricultural water users' association (AUEA) will need to be organized for appropriate management of the river water since it is currently managed individually.

(2) No. 9 Taskourt

In this area, there is a network of 18 principal irrigation channels of traditional type originating from the Assif El Mar. The network is joined and the water taken by the upstream channels is conveyed the downstream ones by the set of successive cascades of irrigation channels to others.

The enjoyment of water rights is generally made according to the priority of the upstream on the downstream. Distributions of water from the river to the channels, and from the channels to the villages are made based on the water rights indicated as perennial, seasonal, and flood irrigation.

The dam site is proposed to be located on the Assif El Mar flowing down from the High Atlas Mountains, about 25 km upstream of Had Mejjat town. An intake structure to supply irrigation water will be placed on the upstream face of the right side of the dam body.

A diversion weir is proposed to be constructed immediately upstream of the existing Taslimant channel (the uppermost of the existing 18 channels) in order to maintain the present water rights.

Main canal route is laid out in the left bank along the seguias, which currently convey the water from the existing diversion weirs to its commanded farmlands. Branch canal is separated from the main canal 5.5 km downstream of the intake weir so as to divert water into farmlands in the right bank. The existing seguias will be used as secondary and terminal systems by rehabilitating their sections, wherever necessary.

Although the agricultural water users' association (AUEA) has been organized to operate and maintain the existing traditional irrigation system, it is suggested to reorganize it for the new system.

(3) No. 10 Timkit

Study area of Timkit consists of three separate areas, Ifegh, Tinejdad and Chitam. In the Ifegh area, irrigation is practiced for an area of 200 ha with the subterranean river water and flood taken from the Ifegh River. The water right of the area with a discharge of 0.035 m^3/sec is authorized. In the Tinejdad area, floods from the Tanguerfa and the Todrha Rivers are conveyed to the fields. Three channels divert water from the Chaaba River to cover the fields with an area of 175 ha, two channels divert water from the Tanguerfa River to cover the fields with an area of 215 ha and four channels divert water from the Todrha River cover 720 ha, totaling 1,110 ha. In the Chitam area, irrigation is practiced in a very limited area using the water from the Felkla River.

The proposed dam site is located on the Ifegh River in the mountain range, 25 km northwest from Tinejdad.

An intake structure to supply irrigation water for the Ifegh area will be placed on the upstream face of the right side of the dam. Water will be led through pipes installed in the dam body, and released to the downstream river through a jet- flow gate.

For the Tinejdad and Chitam areas, the stored water will be released to the chute of spillway through an outlet gate and taken at the existing diversion weirs. The water will be conveyed from the intake weirs to farmlands according to the prevailing traditional water rights. It should be noted that the principal diversion weirs and main canals have been already constructed on the basis of their design concept.

The existing seguias will be used as secondary and terminal systems by rehabilitating their sections, wherever necessary.

Although the agricultural water users' association (AUEA) has been organized to operate and maintain the existing traditional irrigation system, it is suggested to reorganize it for the new system.

(4) No. 17 Azghar

In the Azghar area, there is no irrigation channel to divert water from the Wad Zloul River. However pumping irrigation is practiced at seven locations, five in the right bank of the river and two in the left. Irrigation area is only 42.5 ha in total. There is no AUEA in this area, and river water is managed on an individual basis.

The dam site is located on the Zloul River in the hilly area, 7 km east from Ribat Al Khayre. An intake structure with type of inclined conduit at the left bank will be placed on the slope of the left abutment to supply irrigation water.

The layout of irrigation facilities such as main canal, branch canals and related structures is conducted on the basis of the topography, the existing water rights, and the land suitability as well as the expected land consolidation in the near feature.

All the irrigation facilities consisting of main canals, branch canals, supply canals and related structures as well as terminal systems will be newly constructed as no existing structures are available.

Because the river water is managed individually, it is necessary to organize an agricultural water users' association (AUEA) for appropriate management of the river water.

8.1.8 Agricultural Water Users' Association (AUEA)

(1) Law n° 02-84, Concerning Agricultural Water Users' Association

For a long time, the farmers in small and medium scale irrigation areas (PMH perimeters) were engaged in implementing irrigation facilities depending on their own experiences and know-how.

Likewise, the idea of the water users' association is not recent in the PMH perimeters. Such traditional association was changed to Association of Jury by the promulgated law n° 02-84 (May 13th, 1992). This organization allows a wide partnership covering potentially all fields of creation and management of the perimeters.

This decision aimed at setting up a strategic policy for irrigation. Consequently, the option of a participatory management was adopted in order to:

- Allow the involvement and responsibility of the farmers in the management, operation and maintenance of equipment and facilities;
- Promote a dialogue and a concerted action between the administration and the farmers;
- Establish rational water use;
- Practice appropriate management of equipment and reliant facilities for the best water service;
- Optimize the management expenses;
- Promote agricultural development; and
- Preserve and warrant the equipment durability.

(2) Establishment of AUEA

The government authorities are proceeding to the development of fully modernized equipment facilities including dam/reservoir for the utilization of agricultural water. In this regard, it is necessary to re-organize the existing AUEA for the two proposed projects of Taskourt and Timkit and to newly establish AUEA for the projects of N'Fifikh and Azghar in accordance with the First Article of Law n° 02-84.

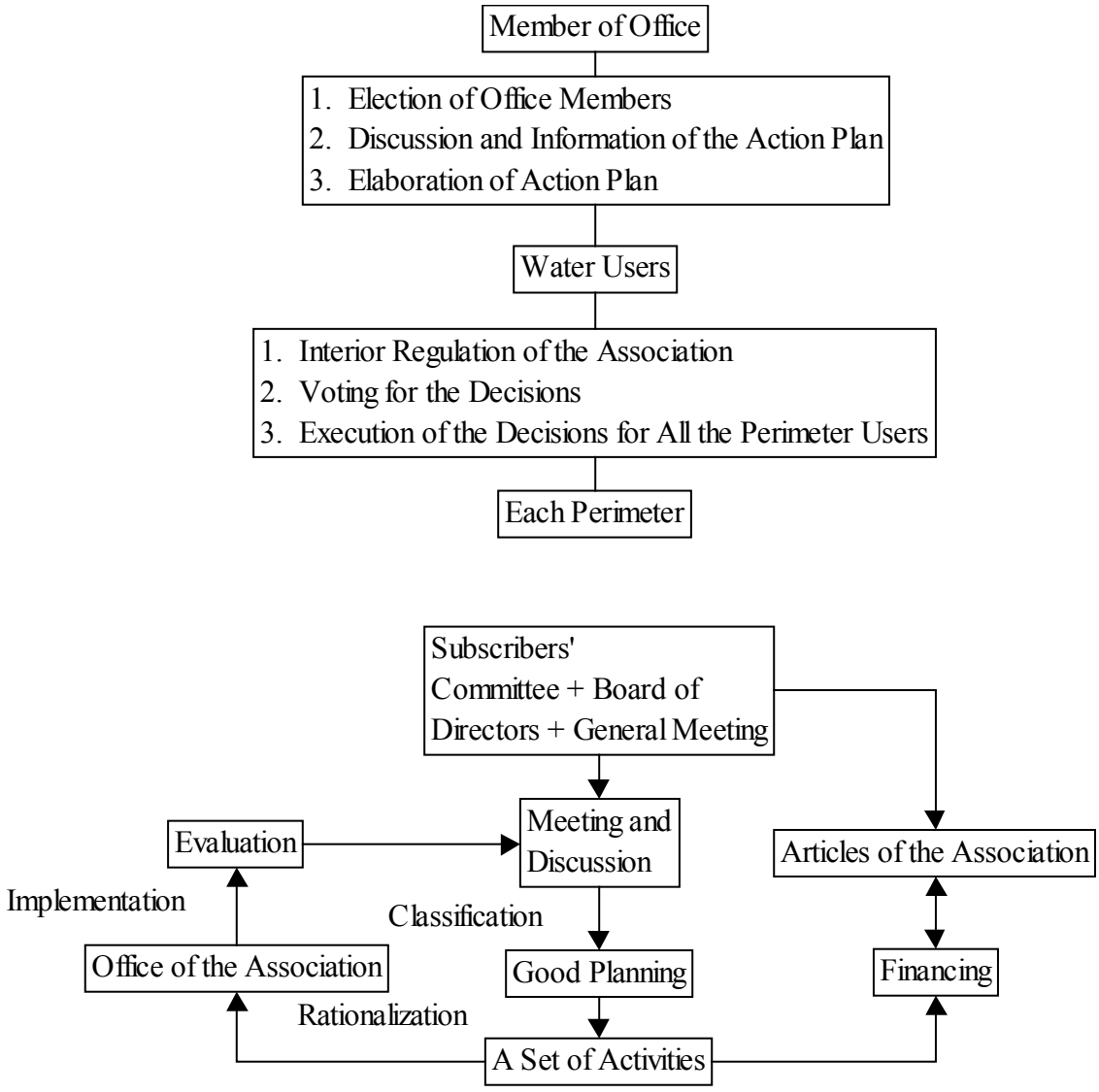
In the four perimeters, the responsibilities for (1) investment for the implementation of equipment facilities, (2) technical management of water service, and (3) financial management of each perimeter are to be shared between the government and the water users.

The government has to take major responsibilities for (1) above. However, a part of the works is to be shared by the AUEA through the contract negotiations between the two parties.

It is proposed that the AUEA be responsible for (2) above consisting of scheduling and organization of irrigators, distribution of water, scheduling of maintenance, etc. The government and the private sector should assist and monitor these activities in favor of AUEA.

It is suggested that the AUEA be responsible for (3) above, which include operation of budget, staff recruitment and payment, invoicing to users, purchase of supplies, etc. It is also proposed that the government and the private sector assist and monitor these activities especially in the initial phase.

As a result of the discussions made above, the formation program of the AUEA and management cycle of the AUEA are illustrated in Figure below:

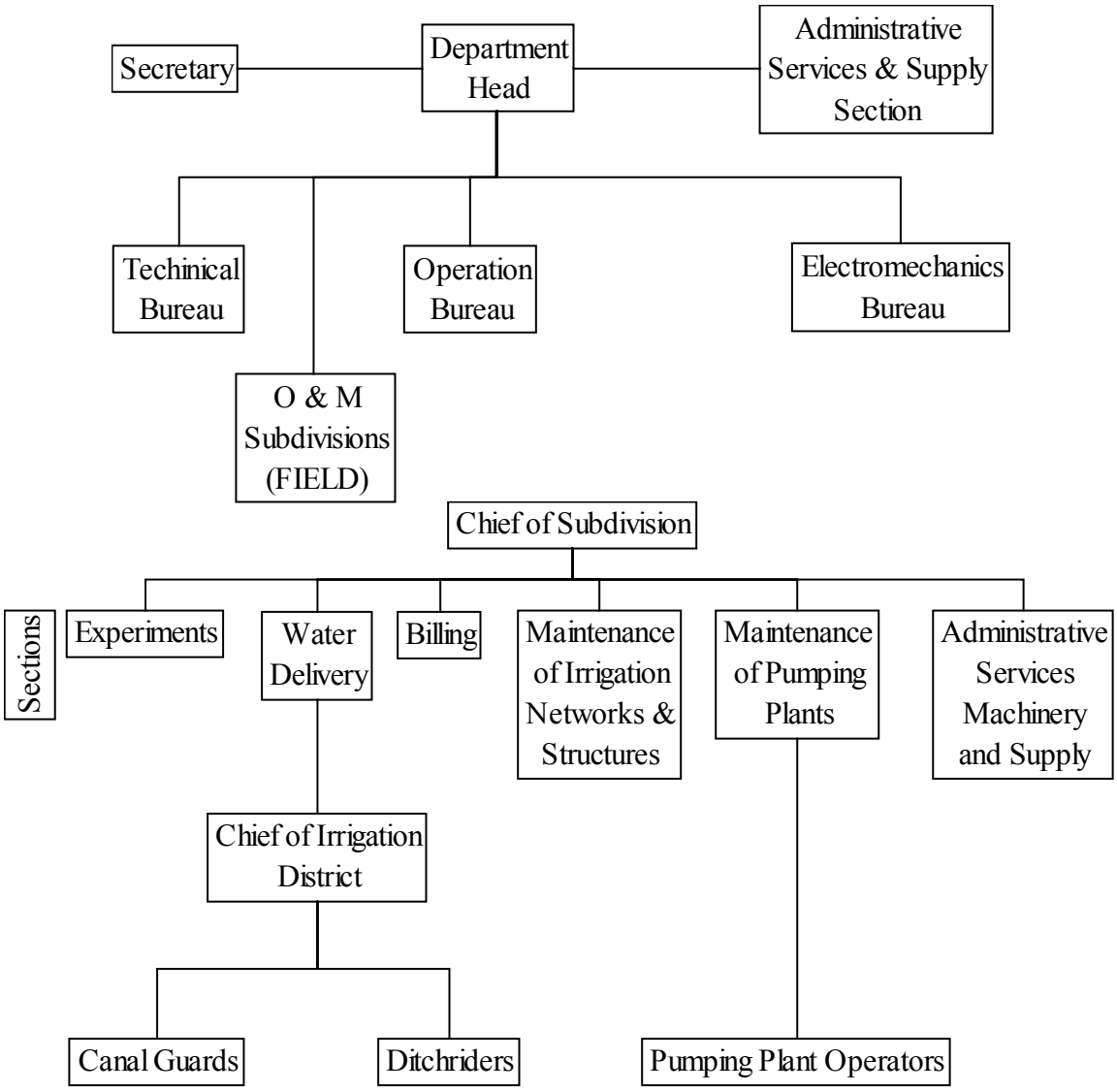


Source: UEA, Amezmiz

Formation Program of the UEA and Management Cycle of the AUEA

The AUEA takes care of all the management problems, planning, allocation of irrigation water, maintenance of facilities, etc. In the management cycle, there is subscribers' committee or general meeting that discusses various problems and sets activities and plans. Formation program of the AUEA is to establish (1) Member of Office, and (2) Water Users' Association. Major activities of (1) are a) Election of the office members, b) Discussion and information of the action plan, and c) Elaboration of the action plan. Meanwhile, the action plan will be executed by the water users, of which main activities are a) Preparation of the interior regulation of the association, b) Voting for any important decision, and c) Execution of the decision for all the perimeter users. At present, the quantity of irrigation water is determined differently from one irrigation channel to another, from one village to another, from one tribe to another according to the existing water rights. Also, enjoyment of water right is made still according to the priority of the upstream over downstream users.

As the river water is regularized with the project, the management of the perimeters is comparative to the large scale ones (GH) in which irrigation water is distributed equally to all the perimeters in terms of area and time as far as the existing water rights are reserved. Typical organization chart of operation and maintenance subdivision for a large-scale irrigation project (OMRVA Gharb) is illustrated below.



Organization Chart of O&M Subdivision

Similar organization is also established in the PMH projects such as Jemaa Sahim scheme (Province of Safi) with an area of 500 ha, Moyen Sebou scheme, First Phase (Provinces of Fes, Taounate and Sidi Kacem) of 6,500 ha in total, and Korimate perimeter (Province of Essaouira) of 400 ha.

The role of the OMRVA is defined by the Code of Agricultural Investment (CIA), which bounds public and private activities and establishes the principles of fixing a tariff and covering costs. The CIA goes in the sense of total covering of the costs of exploitation and maintenance, and of a covering of the order of 40% of the initial capital costs including the dams/reservoirs, irrigation facilities and works of transfer.

(3) Tasks of AUEA

One of the first tasks that new AUEAs of transferred systems will have to undertake is the prioritization of works. The AUEA is likely to include the following kinds of criteria for such prioritization:

- Ensure the continuity and equity of water distribution;
- Optimize irrigation efficiency and water saving;
- Execute first those works that can be done with the resources of the community and leave for later those works that require external financing;
- Expand the service area and the number of service payers;
- Minimize the safety risks;
- Minimize loss of productive land when expanding channels;
- Make transparent the basis for water distribution; and
- Design improvements that minimize management requirements and maintenance costs.

In any case, the members of the community should be consulted and invited to participate actively in prioritization. Sometimes it may be difficult to arrive at an consensus where certain works may benefit some farmers more than others. It is the job of AUEA leaders to forge a consensus or take decisions in the best interests of the association.

Outputs for the planning and implementation phase are the preparation of a basic plan of implementation, establishment of water users' associations and water service providers and infrastructure improvements.

The plan should also include the basic assistance strategy for infrastructure improvement, including terms and conditions for eligibility, financial procedures, technical aspects and the mode and schedule of implementation. This plan should be based on the clear position of the government regarding its role for financing the rehabilitation works.

The main output for creating an effective water users' association and preparing it to govern is the formal establishment of a water users' association. The AUEA should have:

- Agreed and legally-recognized article of association and by-laws;
- An agreed definition of the service to be provided;
- A set of officers duly selected and trained; and
- A general sense of commitment to the organization among its members.

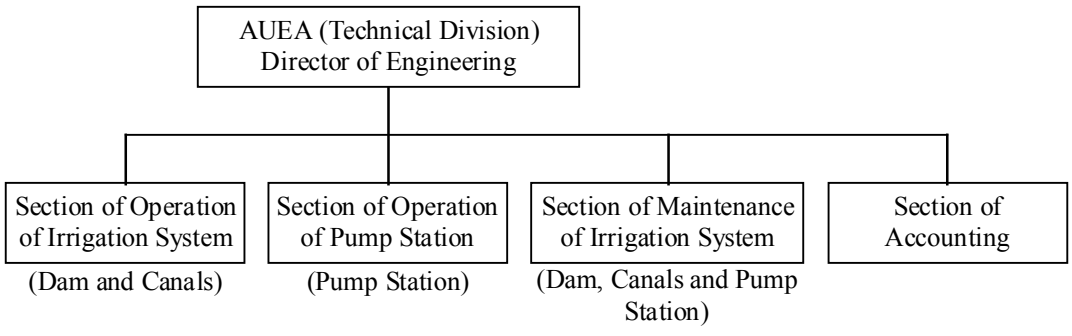
(4) Further steps to be taken

Taking into account the rapid change of the participatory process, it is necessary to set up supplementary measures. At the same time, it is necessary to establish a training program, especially for the following staff:

- Association members; and
- Trainers and water users' supervisors.
- The training program should include the following contents:
- Administrative management of AUEA;
- Distribution management of water;
- Network operation and maintenance;
- Plot irrigation techniques; and
- Participatory approach and communication method.

(5) Organization proposed for the respective projects

Organization of the Technical Division for AUEA and proposed number of technical staff for the respective project of N'Fifikh, Taskourt, Timkit and Azghar are illustrated in the figure below:



– Proposed Number of Technical Staff –

(1)N'Fifikh	4	-	2	2
(2)Taskourt	8	-	4	4
(3)Timkit	6	4	4	4
(4)Azghar	4	-	2	2

8.1.9 For Detailed Design of Irrigation Facilities

Feasibility study for agricultural development has been conducted using photo-maps on a scale of 1:5,000 together with general information on needs of local people, existing water rights, landholdings, etc., collected from the Ministry of Agriculture and its related agencies. In the detailed design stage, it is necessary to study irrigation method and area in detail based on accurate information.

For this, the following information should be taken into consideration:

- Existing water rights and water distribution system. Present condition of existing water rights and water distribution system should be investigated in detail, and they should be incorporated in the design of irrigation network, and size of canals and structures. As such investigation is a key to successfully accomplishing the project, it is necessary to coordinate with the agricultural water users association, which operate and maintain the irrigation network.

- Investigation for land consolidation. For such areas as N'Fifikh and Azghar which are planned to newly develop agricultural land, it is necessary to carry out detailed investigation for land consolidation. Alternative plans for land consolidation should be established for elaborating detailed water distribution method based on the evaluation result of the structure and status of real estate.

- Investigation for optimization of the irrigation system. Investigation for optimization of the irrigation system is required for minimization of construction costs, flexibility of irrigation networks, saving water, relaxation of the restriction related to land consolidation, etc.

- It is necessary to examine the feasibility of low-pressured pipeline networks for the development of undulating lands of N'Fifikh and Azghar.

8.2 Groundwater Recharging

8.2.1 Water Intake at Weirs in Timkit Downstream

For the Timkit dam, there are three weirs, that is, Ait Labzem, Bour and Chitam. Their maximum intake capacities are 16, 13.5 and 11 m^3/s respectively.

These weirs take floodwater from the Tanguerfa and Todrha rivers. Volume of water intake and spill-out, excluding due to discharge from the Timkit dam, at each weir is estimated in the following method:

- Based on the monthly, daily and peak discharge data at the Merroutcha gauging station, a dimensionless hydrograph on a monthly basis is established.
- Inflows to each weir are estimated on a monthly basis based on the flow records at Tadighoust gauging station using catchment area ratio.
- Based on the established dimensionless hydrograph, water volume that exceeds the maximum intake capacity (spill-out) is calculated at each weir. Monthly intake volume is obtained as the difference between the monthly inflow volume and the monthly spill-out volume.

The above calculation was carried out first to the Chitam weir location with total intake capacity of the three weirs in order to estimate total intake volume. Subsequently, intake volumes at the Ait Labzem and Bour weirs are calculated respectively. Intake volume at the Chitam weir is obtained as difference between the total intake volume, and intake volumes at the Ait Labzem and Bour weirs.

Consequently, annual mean intake volumes at the Ait Labzem, Bour and Chitam weirs are estimated as 3.75, 7.87, and 3.75Mm^3, respectively. Accordingly, annual mean volume of 15.37Mm^3 in total is adopted as inflow to the command area of the project. This amount does not include the released volume from the Timkit dam.

8.2.2 Simulation of Groundwater Recharge and Pumping

Based on the hydrogeological parameters and findings obtained by the calibrations results (described in Section 7.1.3) the recharge and pumping method is simulated by the manner to catch floods, to transport it through canals to the command area, and to infiltrate to the underground at the irrigation fields. The simulation is made with the following conditions:

- Groundwater recharge by flood water in the Tanguerfa and Todrha Rivers are considered, but released water from the Timkit dam is not counted.
- 37.5% of water intake at the Ait Labzem weir is assumed to discharge into the Timkit basin, meanwhile remaining water intake at the Ait Labzem, Bour and Chitam weirs is assumed to discharge into the Todrah basin.

- Groundwater level in the outside of the irrigation area is set at 8.5 and 17.6 m the Timkit and Todrah basins respectively at the year of project completion based on the past actual average.
- The 3 scenarios for fluctuation of the groundwater level in the outside of the irrigation area are analysed with condition of; 1) the groundwater level based on the 1973-2000 records, 2) 50% reduction of the groundwater exploitation as of the year 2000, and 3) 100% cut of the groundwater exploitation. For each scenario above, several pumping plan in the irrigation area are studied so as to prevent excessive lowering of the groundwater level in the irrigation area.

Simulation results for each scenario/case are as shown in Supporting Report XV.

For the Timkit basin, it is recommended that 1.12 Mm^3 (80% of annual mean inflow to the basin) is to be exploited annually in the irrigation area by 7 wells of 30 liter/sec capacity with 4 hours operation a day on average. Water exploitation at current levels outside of the irrigation area can be maintained.

However, for the Todrah basin, it is recommended to restrict groundwater exploitation outside of the irrigation area to 50% of the year 2000 level. In the irrigation area, 11.17 Mm^3 (80% of annual mean inflow to the basin) is to be exploited annually by 30 wells of 30 liter/sec capacity with 9 hours operation per day on average. In case of drought with 5-year probability, however, the water intake from the wells in the irrigation areas is to be reduced to 5.58 Mm^3 (50% of 11.17 Mm^3).

8.3 Rural Water Supply

8.3.1 Small-scale Water Supply System

Small-scale water supply system is planned, utilizing water from dam conveyed through irrigation canal or river as its source. Results of water quality test are shown in Table 8.3.1. To secure its quality for drinking purpose, water purification by slow sand filter with settling tank and primary filtration (coarse filtration) will be adopted (refer to Figure 8.3.1). Serious problem in water quality or quantity is recognized for the existing water source. Selection of villages is conducted based on the following conditions:

- The village is located within or in the vicinity of the irrigation area.
- There is no existing or programmed water supply system committed by the ONEP or commune.

(1) No.5 N'Fifikh

It is planned to apply the system to Tlet Ziaida village in Ziaida commune, because: 1) it is relatively close to the river (irrigation canal), and 2) existence of public facilities such as market, school, mosque and hospital.

(2) No. 9 Taskourt

It is planned to apply the system to some of villages in the irrigation area that utilizes "Mattfia", such as Dar Akimakh in Assif El Mal commune, and Tamatoust and Tiguemi Oumrhar villages in M'zouda commune, because of:1) high dependence on "Mattfia" and 2) rather large population.

(3) No. 10 Timkit

No recommendation is done for providing the small-scale water supply system, because the villages in and around the irrigation area are already equipped by adequate water supply facilities or scheduled to cover by ONEP conduit extension.

(4) No. 17 Azghar

No recommendation is done for providing the small-scale water supply system because the villages in and around the irrigation area are scheduled to be covered by ONEP conduit extension.

The project features of the proposed water supply systems are outlined in Table 8.3.2. Demand in target year of 2020 is obtained by multiplying unit water demand of 20 liter/man/day with projected population with 0.7% annual increase rate assumed.

Annual economic benefit of the small-scale water supply systems in the N'Fifikh and Taskourt projects are estimated at 0.16 and 0.28 million DH, based on the average willingness to pay of 16.7 DH/m^3. Meanwhile, financial construction cost of the systems is estimated at 1.8 and 3.0 million DH (local currency portion only), respectively, referring to the past record of the PAGER. Procurement is assumed through local bidding.

The economic analysis is shown in clause 10.1.4 of this report.

8.3.2 Water Intake for ONEP

As a result of reviewing current situation of water supply in urban centers around the Projects, which the ONEP is responsible for, it might be said that the existing water resources other than the Projects would cover the immediate water demand. Therefore, this study does not consider provision of ONEP facilities such as water treatment plant and water conveyance system.

However, in Morocco, it is a common practice to provide a discharge pipe in case of possible future use for potable water supply in accordance with request by the ONEP.

For the Projects, the ONEP suggested to provide water intake of 100, 70, 240 and 100 liter/sec for N'Fifikh, Taskourt, Timkit and Azghar, respectively.

According to the suggestion, it is planned to provide independent pipe and valve separately from water conduit for irrigation equipped in the dam. Inlet for such pipe and valve will be provided also, so as to enable independent water taking.

8.4 Rural Electrification

Mini-hydro power generation utilizing irrigation water is planned on the basis of the so-called subordinate water use for power generation utilizing the unused head without causing any trouble to irrigation. The water for irrigation use is discharged from the dam directly into the river in case of the Taskourt dam, or into the irrigation canal in case of the Azghar dam. In both cases, power generation is obtained by connecting a power station to a branch pipe provided on the water outlet pipe for irrigation that is equipped downstream of the dam.

The vicinities of both sites of the Taskourt and Azghar dams are to be electrified by extension of 22kV grid by the ONE in the immediate future. Therefore, parallel operation by connecting the power stations to nearby 22kV distribution lines of the ONE is assumed. Accordingly, hybrid power generation combined with photovoltaic that is ordinarily applied in case of independent operation is not considered in this study. The power station is planned to provide a greater annual power generation, but not to satisfy the maximum demand. As a result of scale optimization so as to minimize direct construction cost per kWh, plant discharges of $1.5m^3/s$ and $1.0m^3/s$ are adopted for the Taskourt (NWL 995m) and Azghar power stations, respectively. Relevant outputs are 460kW and 50kW.

Annual mean energy produced by the Taskourt (NWL 995m) and Azghar power stations are calculated at 1.22 GWh and 0.09 GWh, respectively.

Assuming of kWh value of 0.6 DH/kWh, annual economic benefit are estimated at 0.73 and 0.05 million DH. Meanwhile, financial construction cost of the power stations is estimated at 10.3 and 2.5 million DH (50% in local currency portion and 50% in foreign currency portion), referring to the past record of the ONE. Procurement is assumed through international bidding.

The project features of the optimal scale are outlined in Table 8.4.1. Calculated unit construction cost per kWh suggests that power generation utilizing irrigation water at the Taskourt and Azghar dams are rather less feasible economically; therefore the plans are discarded.

8.5 Water Balance Study

Reservoir operation calculation on a monthly basis by computer simulation model was carried out to estimate the annual regulated volume from each dam, based on the following equation:

$$\Delta V = VE - VS - EN \times S$$

where,

ΔV : Increase of stored water volume in the reservoir

VE : Inflow volume to the reservoir

VS : Outflow volume from the reservoir (water use and spill-out)

EN : Net evaporation (evaporation - rainfall) per reservoir area

S : Reservoir area

Hydrology Data such as inflow discharge, sedimentation and precipitation are as described in Chapter 7.1.2 and listed in the Data Book. For evaporation from reservoir, pan data collected at the nearest and most similarly situated existing dams were adopted and adjusted with coefficient of 0.8. Correlation curves between elevation and reservoir area/volume are as shown on Figure 8.5.1.

Water demand is considered for the irrigation purpose only, of which details are described in Chapter 8.1.5. Requirement based on drought rainfall with 5-year probability is adopted. Water demand for the small-scale water supply systems is negligibly small; therefore it is seemed to be included in the irrigation water demand. Water demand for mini-hydro power generation is not considered because subordinate water use to the irrigation is assumed.

Duration of simultaneous calculation is taken as long as possible, in so far as the monthly inflow data is available. 50-year sedimentation volume is taken as dead storage volume for the N'Fifikh, Taskourt and Azghar dams.

Meanwhile, 20-year sedimentation volume is applied for the Timkit dam to avoid water loss due to excessive evaporation from reservoir surface. Criteria for supply guarantee for irrigation are set as follows, according to the common practice in Morocco:

- Deficit year is defined as years of which annual deficit overpass 15%.
- Admissible frequency for occurrence of the deficit year is 20%.
- Admissible maximum annual deficit is 50%.

For operation of the reservoir, the following are assumed:

- 100% of water requirement is taken in case that the reservoir water level is between the normal water level and the minimum operation water level-1.
- 68% of water requirement is taken in case that the reservoir water level is between the minimum operation water level-1 and -2.
- 50% of water requirement is taken in case that the reservoir water level is between the minimum operation water level-2 and the minimum water level (same as the dead storage water level).
- No water is taken in case that the reservoir water level is below the minimum water level.

No maintenance flow to downstream reach is considered. Basic data and criteria for the calculation are summarized on Table 8.5.1**.** As a result of the calculation, regulated volumes at respective dam sites are obtained as shown on Table 8.5.2.

8.6 Determination of Project Scale

8.6.1 Applied Criteria

In order to decide development scale for dam and irrigation area, following criteria was applied without consideration of other project components such as rural water supply.

a) For each alternative dam scale, direct construction cost of dam and irrigation facilities per unit-regulated volume were calculated; then optimum scale for project development was sought. The corresponding scale of the dam was determined as the final development scale of the dam.

b) Development scale of the net irrigation facility area was determined as follows:

- For the N'Fifikh and Taskourt dams, final scale of irrigation facility area was set at 126 % of irrigation area that corresponds to water requirement based on drought rainfall with 5-year probability.
- For the Timkit dam, the MOA (ORMVA) has already committed to develop the net irrigation area of 3,060 ha (3,825 ha in gross area). Therefore, this whole area was considered as the development scale.
- For the Azghar dam, the development scale of the irrigation facility area was set considering that the irrigable area is limited to 2,000 ha in net area (2,350 ha in gross area) at maximum due to its topographic condition.

c) For benefit calculation, annual average irrigable area was calculated as below:

- For the N'Fifikh and Taskourt dams, actual irrigation water requirement for each year was assumed using annual rainfall for each year. Then, actual possible irrigation area for each year was estimated as the annual regulated volume by dam with the final development scale being divided by the actual irrigation water requirement for each year. Annual average of such actual possible irrigation area was used for benefit calculation of the project.
- For the Timkit dam, irrigable area for benefit calculation was obtained by water requirement based on drought rainfall with 5-year probability, because difference between drought and abundant rainfalls is negligibly small.
- For the Azghar dam, irrigable area for benefit calculation was set considering that the irrigable area is limited to 2,000 ha at maximum.

8.6.2 Determination of the Project Scale

Based on the above criteria, development scale for dam and irrigation area were determined for each project as below:

(1) No.5 N'Fifikh

a) Upstream

For the N'Fifikh (upstream), correlation between the normal water level in the reservoir and the direct construction cost of dam and irrigation facilities, and the regulated volume are shown on Figure 8.6.1. The direct construction cost per unit regulated volume touches its bottom in case that the normal water level is around EL. 240 to 245m. Therefore, the normal water level is set at EL. 245m as the final development scale of the dam. Annual regulated volume corresponding to this dam scale is 6.4 Mm^3. Net irrigation area that corresponds to the water requirement (Alternative NU1) based on drought rainfall with 5-year probability is 780 ha. Accordingly, development scale of the irrigation facility area is set at 1,000 ha. With the same dam scale, four alternative schemes on cropping pattern or irrigation method are studied as follows:

- Cropping pattern is made as the identical with the existing condition (Alternative NU2).
- Cropping pattern that enhancing vegetable cultivation (Alternative NU3).
- Mechanical irrigation is introduced with the same cropping pattern for NU1 (Alternative NU4).
- Irrigation area is located on the high hills of the left bank (Alternative NU5).

Development scale of irrigation facility area and annual average irrigable area for N'Fifikh upstream area are as follows:

Alternative Schemes for N'Fifikh (upstream)

Alternative	Net Irrigation Area with 80% Probability (ha)	Annual Average Irrigation Area (ha)	Net Irrigation Facility Area (ha)
NU1	780	853	1,000
NU2	810	886	1,030
NU3	590	645	1,000
NU4	900	984	1,170
NU5	780	853	1,000

According to the economic evaluation, Alternative NU3 brings the highest economic internal rate of return, accordingly suggested as the definitive plan. With cropping pattern that enhances vegetable cultivation, net irrigation area was calculated at 590 ha, and annual average irrigable area is 645 ha. Development scale of the irrigation facility is set as the same as the Alternative NU1.

b) Downstream

For the N'Fifikh (downstream), two alternative options are conceivable; that is, 1) with intake weir that has no regulating capacity (Alternative ND1), and 2) with small dam that provides regulated volume (Alternative ND2).

The former option exploits base flow of drought discharge with 5-year probability and groundwater. For the latter, correlations between the normal water level in the reservoir and the direct construction cost of dam and irrigation facilities, and the regulated volume are shown on Figure 8.6.2. The normal water level in the reservoir is set at El. 15 m as the most economical option. Annual regulated volume corresponding to this dam scale is 2.7 Mm^3.

Development scale of irrigation facility area and annual average irrigable area for the above options are as follows:

Alternative Schemes for N'Fifikh (downstream) (Unit:ha)

Alternative	Net Irrigation Area with 80% Probability	Annual Average Irrigation Area	Net Irrigation Facility Area
ND1	210	228	260
ND2	470	510	590

According to economic evaluation, Alternative ND1 brings the higher economic internal rate of return. Nevertheless, as there is still uncertainty in available water at site due to uncounted water consumption in the intermediate basin, both alternatives are not suggested as the definitive plan.

(2) No.9 Taskourt

Correlations between the normal water level in the reservoir and the direct construction cost of dam and irrigation facilities, and the regulated volume are shown on Figure 8.6.3.

Irrigation area of the Taskourt dam consists of perennial, seasonal and flood irrigation areas. Benefit increase with the Project is considerably larger in the seasonal and flood irrigation areas compared to the perennial area, accordingly benefit with unit regulated volume becomes larger in case that the regulated volume increases. Therefore, the regulated volume is adjusted so that unit volume's worth becomes equivalent.

The direct construction cost of dam and irrigation facilities per unit adjusted regulated volume touches its bottom in case that the normal water level is around EL. 995 to 1020 m. The normal water level at EL. 1020 m (Alternative TA1) brings annual regulated volume of 34 Mm^3.

Net irrigation area that corresponds to water requirement based on drought rainfall with 5-year probability is 3,530 ha. Accordingly, development scale of the irrigation facility area is set at 4,500 ha. Annual average irrigable area is 3,831 ha. As the alternative dam scale, the normal water level in the reservoir at EL. 995 m is considered (Alternative TA3). Annual regulated volume corresponding to this dam scale is 24 Mm^3. Moreover, other alternatives in case of introducing mechanical irrigation are also considered for the above two dam scales, respectively (Alternative TA2 and TA4). Development scales of irrigation facility area and annual average irrigable area for each alternative are as follows:

Alternative Schemes for Taskourt (Unit:ha)

Alternative	Net Irrigation Area with 80% Probability	Annual Average Irrigation Area	Net Irrigation Facility Area
TA1	3,530	3,831	4,500
TA2	4,060	4,406	5,100
TA3	2,500	2,713	4,500
TA4	2,880	3,126	4,500

According to economic evaluation, both Alternative TA1 and TA3 bring the highest economic internal rate of return. Considering DGH's policy to implement the Taskourt dam as a medium-scale dam, and vantage to mitigate negative impact due to inundation, Alternative TA3 is suggested as the definitive plan.

(3) No.10 Timkit

Because of inflow characteristics and high evaporation rate, the Timkit dam is not economically feasible if only considering the benefit due to regulated volume from the dam. In order to minimize water loss due to evaporation, reservoir area of the dam is minimized in so far as the water requirement at Ifegh is satisfied. Accordingly, the normal water level is determined at EL. 1,245m. Annual regulated volume corresponding to this dam scale is 2.7 Mm^3. Net irrigation area that corresponds to water requirement based on drought rainfall with 5-year probability at Ifegh is 240ha.

For irrigation purpose at the Ait Labzem and Chitam area, floodwater is assumed to be stored temporarily in the reservoir above EL. 1,245m, and such water is to be released in regulated condition so as to be taken at the Ait Labzem and Chitam weirs.

Correlation between the surcharge water level and the annual average volume released from the dam in regulated condition for Ait Labzem and Chitam weirs is obtained as shown in Figure 8.6.4 with assumption that frequency of major flood is two times a year.

Correlation between the surcharge water level and direct construction cost per average volume released annually from the dam in regulated condition is also shown on Figure 8.6.4. As the most economical scale, the surcharge water level of 1,255.8 m (corresponding to storage volume of 20 Mm^3 above NWL 1,245 m) is selected. The corresponding dam scale brings an average released water volume for Ait Labzem and Chitam of 6.14Mm^3 annually.

Assuming water losses of 20%, an average of 4.9 Mm^3 annually is assumed to be taken from the discharged water from the dam at the Ait Labzem and Chitam weirs.

Moreover, an average annual volume of 15.37 Mm^3 of water, which originates from floods both in the Tanguerfa and Todrah rivers, is assumed to come into the irrigation area. For irrigation method of the Timkit, there are two conceivable options as follows:

- Floodwater from both the Tanguerfa and Todrah rivers are assumed to infiltrate to the underground at the irrigation fields. Meanwhile, the water from the Timkit dam is assumed be to released according to irrigation requirement on time and used as surface water (Alternative TI1).
- Not only the floodwater from the Todrah and Tanguerfa rivers, but also the released water from the Timkit dam infiltrate to the underground for groundwater recharging (Alternative TI2).

Development scales of irrigation facility area and annual average irrigable area including Ifegh for each alternative are as follows:

Alternative Schemes for Timkit (Unit:ha)

Alternative	Net Irrigation Area with 80% Probability	Annual Average Irrigation Area	Net Irrigation Facility Area
TI1	1,350	1,690	3,060
TI2	1,700	1,570	3,060

According to the economic evaluation, Alternative TI1 brings the highest economic internal rate of return, therefore it is suggested as the definitive plan.

(4) No.17 Azghar

Correlations between the normal water level in the reservoir and the direct construction cost of dam and irrigation facilities, and the regulated volume are shown on Figure 8.6.5.

Development scale of the irrigation facility area is set at 2,000 ha, that is the maximum limit from the topographic condition. Required regulated volume that corresponds to this irrigation area is calculated at 14.6 Mm^3, with water requirement based on drought rainfall of 5-year probability. The normal water level in the reservoir is set at EL. 854 m so as to bring this regulated volume.

According to the economic evaluation, this project scale brings high economic viability even if the negative impact on existing dams in downstream is also considered. Therefore, this scale is suggested as the definitive plan.

Detail results are shown in Section 10.1.3 of this Report.

8.7 Environmental Impact and Resettlement Plans

8.7.1 Natural Environment

(1) Basic Approach of EIA

Based on the results of the IEE that was conducted in the First Phase of the Study, a more detailed environmental survey was conducted in the Second Phase. The Ministry of Environment, Morocco has proposed to establish an official EIA procedure, but the Government has not authorized the proposal yet. So there is no legal status on the EIA procedure in Morocco at present time. Therefore, JICA guidelines were used in this study, but draft law of Morocco was also respected and fully applied in this study. Environmental laws, rules, regulations and guidelines that were used as a basis of this environmental study are primarily as follows:

- The protection of environment (draft EIA law) in Morocco (Ministry of Environment, Morocco)
- SIBE (Sites of Biological and Ecological Interests)
- Guidelines for Environmental Considerations on Rivers and Protection of Erosion (JICA)
- Guidelines for Environmental Considerations on Dam Construction (JICA)

(2) Environmental Factors

According to the results of the environmental screening during the First Phase, water quality was found to be one of the most important environmental factors to be analyzed. Therefore, the following aspects were carefully addressed and applied for the Environmental Management Plan (EMP).

- Upstream: Eutrophication
- Immediate Downstream: Level of groundwater
- Downstream: Changes in water quality with irrigation

(3) Potential Environmental Impacts

Water turnover ratio (α) of the dam reservoirs was calculated to examine the possibility of eutrophication. The turnover ratio was found to be quite low at all the reservoirs so that eutrophication is likely to occur.

It is also predicted that a level of groundwater may be lowered. Underground aquifer will be stored in the reservoirs with the dams so that underground water downstream of the dam sites is likely to be diminished. There will be irrigation areas downstream of all the dam sites. It is likely that agricultural chemicals will be applied in the field, which may contain detrimental chemicals to the surrounding environment. As a result, water quality of the rivers downstream of the dam sites will likely to be deteriorated.

(4) Mitigation during the Construction Stage

The following mitigation measures should be taken in the construction stage:

- Upgrading existing roads that are to be used as access roads to the dam sites instead of establishing new access roads so that impacts on natural environment can be minimized.
- Avoiding vegetative patches for the establishment of river diversion tunnel at Azghar site.
- Quarry sites and borrow pits will be located in the submerging areas
- Most of the construction materials will be collected from the riverbed using a bed material sampler so that a baching plant crushing rocks will not used.
- Increasing alkalinity of the water by using cement (concrete and grout) will be minimized with chemical treatment.
- Turbidity of water will be minimized with the settling basins establishment.

(5) Environmental Management Plan (EMP)

Establishment of Environmental Management Plan (EMP) is the most important practice as a long-term mitigation of the environmental impacts. Practical institutional organization for environmental monitoring and management, environmental parameters and sampling locations for water quality have been determined and proposed. The following recommendations are made on the EMP:

- Environmental Management Unit (EMU) should be established, and the DGH be responsible for the implementation of the EMP.
- Development of tree planting program as a counter measure for erosion problem particularly at Taskourt site is important. This should be included as one of the main components of the EMP.
- Ministry of Forestry should be fully involved into the tree planting program (the Ministry be involved as a regular member of the Steering Committee so that appropriate counterpart be appointed).

Detail results of natural environmental study are shown in Supporting Report XVI.

8.7.2 Social Environment and Resettlement Plans

(1) Introduction

The social environmental impacts of dam constructions were tentatively studied in the first Phase (Basic Study) for the proposed 25 dam sites. The Study was intensified on the second Phase (Feasibility Study) for the priority four dam sites with special investigations to identify proper resettlement plans for the dam implementations. These plans were evaluated based on site investigations for both upstream and downstream, people hearing, people land and water rights, existing Moroccan Laws for compensation programs and socio-economic factors. Results of the survey include identification of negative impacts of dam construction for upstream and downstream areas, recommended resettlement plans as well as resettlement costs. These results are summarized in the following paragraphs and their details are presented in the Supporting Report XVI.

(2) Potential Social Impacts in Upstream

The following negative impacts may occur with the dam implementation in the upstream areas:

a) In all dam sites (except Azghar), some people are supported by the communities regarding their land and water ownerships. However, people without properties, represented by young couples, poor families, and women heading households will have lower or none compensation offer by the Moroccan Government if projects implemented. Therefore, a strong measure is necessary to maintain familial and social balance to preserve the present solidarity.

b) In all dam sites (except Azghar), schools are located in or near the submerged areas. This will requires scheduled resettlement to be conducted with the beginning or end of the school year. Also, looking for better schools locations in the resettlement sites are essential. Without the above measures, school movement will be difficult.

c) Women will be potentially impacted with the dam implementations in several ways that may be summarized as follows:

- Only about 6% of the women population who heads the households will benefit from the compensation if the compensation is paid directly to the heads of families. They can be profitable if involved equitably.
- In case of land compensation, women involvement in land distribution will be minimal due to their weak mobility and low contact with the external world.
- Resettlement of women in new areas will create additional working hours, as modernized agricultural techniques will be applied.
- Currently, men involvement in social decisions is extreme and unequal to women. This involvement will be strengthening with the resettlement, as men will gain more decisional power.

d) Recommended measures to reduce these impacts can be considered with specific actions on gender development as well as linking the resettlement plans with impact on women.

e) In Timkit, farmers' water rights involve their ownership of springs and khettara located in the upstream. However, farmers are willing to re-own similar rights if they move to the downstream areas with the proposed resettlement plans described in section 8.7.2 (4).

f) In Taskourt, initial resettlement plans were suggested to resettle the population in nearby regions, the upstream called l'aâzib. However, in the this stage, detail investigation of it was recommended to avoid resettlement of all the population in this area to avoid the negative natural impact in l'aâzib the over population with the existing people. It is recommended that only a portion of the population with entitled beneficiaries can be resettled to l'aâzib and the remaining should follow the proposed resettlement plans.

(3) Potential Social Impacts in Downstream:

The following negative impacts may occurred with the dam implementation in the downstream areas:

a) A general limitation to the resettlement plans is the land availability in the downstream. It is especially foreseeable in Taskourt and Timkit sites. Besides, the existing collective lands (Mahroum) in Taskourt site will develop ambition regarding farms from inside and outside of the area. It is therefore urgent to involve local and provincial authorities such as Ministry of Interior into the resettlement plans so they can protect and control these lands.

b) Women will potentially be impacted with the dam implementations in several ways that may be summarized as follows:

- In Taskourt and Timkit, women are excluded from the collective lands ownership. Therefore, future distributions of those lands would not benefit to women. To negotiate, with responsible communities (Jmaa Soulalia), there is a need the change of the traditional rights (Ourf) concerning this aspect like the rural commune (CR) of Ferquela Haut district. This CR was implemented to change the Ourf since 1982.
- Currently, men involvement in social decisions is extreme and unequal to women. This involvement will be strengthening with the resettlement, as men will gain more decisional power.

(4) Recommended Resettlement Plans

In all the proposed dam sites, social incomes are very limited by the existing agricultural and breeding activities. These incomes are not viable enough for the local people in the sites under the existing natural and social conditions. In order to identity the new resettlement areas, the Study Team evaluated the assets and number of families in the existing dam sites having investment outside the dam sites.

The results of these assets and the family numbers are presented in the Supporting Report XVI. The Study Team investigated in the field all the new resettlement areas based on the following two major points:

- The people's perception regarding resettlement locations outside the dam sites. These locations are generally influenced by their existing properties in different areas.
- The Study Team's perception based on social data analysis and potential impacts.

The findings of the study are presented and summarized as follows:

i. No. 5 N'Fifikh

Submerged Area: 31 houses, 38 families, 187 persons

Resettlement Scenarios:

a) Option A: SODEA lands, located downstream of proposed dam (Lands owned by public agricultural company and existing in proposed irrigation area)

b) Option B: Land purchasing from large scale vegetable farm located downstream of proposed dam (Private land can be bought using compensation money)

Expected Resettlement Cost: about 4,109 x 10^3 MDH

Resettlement Identification:

The survey shows that population having outside properties is as follows:

- 48% of the families own agricultural land areas ranging from 0.14 to 20 ha
- 36% of the families own houses

People willing to the dam construction and resettlement plans is as follows:

- 75% of the people wish to expand their current agricultural and livestock activates in new areas at downstream.
- 17% of the people wish to invest in small marketing and business outside

As 48% of the families own land properties, 37% who wish to expand activates will require additional resettlement lands. Resettlement options (A or B) can be adopted as high successful measure. However, according to the president of the rural commune of Melila, option B is more favorable but requires involving and negotiating with the downstream beneficiaries before starting any dam construction works.

ii. No. 9 Taskourt

Following is in case of N.W.L being 995.00m and estimated based on one in case N.W.L being 1,020.00m shown in XVI 10.2 of Volume V Supporting Report (2.B). During the detailed design stage, these will be reviewed.

Submerged Area: 154 houses, 205 families, 1,014 persons

Resettlement Scenarios:

a) Group A: 74 families (36%); people applying to their own resettlement plans

b) Group B: 62 families (30%); people having lands in l'Aazib area and to be settled there.

c) Group C: 69 families (34%); people having no lands property and to be settled in new lands

Expected Resettlement Cost: about 35,700 x 10^3 MDH

Resettlement Identification:

According to the hearing survey, if proper compensation would be made, people in the submerged area would cooperate with recommended resettlement plans. The summary of the recommended resettlement plans is as follows:

Group A: about 49 families are comparatively wealthy people having rather high income by different investment trade. These families have their own resettlement plans by purchasing agricultural land of few hectares in the downstream area. However, providing these people by agricultural extension services with modern techniques will be necessary. Remaining 25 families are relatively less wealthy but they share the Group resettlement plans. Their financial deficit could be compensated through the expected compensation cost.

However, careful monitoring and training of the compensation money utilization and resettlement plans of these families is necessary.

Group B: about 62 families having houses and agricultural lands (2ha in average) in l'Aazib district located on left bank of the proposed dam. They are willing to expand their current agricultural and livestock activates in the l'Aazib area. For their resettlement, construction of new social infrastructure facilities such as road, water and electricity supply, school, hospital, … etc. are highly necessary. Existing archeological sites such as religion monuments (Zaouia), should be transfered to the l'Aazib area. Agricultural extension services to this group regarding planting fruit trees and natural resources utilization are also necessary.

Group C: This group has 69 families and is comparatively poor people currently making small-scale agricultural activities in the submerged area. They can be resettled to Mahroum land (public land) in the downstream irrigation area. The new Mahroum land does not have agricultural activities at present but the soil is suitable for future agricultural practicing. On average, agricultural land of 5 hectares is required for each family.

Approximately two villages (cooperatives) equipped by social infrastructure facilities such as schools, roads, mosques, …etc. should be newly created. Careful monitoring and training of resettlement plans of these families is necessary. Among this group, there are 11 families who are considered to be the poorest people among all the groups. These families are without properties represented by young couples, poor families and women heading households and making small-scale agricultural activities in the submerged area. Strong measure is necessary to maintain familial and social balance to preserve the present solidarity. A special counter-measure such as moving to old people's homes should be given to them with careful monitoring during the resettlement.

iii. No. 10 Timkit

Submerged Area: 39 houses, 64 families, 342 persons

Resettlement Scenarios:

a) Group A: 60 families (93%) with lands in Ifegh will be settled there

b) Group B: 4 families (7%) with lands in Ifegh area will be settled outside

Expected Resettlement Cost: about 7,992 x 10^3 MDH

Resettlement Identification:

According to the hearing survey, if proper compensation would be made, people in the submerged area would cooperate with recommended resettlement plans. The summary of the recommended resettlement plans is as follows:

Group A: The main resettlement plans affect this group. The people located in the submerged area originated from Ifegh command area located just downstream of the proposed dam with houses, lands and water rights. However, more agricultural lands and water rights would be required if they asked to resettle in Ifegh. These additional rights could be smoothly obtained subject to senior persons who administrate generally the water rights in Ifegh agreement.

Group B: about 7 % of the total population has their own source of incomes in different regions and they are looking forward to continue and develop their projects in the regions.

iv. No. 17 Azghar

Submerged Area: 6 houses, 10 families, 42 persons

Resettlement Scenarios:

Government compensation in compliance with Moroccan legal standards.

Expected Resettlement Cost: about 6,351 x 10^3 DH

Resettlement Identification:

All the families originate from Bni Souhane's area. 34% of the families have land downstream and 66% own homes. Resettlement does not produce any problem because the dam site is an appropriate location for the families from social, economic or culture aspects. Simple government compensation in compliance with Moroccan legal standards will be satisfactory.

CHAPTER 9 PRELIMINARY DESIGN AND COST ESTIMATES

9.1 Preliminary Design

9.1.1 No. 5 N'Fifikh

(1) Dam Site and Type

The dam site is located in a hilly area, 25 km southwest from Ben Slimene. The site was selected at just upstream side of the narrow valley on the Daliya River where both abutments become closer. Many out-crops of quartzite (hard rocks) are observed at both abutments running across the site with narrow width. However both upstream and downstream sides of the quartzite are deteriorated by faults. Therefor, the dam body, especially impervious embankment zone, could not be placed on the quartzite layer. This will cause harmful un-uniform settlement of the embankment due to difference of settlement characteristics of hard foundation and weak foundation. In order to avoid this, the dam axis was slightly shifted to upstream side where impervious embankment may not be placed on the quartzite layer. In this case the foundation of the dam body is rather soft rock of weathered sandstone and pelite stone.

This foundation rock may belong to CL of rock classification, which will not have sufficient bearing capacity for concrete gravity type dam. Accordingly, a fill type dam that can be applied to this soft foundation is selected at this site.

(2) Dam Design

The dam foundation is weathered rock, and is seemingly semi-pervious rock that probably requires grouting against leakage. General layout and typical cross sections of the dam are shown in Figures 9.1.1 and 9.1.2.

In the right abutment, pervious quartzite may stretch to the foundation of spillway inlet portion and higher parts of the dam foundation. So limb grouting will be also necessary. Considering the availability of the embankment materials and necessity of grouting, a center-cored fill dam is recommended. The dam was designed for the following conditions:

- Sediment volume that would be accumulated over 50 years will be stored by the dam. This amounts to 1.5 MCM. Total sediment volume will be stored in the reservoir without other storage measures such as Sabo dam, which were judged to be less economic by an alternative study. Therefore, minimum water level of reservoir to store this total sediment volume is El 222.5 m.

- The dam crest elevation was estimated as follows:

  Crest Elevation= El 248.36m (FWL)+1.21m (Free Board)+1.35m (dam type allowance) + 0.3m (Core Protection) = El 251.5m

- Dam crest will not provide for the use of public road. Width of dam crest is selected as 6m,

- Stability analysis of sliding by slip circle method is performed to ensure the safety of dam body. Safety factors satisfy minimum allowance of the Moroccan standard that is almost same as that of the Japanese standard. In this analysis, intensity of seismic acceleration is estimated to be 0.1g as a zone of low frequency based on the analysis of seismic intensity and frequency. Parameters of shear strength are also estimated for soil embankment and rock embankment densities that are not less than D95% and Dr (relative density) 80%, respectively.

(3) Dam Foundation Design

Weak layers, such as organic soil, clayey soil, alluvium deposit containing silt and clay, etc. should be removed beneath the whole of the dam body. Thickness removed will be 0.5 to 1.0 m at both abutments and about 1.0 m at the riverbed. Excavation of the core trench for the dam will be done down to a depth of about 10m in the foundation of both abutments and the riverbed to expected rock where grouting could effectively improve perviousness of shallow foundation.

Grouting is planned to avoid a leakage through the dam foundation and its limb foundation targeting pervious rock more than 3 to 5 Lugeon. The maximum depth and the minimum depth of the grouting are planned to be 15 m at the riverbed and 10 m at the abutments.

(4) Diversion Design

Box culvert will be used as river diversion facility and will be placed in the sound rock foundation of left abutment slope along the riverbed. A tunnel type is common for medium to large-scale fill dam as diversion facility but it is more expensive than culvert type. The culvert location was selected to avoid the damage by the dam embankment contact due to un-uniform deformation of large load from the dam embankment. As the dam height above the culvert is only 30 m and the culvert is not designed to be set into the dam embankment to disperse the dam embankment load, a culvert type is judged to be possible for the dam site. The culvert size was designed as 5 x 5 x 300 m (height x width x length).

Principal designing conditions was based on flood characteristics in which design discharge of diversion facility is based on a flood return period of 20 years (236 m^3/s). To ensure the safety against a leading flood with a discharge of a 50 years return period (271 m^3/s) in the culvert, hydraulic condition is also checked.

(5) Spillway Design

A spillway facility will be placed on the right abutment. Hard foundation rock of quartzite is suitable for the base of concrete structure. Quartzite on the right abutment spreads more widely than on the left abutment. Also, the total length of spillway channel on the right abutment can be shorter than on the left abutment. The spillway was designed based on the following conditions:

- The spillway is non-gated weir type, which costs less to construct and is easy to operate and maintain.
- As the dam is a fill type, the spillway was designed based on a flood return period of 10,000 years (1,800 m^3/s inflow and 1,668 m^3/s outflow).
- The weir length is 120 m and maximum height of overflow on the spillway weir is calculated as 3.64 m.
- The transition channel, chute way, and stilling basin are 25 m long, the most effective length based on the hydraulic study.
- Stilling basin was considered as energy dissipater after chute way channel considering topography and geology of the foundation.

(6) Intake Facility Design

An inclined conduit type intake facility, at the left bank, will be placed on the slope of the left abutment to supply irrigation and potable water for downstream local villages. Water from the reservoir will be led through pipes installed inside the box culvert of the river diversion. Steel pipes of 1,000 mm diameter for irrigation and steel pipes of 300 mm for potable water are planned. Irrigation water will be released to the downstream river through a jet-flow gate.

(7) Irrigation Facility Design

Along Daliya river stream there are old irrigation facilities such as intake weirs and canals, etc.,that were built during French rule. But all of them are so damaged wholly that most of facilities are not available for farmers to use and water right does not exist at present. In this Study the former irrigation system is judged not to be worth rehabilitating. Accordingly irrigation plan is made for newly irrigated area where only rain-fed farming is performed.

The layout of irrigation facilities such as diversion, canal and related structure was conducted on the basis of the topography, the existing water rights and the land suitability as well as the expected land consolidation in the near future. The net total irrigation area of 1,000 ha is divided into three irrigation systems. Irrigation diagram for the proposed irrigation system is shown in Figure 9.1.3. The main points studied for the respective project are summarized as follows:

- The water stored in the reservoir will be released to the river and taken at the diversion weirs. The irrigation water will be diverted from the intake weir to the field located along the river in due consideration of the traditional water rights.

- Considering average size and shape of irrigation block, the typical block will be rectangular, 400 m x 750 m of 30 ha in gross.

Irrigation Blocks for Each Zone

Name of Zone	Irrigation Area In Net (ha)	Number of Irrigation Blocks
Main Feeder Canal (1)	43	3
Main Feeder Canal (2)	157	12
Main Canal	800	29
Total	1,000	44

- The following diversion weir alternatives in each zone were proposed at the site of which the irrigation water was available at a higher level than the irrigated land. The site of each weir is located 0.7 km, 4.9 km and 16.0 km downstream from the dam respectively.

Diversion Alternatives

Item	Diversion		
	(1)	(2)	(3)
Dam Type	Fixed Concrete		
Crest elevation (El. m)	211.3	194.0	157.0
Crest length (m)	8.0	8.0	12.0
Crest width (m)	1.0	1.0	1.0
Weir height (m)	3.0	3.0	4.0
Upstream Side slope	Vertical		
Downstream Side slope	1:0.7	1:0.7	1:0.7
Width of sluice section	1.0	1.0	1.5
Scouring sluice gate	1.0	1.0	1.5
Slide gate (W m x H m)	0.5 x 0.5	0.5 x 0.5	1.5 x 1.0

- Main feeder canal routes were laid out along the skirts of gently sloping hills. Both feeder canals are meant primarily for conveying water from the diversions to the area in which river water is at present used for irrigation. Main canal route was laid out in the left bank along the gentle slope with a gradient of less than 8^{o} available to irrigate lands by gravity. Branch canal is separated from the main canal 2.2 km downstream of intake weir so as to convey water to farmlands in the right bank.

General Features of the irrigation canals

Canal Name	Canal Length (m)	Canal Discharge (m^3/s)	Canal Base Width (m)	Water Depth (m)	Canal Height (m)
Main Feeder (1)	2,500	0.07	0.15	0.10	0.11
Main Feeder (2)	4,450	0.26	0.50	0.46	0.70
Main Canal	9,200	1.28-0.29	0.80-0.62	0.80-0.60	1.00-0.80
Branch Canal	9,250	0.68-0.14	1.35-0.70	0.69-0.37	0.89-0.57
Total	25,400	-	-	-	-

Principal features of the dam, its appurtenant facility, irrigation facilities and related structures are shown in Table 9.1.1.

9.1.2 No. 9 Taskourt

(1) Dam site and type

The dam site is located on the valley of the skirt of the Grate Atlas Mountains, about 70 km southwest from Marrakech. An access to the dam site is possible by 4-wheel vehicle through both routes of the riverbed plain of the Asif el Mehl River and local unpaved road running in the middle of steep hill slope.

The Asif el Mehl River has open mouth of valley at the upstream of Taskourt Village. The dam site is selected just downstream, where an efficient reservoir can be planned. Both the right and left abutments have rather steep slopes and the riverbed is narrow. The foot of the left abutment has a high upright slope where mass of foundation rock is exposed widely. On the contrary right abutment has less exposure of rocks. It is mostly covered with shallow talus deposits. Depth to reach foundation rock is shallow on both abutments. And the planned height of the dam is around 80 m. Judging from these geological condition, topography and scale of dam, it is clearly recommended that the dam should be a concrete gravity type. According to the exploration of subsurface geology and drilling survey it is recognized that the left abutment is very good condition with massive and hard sandy schist exposures. However, it is anticipated that the right abutment is possibly covered with thickly fractured and weathered rocks beneath the talus deposits because of faults running across the right abutment. Excavation of the right abutment thus becomes somewhat large. But the dam site is still in a narrow valley.

There is a possibility that a alternative dam site about 100m upstream from proposed present site is also suitable for gravity dam if the geology of the site is as good as its appearance of surface rock of hard sandy schist. Further detailed survey is expected for the next stage.

(2) Dam Designing

As mentioned above, a large amount of suitable sand and gravel materials are deposited around the dam site. The dam is planned to be a type of roller compacted cement dam (RCC) with natural sand and gravel, which is very common in Morocco recently. General layout and typical cross sections of the dam is shown in Figures 9.1.4 and 9.1.5, respectively. RCC with maximum gravel size of 80mm will be placed as inner concrete to support dam body stability and to make an economic embankment. Normal concrete with maximum gravel size of 80 mm will be placed as outer concrete to make a dam impervious and to obtain high resistance against deterioration of appearance.

Inspection gallery tunnel will be planned to set drainpipes for releasing water pressure acting on the bottom of the dam. The dam was designed for the following conditions:

- Sediment volume accumulated over 50 years is to be stored by the dam. Total sediment volume will be stored in the reservoir without other storage measures such as Sabo dam, which are judged to be less economical by the alternative study. Total sediment volume is planned as 6 MCM. So the dead water level of reservoir that is equivalent elevation to store this total sediment volume is planned to be EL 973 m.

- Height and dam type allowance were estimated from the normal water level and the flood water level of the reservoir. Then dam crest is decided as follows:

  a) Dam crest; El 998.95m(as FWL)+1.24m(as wave height due to wind)+0.31m(dam type allowance)=El 1,000.5m

  b) This is almost equivalent as water level at the exceptional flood of 10,000 year return period. (Max WL=El 999.85m)

  c) Dam crest will not provid for the use of public road. Width of dam crest is selected as 5m,

- Stability analyses of overturning and shear sliding are performed to ensure the safety of dam body. Safety factors satisfy minimum allowance of Moroccan standard that is almost same as that of Japanese standard. In this analysis intensity of seismic acceleration is selected to be 0.12g concerning concrete dam as a zone of high frequency based on the analysis of seismic intensity and frequency. Parameters of shear strength of rock foundation are also estimated considering that rocks beneath dam body will be mainly sound sandy schist.

(3) Dam Foundation Designing

All of deposit materials and highly weathered rock should be removed under the dam body. Especially the foundation at riverbed will demands sound rock. Thickness removed from dam foundation will be about 15 m at the left abutment and riverbed, and about 10 m at the left abutment. Consolidation grouting with length of 5m into rock will be planned to make a firm and even foundation of dam that might suffer loosening of surface rock by excavation work. This grout will be carried out on the spread of dam concrete after finishing some layers that is expected the effect of concrete capping.

Grouting is also planned from the upstream taper filet of the dam to avoid a foundation leakage that will cause as lifting pressure, targeting pervious rock more than 2 Lugeon. The maximum depth and the minimum depth of the grouting are planned to be 45 m at the riverbed and 20 m at the left abutment respectively.

(4) Diversion Facilities

The river flow at the dam site is perennial. Discharge of flood in rainy season is very large. As the construction of the dam can not be completed within a single dry season, Diversion Facilities are necessary. It is recommended to place a box culvert on the rock foundation in the riverbed. The culvert will be constructed by half closing river method during dry season. Other Diversion Facilities such as tunnel in the abutment is conceivable. This is, however, very expensive compared with the culvert type. Namely, the culvert type diversion is selected as it is cheap and is possibly constructed in the site. Principal points of diversion design are as follows:

- Design discharge of Diversion Facilities is basically that of return period of 10 years, as the dam is a rigid concrete gravity type. To ensure the safe leading of flood flow, a discharge of 20 year return period is checked to pass without overflowing the culvert wall.
- Discharges of both return periods are 340 m^3/s for 10 years and 474 m^3/s for 20 years considering the storage effect of the flood in the reservoir. So the size of culvert is planned to be 7.2m high and 7.2m wide with a total length of 270m.

The culvert will be used as room for conduit of intake facility for irrigation and others afterward.

(5) Spillway

A spillway facility will be formed on the center of the dam body. Principal points of spillway design are as follows:

- The spillway weir for the dam is non-gated type, which is more economical to construct and is easy to operate and maintain.
- The return period of design flood is set at 1,000 years, as the dam is a concrete type. Estimation for discharge of design flood considers storage effect in reservoir. So the design discharge is Qout=1,569 m^3/s as outlet flow against Qin=1,700 m^3/s of in-flow of reservoir for the selected case of weir length of 100 m. Maximum height of overflow on the spillway weir is calculated as 3.95 m.
- Spillway is also checked against a flood with a return period of 10,000 years.
- The width of chute way is 100 m at the top beginning and 80 m at the bottom ending, and a width of stilling basin to dissipate energy from chute flow is selected to be 80 m considering the geometry of riverbed.

(6) Intake Facility Designing

An intake facility to supply irrigation water for around 4,500 ha and potable water for downstream local village will be placed on the upstream face of the right side dam body. Water from the reservoir will be led through pipes installed inside the box culvert of the river diversion. Steel pipe of 2,000 mm diameter for irrigation and steel pipes of 300 mm for potable water are planned. Irrigation water will be released to the downstream river through a jet-flow gate.

(7) Irrigation Facility Designing

There are the existing irrigation facilities in the project area. These irrigation facilities were, therefore, incorporated as much as possible in proposed plan for the whole irrigation system. Irrigation diagram for the proposed irrigation systems is shown in Figure 9.1.6. The layout of irrigation facilities such as diversion, canals and related structures was conducted on the basis of the topography, the present water rights and the land suitability. The study points are summarized as follows:

- The total irrigation area of 4,500 ha is divided into 18 irrigation zones in the same manner as the existing irrigation systems.
- A diversion weir was proposed at the near site of existing diversion of Taslimant in order to maintain the present water rights. The following diversion will be constructed with the intake design discharge of 6.75 m^3/s based on the irrigation water requirement.

Item	**Unit**	**Dimension**
Dam type	-	Fixed Concrete Type
Crest length	m	70
Crest width	m	2.0
Weir height	m	5.0
Side slope (upstream)	-	Vertical
Side slope (downstream)	-	1: 0.7
Width of sluice section	m	2.0
Slide gate (W x H x nos.)	m x m x nos.	2.0 x 2.0 x 2

Main canal route was laid out in the left bank along the seguias, which currently convey the water from existing diversion weirs to its commanded farmlands. Branch canal was separated from the main canal at 5.45 km downstream of the intake weir so as to divide water into farmlands in the right bank. Irrigation canals were, in principle, designed as masonry with concrete filled or concrete flume, considering the rapid flow caused by steep slope of canal bed, water loss and maintenance of canals. General features of the irrigation canals are as follows:

General Features of the irrigation canals

Name of Canal	Canal Length (m)	Canal Discharge (m^3/s)	Canal Base Width (m)	Water Depth (m)	Canal Height (m)
Main Canal	21,600	6.75-1.26	1.60-1.20	1.59-0.62	2.10-0.90
Branch Canal	15,280	1.67-1.02	1.35-1.10	1.30-0.52	1.50-0.80
Total	36,880	-	-	-	-

Principal features of the dam, its appurtenant structures, irrigation facilities and related structures are shown in Table 9.1.2.

9.1.3 No. 10 Timkit

(1) Dam site and type

The dam site is located on the Ifegh River in the mountain range 25 km northwest from Tinejdad, which is about 70km southwest of Er-Rachidia. It takes about one hour from Tinejdad by 4-wheel drive vehicle to reach the dam site via a road on the riverbed plain and a rough unpaved road, passing close to Ifegh village. Around one km upstream from Ifegh village, the river forms a series of gorges. After passing the gorge there is a confluence of two rivers, where the riverbed would create a very efficient reservoir.

The dam site is selected in the downstream end of this series of gorges with very steep slope in the left abutment and moderately steep slope in the right abutment.

The geology of this area mainly consists of limestone, which normally possesses many cavities and open cracks being highly pervious. However, there are clayey limestone layers that make wide impervious planes in the foundation of the dam. Strike of the planes is parallel with the dam axis, dipping 20 to 30 degrees to upstream. The dam axis should be properly selected so that the dam body can be connected with the impervious planes by grouting work.

The base of dam body mostly sits on pervious limestone layer. As limestone itself is hard rock foundation, it could bear the load from both a concrete gravity dam or a fill dam. However, there remains a little anxiety that some cavities and open cracks of limestone beneath the dam base could be left unplugged even if enough contact grouting were carried out. If this happens with a fill type dam, erosion and piping in the embankment, which may lead to fatal damage of the dam, is anticipated. Accordingly a concrete gravity dam that is highly resistible against such erosion is selected for this dam site.

(2) Dam Design

As mentioned above, there are large suitable sand and gravel deposits around the dam site. The dam is planned to be a type of roller compacted cement dam (RCC) with natural sand and gravel, that is very common in Morocco recently. General layout and typical cross sections of the dam is shown in Figures 9.1.7 and 9.1.8, respectively. RCC with maximum gravel size of 80mm will be placed as inner concrete to support dam body stability and to make an economical embankment. Normal concrete with maximum gravel size of 80 mm will be placed as outer concrete to make an impervious dam and to obtain high resistance against deterioration of appearance. Inspection gallery tunnel is planned to set drainpipes for releasing water pressure acting on the bottom of the dam. The dam was designed for the following conditions:

- For planning a reservoir to store the sediment volume, alternative measures were studied. One is to store total sediment volume in the reservoir as dead water storage. Other is to share a part of the sediment load on a Sabo dam, which would be located nearby upstream of main dam reservoir to stop only sediment. Sharing on Sabo dam varies from 30-year sediment as maximum sharing to 0 years sediment (0%)as minimum sharing. Comparison study on main dam and Sabo dam was carried out. Study shows that Sabo dam to share the storage of sedimentation is slightly less economical. If total sedimentation is planned to rest in the main dam's reservoir, water storage for irrigation should be kept on the storage volume of sedimentation. This implies a larger surface area of the reservoir for irrigation. On the other hand, as the dam site is located in semi-arid dry area, there will be a significant loss of storage water by evaporation.

  Accordingly 30 years sediment on Sabo dam, that is maximum sharing, is recommended for storage. So the sediment volume in the reservoir of the main dam is 4,000,000m3 of 20 years sedimentation. The dead water level of reservoir that is equivalent to elevation to store the total sediment volume is 1,240.3 m.

- To decide the dam crest elevation, free board against/for wave rush-up height and dam type allowance were estimated from the normal water level and the flood water level of the reservoir. So dam crest is decided as follows:

  a) Dam crest; El 1,258.12m(as FWL)+1.17m(as wave height due to wind)+0.21m(dam type allowance)=EL 1,259.5m

b) Dam crest will not provide for the use of public road. Width of dam crest is selected as 5m,

- Stability analyses of overturning and shear sliding are performed to ensure the safety of dam body. Safety factors satisfy minimum allowance of the Moroccan standard that is almost the same as that of the Japanese standard. In this analysis, intensity of seismic acceleration is selected to be 0.10g concerning concrete dam as a zone of high frequency based on the analysis of seismic intensity and frequency. Parameters of shear strength of rock foundation are also estimated as rocks beneath dam body will be mainly hard limestone.

(3) Dam Foundation Design

All deposit materials and highly weathered rock should be removed under the dam body. Especially, the foundation at riverbed will demand sound rock. Thickness removed from dam foundation will be about 15 m at the left abutment and riverbed, and about 10 m at the left abutment.

Most of dam bottom is on limestone foundation that has open cracks and cavities and is excessively pervious. On the other hand, there is an impervious plane of sedimentation rock layer that forms under dam foundation. To avoid leakage of foundation, grouting is required that makes a continuous water-stop curtain connecting impervious plane and dam body, which is in addition to common consolidation grouting.

Grouting at riverbed will be performed from the upstream taper filet of dam. And grouting position will gradually move toward downstream of dam site from middle of both abutments to make grouting depth as shallow as possible. The maximum depth of the grouting is planned to be about 15 m at riverbed. The maximum depth of the grouting at abutments is about 60 m, which is much deeper than that of riverbed because of geometry of impervious rock plane in the limestone.

(4) Diversion Facilities

The river of the dam site is non-perennial, but it has subsurface flow in the riverbed throughout the year. Floods also occur two or three times a year, but their timing is unpredictable. So the diversion is necessary during the dam construction. A box culvert for diversion will be placed on the foundation of the riverbed. The culvert should be constructed by closing half the river for some months, when flood is not likely to occur statistically. Principal points of diversion design are as follows:

- Design discharge of Diversion Facilities is basically that of return period of 10 years, as the dam is a concrete gravity type. To ensure the safe leading of flood flow, a discharge of 20-year return period is checked to pass without overflowing the culvert wall.
- Discharges of both return periods are 300 m^3/s for 10 years and 348 m^3/s for 20 years considering the storage effect of the flood in the reservoir. Thus, the size of culvert is planned to be 6m high and 6m wide with total a length of 200m.

The box culvert will be used as room for conduit of intake facility for the use of reservoir water.

(5) Spillway

A spillway facility will be formed on the center of dam body. Principal points of spillway design are as follows:

- The spillway weir for the dam is non-gated type, which is more economical and easy to operate and maintain.
- The return period of design flood is applied to be 1,000 years, as the dam is a concrete type. Estimation for discharge of design flood considers storage effect above the normal water level (EL 1,255.8m) in reservoir. Room for flood control between the surcharge water level (EL 1,255.8m) and the normal water level is counted in the calculation of storage effect. Thus, the design discharge is Qout=426 m^3/s as outlet flow against Qin=2,000 m^3/s of in-flow of reservoir for the selected case of weir length of 60 m. Maximum height of overflow on the spillway weir is calculated as 2.32 m.
- The width of chute way and stilling basin is selected to be 60 m considering the riverbed geometry.
- The energy dissipater after chute way channel selected to be a stilling basin type considering condition of topography and geology of the foundation

(6) Intake Facility Design

An intake facility to supply irrigation water for Ifegh and potable water for downstream local village will be placed on the upstream face of the right side of the dam. Outlet gate to supply irrigation water for Tinejdad and Chitam will be placed on the dam body.

Water from the reservoir will be led through pipes installed in the dam body. Steel pipe of 600 mm diameter for irrigation and steel pipes of 400 mm diameter for potable water are planned. Ifegh irrigation water will be released to the downstream river through a jet-flow gate.

Floodwater from 4m x 4m outlet gate will be released on the chute of the spillway. This water will finally contribute to the irrigation of farmlands around 30 km downstream of Tinejdad and Chitam.

(7) Irrigation Facility Design

There are the existing irrigation facilities in the project area. These irrigation facilities are, therefore, incorporated as much as possible in the proposed plan for the whole irrigation system. Irrigation diagram for the proposed irrigation systems is shown in Figure 9.1.9.

The water stored in the reservoir will be released to the river and taken at the existing diversion weirs. The irrigation water will be conveyed from the intake weir to farmlands according to the prevailing traditional water rights. In the Tinejdad and Chtam areas, the principal diversion weirs and main canals have already been constructed on the basis of their design concept. The main points considered for the rehabilitation of irrigation facilities are summarized as follows:

- The total irrigation area of 3,825 ha in gross is divided into three areas Ifegh, Tinjidad and Chtam areas;
- All of the traditional diversion weirs located along the rivers and those related seguias are required of the rehabilitation works;
- The canal bases, which are shallow owing to erosion of inside slopes and to sedimentation on the basis of the canal route survey results, will need to be excavated and the destroyed inside slopes will need to be re-embanked by masonry;
- The diversion of 12 weirs will be rehabilitated to convey the water of flood to entire fields with the empirical design intake discharges of 15 liters/sec/ha. General features of the irrigation canals are as follows:

Features of the Irrigation Canals

Type of Canal	Canal Length (m)	Canal Discharge (m^3/s)	Canal Base Width (m)	Water Depth (m)	Canal Height (m)
Concrete flume	3,600	0.45	0.50	0.61	0.85
Masonry	34,900	3.50-1.00	1.23-0.71	0.71-1.23	1.53-0.91
Total	38,500	-	-	-	-

Principal features of the irrigation facilities and related structures are shown in Table 9.1.3.

9.1.4 No. 17 Azghar

(1) Dam site and type

The dam site is located on the Zloul river in a hilly area, 7 km east from Ribat Al Khayre, around 50 km eastward from Sefrou. Access by paved road is possible up to around one(1) km downstream from the dam site. Further access to the dam site is only possible by 4 wheel drive vehicle.

From hilly point in Ribat el Kheir, future irrigation service area could be nicely observed. The Zloul river runs along the south edge of the irrigation service area. A mountain range closes the upstream end of the irrigation service area. The valley in the mountain range created by the Zloul River is the dam site.

Geology of the dam site is blackish marl. Hard foundation rocks of the marl expose on the riverbed and on the slopes of both abutments. Lots of bedding stratification is observed in the marl, but their contacts are firm. So the foundation allows for both a gravity dam and fill dam. Construction materials for both dams could be obtained near the dam site. In order to select the dam type, fill type dam with center-core and concrete gravity type dam, to be constructed by RCC (BCR in French) were compared.

The comparison study found the construction cost of the center-cored fill dam is cheaper by about 30 % than BCC as shown in Supporting Report XVII, so a fill type dam for this site is recommended.

(2) Dam Designing

The foundation rock of dam site has scarce cracks and it is mostly impervious. But some parts of foundation near surface are semi-pervious rocks that require grouting against leakage. General layout and typical cross sections of the dam is shown in Figures 9.1.10 and 9.1.11, respectively.

Considering the availability of the embankment material and necessity of grouting, a center-cored fill dam is recommended.

The impervious core-zone requires residual or colluvial deposit materials from reservoir area. Zones of filters and drain are river deposit material, and the main embankment of upstream-side and downstream-side dam are river deposit materials and excavation material from spillway. Upstream-side slope of the dam will be protected by riprap of quarry site material. These arrangements of materials for each zone will make dam cost economical. The dam was designed for the following conditions and considerations:

- Sediment volume accumulated over 50 yeas is to be stored by the dam. Total sediment volume will be stored in the reservoir without other storage measures such as Sabo dam, which were judged to be less economical by the alternative study. Total sediment volume is 6.5 MCM. So the dead water level of reservoir that is equivalent elevation to store the total sediment volume is 848.5 m.

- To decide the dam crest elevation free board against/for wave rush-up height and dam type allowance were estimated from the normal water level and the flood water level of the reservoir. The crest of impervious core is decided as follows:

  a) Core crest; El 856.89m(as FWL)+1.16m(as wave height due to wind)+1.15m (dam type allowance)= El 859.20m

  b) Dam crest is El 859.5m by adding 0.3m thickness of core protection.

- Dam crest will not provide for the use of public road. Width of dam crest is selected as 6m,

- Stability analysis of sliding by slip circle method is performed to ensure the safety of dam body. Safety factors satisfy minimum allowance of the Moroccan standard that is almost same as that of the Japanese standard. In this analysis, intensity of seismic acceleration is estimated to be 0.12g as a zone of high frequency based on the analysis of seismic intensity and frequency. Parameters of shear strength are also estimated,considering soil embankment and rock embankment densities that are not less than D95% and Dr (relative density) 80%, respectively.

(3) Dam Foundation Designing

Weak layers, such as organic soil, clayey soil, alluvium deposit containing silt and clay, etc. should be removed beneath the whole of the dam body. Thickness removed will be less than 0.5m at left abutment where many rock exposures are observed. And it is about 1.0 m at the right abutment and riverbed.

Excavation of the core trench for the dam will be done down to a depth of about 10m in the foundation of the abutments and the riverbed to expect the sound rock where grouting could effectively improve perviousness of shallow foundation.

Grouting is planned to avoid a leakage through the dam foundation and its limb foundation targeting pervious rock more than 3 to 5 Lugeon. The maximum depth and the minimum depth of the grouting are planned to be 20 m at riverbed and 25 m at the abutments.

(4) Diversion Designing

River diversion facilities may be proposed to be box culvert type in the gentle slope of the right abutment. Although the tunnel type diversion likely to be proposed in the left abutment will be also studied, it is much more expensive. Principal points of diversion design are as follows:

- Design discharge of diversion facilities is basically that of return period of 20 years, as the dam is fill type. To ensure the safe leading of flood flow, a discharge of 50-year return period is checked to pass without overflowing the culvert wall.
- Discharges of above both return periods are 213 m^3/s for 20 years and 222 m^3/s for 50 years after considering the storage of flood in the reservoir. So the size of culvert is planned to be 5x5m with total a length of 240m.

(5) Spillway Designing

A spillway facility will be planned on the moderate slope of the right abutment, where the spillway channel can be placed on the hard rock with small amount of excavation works. On the other hand, spillway on the left abutment, of which length will be the same as on the right abutment, is easily recognized to produce much volume of rock excavation because of steep slope. Principal points of spillway design are as follows:

- The spillway weir for the dam is non-gated type, which is more economical to construct and is easy to operate and maintain.
- The return period of design flood is applied to be 10,000 years, as the dam is fill type. Ddischarge of design flood was estimated considering storage effect in reservoir. The design discharge is Qout=592 m^3/s as outlet flow against Qin=700 m^3/s of in-flow of reservoir for the selected case of weir length of 60 m. Maximum height of overflow on the spillway weir is calculated as 2.89 m.
- The width of transition channel, chute way and stilling basin is selected to be 15 m as the most effective cross-section determined by the hydraulic study.
- The energy dissipater after chute way channel is selected to be a stilling basin type considering condition of topography and geology of the foundation.

(6) Intake Facility Designing

An intake facility with type of inclined conduit at the left bank will be placed on the slope of the left abutment to supply irrigation water for around 2,000 ha and potable water for downstream local villages. Maximum total design discharge is about 2.6m^3/sec. Water from the reservoir will be led through pipes installed inside the tunnel of the river diversion. Steel pipe of 1,000 mm diameter for irrigation and steel pipes of 300 mm for potable water are planned. Irrigation water will be supplied to the downstream water tank that will control water head to supply water to farmland.

(7) Irrigation Facility Designing

At present most farmlands are rain-fed. A block of private fruit farmland faces the Zloul river where drip-by-drip with pumping water is operated. And a few small farmlands are temporary irrigated with water pumped from the river. Several legally entitled water rights exist in the project area, however, those quantities of water available to the irrigation are not enough for the lands at all.

The layout of irrigation facilities such as main canal, branch canals and related structures was conducted on the basis of the topography, the existing water rights and the land suitability as well as the expected land consolidation in the near future.

The total irrigation area of 2,000 ha in net will be obtained by maintaining the water level of canal as high as possible for maximizing the irrigation area. Irrigation diagram for the proposed irrigation system is shown in Figure 9.1.12. The main considerations for the alignment of irrigation facilities are summarized as follows:

- Considering average size and shape of irrigation block, the typical block will be rectangular, 400 m x 750 m, of 30 ha in gross. The total number of irrigation blocks is determined to be 77 blocks of which average area in net was about 26 ha as shown below.

Irrigation Blocks for Each Zone

Name of Canal	**Irrigation Area In Net (ha)**	**Number of Irrigation Blocks**
Main Canal	967	37
Branch Canal 1)	319	15
Branch Canal 2)	541	17
Branch Canal 3)	173	8
Total	2,000	77

- Main canal route was laid out in the right bank along the gentle slope with a gradient of less than 8 degrees available to irrigate lands by gravity. Branch canal 1) was directly connected to the end of main canal. Branch canal 2) was separated from the main canal at 3.72 km downstream of the stilling basin so as to convey water to farmlands located along or near the river. Branch canal 3) route was laid out along the skirts of gently sloping hills in the left bank.
- Irrigation canals were, in principle, designed as stone with concrete filled or concrete flume in consideration of water loss and canal maintenance.
- The canal section was designed taking into account the effective water flow and the canal slope stability.

General Features of the irrigation canals

	Canal Length (m)	Canal Discharge (m^3/s)	Canal Base Width (m)	Water Depth (m)	Canal Height (m)
Main Canal	13,545	2.38-0.63	1.60-0.60	1.01-0.58	1.25-0.80
Branch Canal (1)	2,580	0.25-0.14	0.50-0.40	0.45-0.35	0.60-0.50
Branch Canal (2)	5,515	0.71-0.29	1.00-0.60	0.57-0.40	1.00-0.70
Branch Canal (3)	2,670	0.23	0.80	0.40	0.60
Total	24,310	-	-	-	-

Principal features of the irrigation facilities and related structures are shown in Table 9.1.4.

9.2 Construction Plan and Cost Estimates

9.2.1 Construction Plan

(1) Basic Assumption

- Monthly Workable Days

The number of monthly workable days for construction works of excavation, embankment and concrete are estimated based on the rainfall data at each project area from 1991 to 2000. The results are shown in the table below

Monthly Workable Days

Work	N'Fifikh	Taskourt	Timkit	Azghar
Excavation	25	25	27	23
Embankment	25	26	28	24
Concrete	25	26	28	24

- Daily Workable Hours

The daily workable hours are follows:

i- Earthworks and concrete works – 8 hours/day, 1-shift

ii- Grouting works – 9 hours/day, 2 shifts, 2 hours overtime

- Equipment Used for Earthworks

Earthworks require equipment during construction of dams and irrigation facilities as shown below.:

Earthworks and Equipment

Works	Materials	Proposed Equipment
Excavation	Common Soil	Bulldozer (21-44t), Backhoe (0.6-1.2m3)
	Weathered Rock	Ripperdozer (32t)
	Rock	Blasting and Bulldozer (32t)
Loading	All materials	Tractor Shovel (5.4m3)
		Backhoe (0.4-1.2m3)
Hauling	All materials	Dump Truck (4-32t)
Spreading	All materials	Bulldozer (21-32t)
Compacting	Dam Core	Tamping Roller (30t)
	Other materials	Vibrating Roller (15-18t), Tamper (60kg)

(2) Construction Volume and Schedule

Construction volumes of each work in the four sites are shown on Table 9.2.1. The construction period of each work is calculated based on production rate as shown on Table 9.2.2, and the results are shown on Table 9.2.3. The same equipment and production rates are assumed for the respective work in all four sites.

The hauling distance of dump trucks is assumed to be 0.5km because in-situ materials are basically used for all construction works after processed by screens and aggregate plants.

(3) Construction Method

a) Dam Construction Work

Construction methods for major works are listed as follows:

- River diversion

A cofferdam should be constructed for a fill type dam (N'Fifikh, Azghar), which is very fragile against overflowing during construction, to divert mainstream of a river. The type and length of diversion are shown below:

Type and Length of Diversion

Item	N'Fifikh	Taskourt	Timkit	Azghar
TypeChannel	Culvert	Culvert	Culvert	
Length (m)	300	270	200	240

- Foundation excavation

Beneath the whole of dam body, weak layers, such as organic soil, clayey soft deposit, alluvium deposit containing silt and clay, etc., should be removed to avoid un-even settlement and sliding of dam.

- Foundation treatment

After foundation excavation work, grouting work should be carried out in order to avoid excessive leakage through foundation. Especially Timkit dam site has limestone foundation, so that grout curtain should be appropriately connected to the impermeable clayey limestone layer. The depth of curtain grouting is maximum 60m at Timkit dam site and minimum 10m at Azghar dam site.

Besides this, consolidation grouting should be done with 5m deep for concrete dams (Taskourt, Timkit) to make dam body stick well to foundation.

Rotary boring and percussion boring should be applied for curtain grouting and consolidation grouting respectively.

- Dam embankment

i- Fill type dam

A center-cored fill type is chosen for N'Fifikh and Azghar site due to low bearing capacity of foundation and cost comparison study, respectively. In-situ materials are used as much as possible by screening or mixing for proper gradation. The core zone is compacted by tamping roller and, filter and transition zones are compacted by vibrating roller.

ii- Concrete gravity dam

A concrete gravity type is chosen for Taskourt and Timkit. Outer conventional concrete is rich concrete and inner concrete is roller compacted concrete. Aggregate would be produced by aggregate plants from in-situ materials and concrete is mixed by batching plants. Hauling should be done by agitator cars and dump trucks respectively. Inner concrete is spread by swamp bulldozers and compacted by vibrating roller. Outer concrete is placed by concrete pumps and chutes between fixed precast concrete plate and inner concrete.

- Spillway

A fill type dam requires an independent spillway constructed on the stable foundation. The spillways are constructed on the right bank in both N'Fifikh and Azghar sites. The size of the spillway in N'Fifikh is quite big due to the big design flood. Both are made of reinforced concrete.

Guide wall and downstream slab are counted as the volume of spillway in Taskourt and Timkit, as a flood overflows the dam crest on the concrete dam.

- Outlet

The outlet facility is constructed to control discharge, connecting the intake facility to outlet structure. Its pipeline is constructed in the diversion channel /tunnel of N'Fifikh and Azghar, and in the dam body of Taskourt and Timkit. Besides slide gates, jet flow gates and flow meters are installed.

- Sabo dam

A sabo dam is constructed in Timkit to store 6.0 million m3 of sediment, equivalent to 30 years of sediment volume accumulated at the main dam site. The site of sabo dam is located approximately 20km upstream from the main dam and it has 60% of basin area of the main one. Rubble masonry is applied for sabo dam body.

b) Irrigation Facility Construction Work

- Main Canal

The structures of main canals, named Main, Branch and Main Feeder canal, are masonry lining, masonry flume, and reinforced concrete flume, depending on the discharge and geological condition. Backhoes are used for excavation work and masonry work would be implemented manually.

- Structures

Structures of irrigation facility are head works, siphons, drops, offtakes, spillways, checks, aqueducts, cross drains, bridges, box culverts and on-farm facilities. Wells and river channel shaping are also planned in Timkit.

9.3 Cost Estimate

9.3.1 Basic Assumptions and Conditions

Financial construction costs for the dam and irrigation facilities in all four sites are estimated based on the following conditions.

- The costs are estimated at the price level of April 2000.
- The exchange rate used in the estimate is shown as below:

  US$1.00 = DH10.68, JYen100 = DH9.90 DH; Dirhams
- Both local and foreign currency portions are estimated in Dirhams.
- Physical contingency is fixed at 10%.
- Price escalation rate is estimated at 3% per annum for both local and foreign currency portions.
- The estimation includes the following rates of value added tax.
  - Construction works: 14%
  - Resettlement: 14%
  - Engineering services: 20%
- International competitive bidding (ICB) is applied for the construction of dams and local competitive bidding (LCB) is applied for the construction of irrigation and small-scale water supply facilities.
- The rate of local and foreign currency portion is 0.35 : 0.65 for the dam construction cost and 0.50 : 0.50 for the irrigation facility construction cost. The construction of a dam has higher dependence to foreign resources. Those values are referred from statistical data.
- Earth materials will be obtained in and around the construction sites, and aggregates will be produced with such materials.

9.3.2 Unit Cost

The construction costs are estimated on the unit cost basis. They are calculated based on basic costs collected through a survey. Each unit cost is cautiously fixed considering the prices used in actual bidding. Tables 9.3.1 to 9.3.3 show basic costs of major laborers, materials and equipment.

9.3.3 Constitution of Construction Cost

The construction cost consists of the following items.

1) Direct Construction Cost comprises the cost for actual civil works, and overhead and profit of contractor, the percentage of which varies13 to 16% in fill dams, 15 to 22% in concrete dams, and 7% in irrigation works.
2) Physical Contingency is fixed at 10% of 1) for all construction works.

3) Price Contingency is estimated at 3% per annum for both local and foreign currency portions, based on the price escalation rate, and calculated at compound interest on the sum of 1) and 2) according to the project implementation schedule.

4) Value Added Tax is fixed at 14% for all construction works, the standard percentage for a civil work contract, and multiplied by sum of 1) to 3).

The total construction cost of each site is summarized on the table below, and Table 9.3.4 shows the cost of each work item.

Unit: Million Dirham

Item	N'Fifikh	Taskourt	Timkit	Azghar	Total
Dam	220.7	424.6	250.3	173.4	1,069.0
Irrigation	56.3	203.2	173.2	113.1	545.8
Total	277.0	627.8	423.5	286.5	1,614.8

9.3.4 Annual Operation and Maintenance Cost

Annual operation and maintenance cost is estimated 0.5% for a dam project cost and 2.0% for an irrigation project cost, based on the data obtained from the Ministry of Equipment and Ministry of Agriculture, respectively.

9.3.5 Project Cost

The project cost has been estimated based on the following conditions and assumptions:

1) Resettlement cost has been estimated on preliminary basis and it includes compensation for properties, compensation for earning shortage, and expenses for monitoring and guidance. The cost does not include the cost for infrastructure and public utilities at resettlement location.

2) Engineering service cost is estimated at 7% of the total costs of construction works.

3) Administration cost is assumed at 5% of the total costs of construction works and resettlement.

4) Physical contingency is assumed to be 10% of the total costs of construction works, resettlement, engineering services, and administration.

5) Price contingency is assumed to be 3% per annum for both foreign and local currency portions of all the costs.

6) Value added tax is calculated at 20% of the engineering service cost and 14% of all other costs.

Estimated costs are presented in Table 10.1.4 and summarized below:

Unit: Million DH

Cost Item	N'Fifikh	Taskourt	Timkit	Azghar	Total
1. Construction cost	181.0	409.5	274.6	185.8	1,050.9
2. Resettlement cost	3.3	28.5	6.4	5.1	43.3
3. Engineering service cost	12.7	28.7	19.2	13.0	73.6
4. Administration cost	9.2	21.9	14.0	9.5	54.6
5. Physical contingency	20.7	48.9	31.4	21.3	122.3
Sub-total (1.-5.)	226.9	537.5	345.6	234.7	1,344.7
6. Price contingency	44.3	101.0	77.5	46.3	269.1
Sub-total (1.-6.)	271.2	638.5	423.1	281.0	1,613.8
7. Value added tax	38.9	91.6	60.8	40.4	231.7
Total (1.-7.)	310.1	730.1	483.9	321.4	1,845.5

CHAPTER 10 ECONOMIC AND FINANCIAL EVALUATION

10.1 Economic Analysis

10.1.1 General

The methodology applied for the economic evaluation of the projects is basically the same as that applied for the evaluation of the projects in Phase I (Basic Study). Some parameters for evaluation have been changed based on new findings in Phase II (Feasibility Study).

(1) Price Level and Exchange Rate

The analyses are made at the price level of April 2000 and applied foreign exchange rate is one U.S. dollar equivalent to 10.68 Dirhams and 100 Japanese Yen equivalent to 9.90 Dirhams.

(2) Project Life

The project life depends on the insurability of the facilities. The project life of 50 years after construction of dams is assumed for the economic evaluation. Average lifetime of the metal and mechanical facilities related to the projects is assumed to be 25 years after installation. The replacement cost covers the cost for replacement of such facilities after their lifetime during project life.

(3) Discount Rate

A discount rate of 8% has been applied to reflect the opportunity cost of capital in Morocco. Discount rates of 6, 10 and 12% are also tested for calculation of NPV for reference.

(4) Price Index

Since the prices of crop and agricultural inputs fluctuate largely year-by-year, the average prices for the last 3 to 5 years have been applied. Price indexes were used for converting the past values into the present values. For converting the value of domestic price, domestic price index was used and for international commodities, “World Bank Commodity Price Indices for Low and Middle Income Country” was applied.

10.1.2 Economic Prices

(1) Standard Conversion Factor (SCF)

The same standard conversion factor (SCF) as estimated in the Phase I study has been applied to the price of non-traded goods and services in order to estimate the economic values of them. SCF in this study is 0.86.

(2) Transfer Payment

From the viewpoint of national economy, the transfer payment such as taxes, duty, subsidy and interest is merely a domestic monetary movement without direct productivity. Therefore, it is excluded in the economic prices of goods and services.

(3) Economic Prices of Agricultural Inputs and Outputs

The economic prices of agricultural inputs and outputs were estimated for both with and without project conditions on the assumption that the quality of the inputs and the outputs would be different between the two conditions.

- Without Project Condition

The actual farm gate prices of crops except wheat and barley were converted into economic value by applying SCF on the assumption that the crops would not be sufficient for external trade due to their quality and the most of crops would be consumed domestically. As for wheat and barley, the import parity value at farm gate has been applied since the production of wheat and barley are import substitute. The actual farm gate prices of seeds were also converted into economic value by applying SCF since the most of the seeds are local species.

For estimation of economic value of fertilizers, the import parity value at farm gate has been applied. As for agricultural chemicals, an average conversion factor of fertilizer has been applied for estimation of economic value of them.

- With Project Condition

Under “with project” condition, it is assumed that more crops than ever would be of better quality and sufficient for external trade on account of appropriate water and inputs. It is assumed 30% of tomato, 5% of potato, 1% of grape, some 20% of olive, and half of dates would be sufficient quality for external trade based a statistical data on production and external trade of agricultural crops. The ratios are slightly higher than present situation but they may be feasible with appropriate water use and inputs. The economic value of these crops is estimated by

proportional distribution of domestic farm gate price and import/export parity value at farm gate.

For wheat and barley, the import parity value at farm gate has been applied. As for other crops, SCF has been applied on assumption that most of the crops would be consumed domestically.

The economic prices of seeds/seedlings are estimated from import/export parity value if they are actually imported or exported. If most of them are procured domestically like seeds of watermelon, seedling of grape and dates, the economic prices of seeds/seedlings are estimated by applying SCF.

Supporting Report XVIII shows the calculation of the economic price of agricultural crops and inputs under " without and with project" conditions.

(4) Economic Prices for Farm Labor, Mechanization, and Animal Traction

In each project site, cropping pattern must be almost same among farmers due to its climate, availability of water, and sometimes by instructions of associations. Hence, many farmers need the labor force at the same timing. Thus, we may assume that the peak season labor market is a relatively competitive one, that labor is in relatively short supply at this period, and that the daily wage at this period may be a good estimate of the daily marginal value product of the labor engaged. On this assumption, the actual daily labor cost obtained by interview is applied by multiplying SCF as the economic value of the farm labor. Similarly, the demand of agricultural equipment and animals increases at the same timing. Their market may also be relatively competitive during the peak period. Therefore, the actual costs of mechanization and animal traction are applied by multiplying SCF as the economic value of them.

(5) Economic Project Cost

The economic project cost has been estimated from the financial project cost based on the following assumptions:

a) Value added tax is deducted from the project cost as the transfer payment.

The following rates are assumed as the value added tax:

- Construction works: 14%
- Resettlement: 14%
- Engineering services: 20%

b) Construction cost has been estimated dividing into two categories:

- Traded goods and services: Foreign currency portion (F.C.)

- Non-traded goods and services: Local currency portion (L.C.)

The costs of non-traded goods and services have been converted into an economic value by applying Standard Conversion Factor (SCF).

c) Engineering service cost will not be adjusted since it is considered as professional labor.

d) Price contingency will not be considered for the economic evaluation.

10.1.3 Economic Evaluation for Irrigation Alternative Study

(1) Irrigation Alternative Plans

In order to select the optimum irrigation plans; economic analyses of alternative plans have been conducted. Subsection 8.1.3 describes the features of the alternative plans and they are summarized in Table 10.1.1.

For the comparative purposes, only agricultural benefits were considered.

(2) Benefit of the Alternative Plans

Farm income by the project sites under the present condition has been estimated by the Study Team as shown in the table below.

Farm Income under Present Conditions (Economic price, DH/ha)

	N'Fifikh		**Taskourt**		**Timkit**			**Azghar**
	Up	Down	Perennial	Seasonal	Ifegh	Tinejdad	Chtam	
Gross Income	4,111	4,606	15,022	1,453	9,745	11,044	3,202	1,571
Expenditure	1,844	2,425	2,602	1,315	2,035	2,168	450	1,406
Net Income	2,267	2,181	12,420	138	7,710	8,876	2,752	165

According to the agronomic study using model crops and cropping patterns based on the characteristcs of each project area as described in Subsection 8.1.4, after implementation of the projects, improvement in crop yields and production of higher value crops are expected. The expected net income by the alternatives is estimated as shown below. The detailed estimation of the net incomes under "without project (present situation)" and "with project" conditions is presented in Supporting Report XVIII.

Net Income of Each Alternative Plan with Project (Economic price, DH/ha)

Project	Alternative	Gross Income	Expenditure	Net Income
N'Fifikh (Upstream)	NU1	24,124	6,071	18,053
	NU2	12,358	3,989	8,369
	NU3	37,095	7,337	29,758
	NU4	24,124	6,071	18,053
	NU5	24,124	6,071	18,053
N' fifikh (Downstream)	ND1	21,428	5,314	16,114
	ND2	21,428	5,314	16,114
Taskourt	TA1	26,932	4,602	22,330
	TA2	26,932	4,602	22,330
	TA3	26,932	4,602	22,330
	TA4	26,932	4,602	22,330
Timkit TI1 & TI2	Ifegh	32,937	5,677	27,260
	Tinejdad	31,394	5,840	25,554
	Chtam	20,962	4,118	16,844
Azghar	AZ1	36,080	6,802	29,278

The difference of the net incomes between with and without project is considered as the agricultural benefit of the Projects. The incremental net income by each alternative plan is as shown in Table 10.1.2 and summarized below:

Annual Net Benefit of Each Alternative Plan (Economic price)

Project	Alternative	Average annual irrigable area (ha)	Benefit without project (million DH)	Benefit with project (million DH)	Incremental net benefit (million DH)
N'Fifikh (Upstream)	NU1	853	1.9	15.4	13.5
	NU2	886	2.0	7.4	5.4
	NU3	645	1.5	19.2	17.7
	NU4	984	2.2	17.8	15.6
	NU5	853	1.9	15.4	13.5
N'Fifikh (Downstream)	ND1	228	0.5	3.7	3.2
	ND2	510	1.1	8.2	7.1
Taskourt	TA1	3,831	11.6	85.5	73.9
	TA2	4,406	11.7	98.4	86.7
	TA3	2,713	11.5	60.6	49.1
	TA4	3,126	11.5	69.8	58.3
Timkit	TI1	1,690	13.1	41.2	28.1
	TI2	1,570	12.1	38.3	26.2
Azghar	AZ1	2,000	0.3	58.6	58.3

Implementation of Azghar Dam Project may have negative impacts to the existing Allal Al Fassi and Idriss 1er Dams which are located downstream of the Azghar Dam site. The major negative impacts are losses of hydroelectric power generation and irrigation water supply due to reduction of usable water.

The annual loss of hydroelectric power generation has been estimated at 2.3 GWh or 1.4 million DH.On the other hand, the loss due to reduction of irrigation water is estimated from decrease of agricultural benefit.

The loss is estimated at 5.19 million m^3 or 20.7 million DH. The total annual losses are 22.1 million DH and the losses are deducted from the benefit of Azghar Dam Project as the negative benefit.

(3) Economic Project Cost

Financial project costs have been converted into economic prices as discussed in Subsection 10.1.2. The financial and economic project costs of the irrigation alternative plans and their annual economic costs are shown in Supporting Report XVIII.

(4) Results of the Evaluation

The results of economic evaluation of the irrigation alternative plans are presented in Table 10.1.3.

As for N'Fifikh (Downstream), alternative ND1 has higher economic internal rate of return among the two. Nevertheless, as there is still uncertainty in availability of water, the alternative has been discarded from the priority projects.

As for Taskourt Project, alternative TA1 with a large-scale dam and TA3 with medium-scale dam had almost the same economic efficiency. However, TA3 has been selected as the optimum plan from the following consideration:

1) The difference of economic efficiency between two plans is very small,
2) TA3 will give smaller impact to natural and social environment than TA1, and
3) Moroccan Government has intention to reduce the construction cost as much as possible.

As a result, the following four plans are selected as the optimum irrigation plans:

Optimum Irrigation Plans

Project	Alternative	EIRR	B/C	NPV (Unit: million DH)			
		(%)	DR=8%	DR=6%	DR=8%	DR=10%	DR=12%
N'Fifikh (Upstream)	NU3	6.1	0.77	2.2	-41.7	-66.4	-80.4
Taskourt	TA3	7.3	0.91	85.9	-36.2	-104.5	-143.3
Timkit	TI1	6.2	0.80	8.9	-55.1	-89.9	-108.9
Azghar	AZ1	10.6	1.38	175.1	73.7	13.8	-23.1

Note: 1: DR means discount rate applied for calculation of B/C and NPV.
2: Agricultural benefit only.

10.1.4 Economic Evaluation of the Priority Projects

(1) Benefit of the Projects

1) Functions of the Projects

The priority projects are planned in order to overcome the problems of water scarcity in rural areas due to repeated drought and to sustain the livelihood of the rural farmers as a major function. Other than the major function, each project has the following functions:

Functions of the Projects

Functions	N'Fifikh	Taskourt	Timkit	Azghar
Major Function				
- Irrigation	x	x	x	x
- Flood and erosion control	x	x	x	
Subordinate Function				
- Domestic water supply	x	x		

Benefits of these functions will be estimated as the benefit of the projects. Moreover, other direct and indirect benefits are also taken into account for the economic evaluation.

2) Agriculture

The agricultural benefits have already been discussed in Subsection 10.1.3 for selection of the optimum irrigation plans. The annual net benefit of each project is summarized below.

Agricultural Benefit (Economic price)

Project	Average annual irrigable area (ha)	Benefit without project (Million DH)	Benefit with project (Million DH)	Incremental net benefit (Million DH)
N'Fifikh	645	1.5	19.2	17.7
Taskourt	3,831	11.6	60.6	49.1
Timkit	1,690	13.1	41.2	28.1
Azghar	2,000	0.3	58.6	58.3

3) Flood and Erosion Control

According to the results of the interview survey, as presented in Subsection 7.2.1, all of the four project sites have suffered from flood inundation. After construction of the dams, flood discharge will be regulated and the flood and erosion damages will be mitigated. However, such benefit is very limited and far smaller than the agricultural benefit. Therefore, the flood and erosion control benefits have been preliminarily estimated based on a bold assumption in this study.

The flood and erosion control benefits were estimated as shown below and the calculation of the benefits are presented in Supporting Report XVIII.

Flood and Erosion Control Benefit (Unit: 1,000 DH)

Project	Annual Mean Flood and Erosion Control Benefit		
	Flood	Erosion	Total
N'Fifikh	109	12	121
Taskourt	283	114	397
Timkit	482	53	535
Azghar	21	9	30

4) Small-scale Water Supply

a) Benefit of Small-scale Water Supply

Small-scale water supply system is planned for some villages in N'Fifikh and Taskourt project areas. The beneficial population of the small-scale water supply system is estimated at 1,300 for N'Fifikh and 2,300 for Taskourt in the year 2020 with average annual population growth rate of 0.7%. Annual water requirement is estimated at 9,490 m^3 for N'Fifikh and 16,790 m^3 for Taskourt when the daily water consumption per capita is 20 liters.

The value of water is estimated at 16.7DH/m^3, which is an average of people's willingness to pay obtained by the household interview survey at N'fifikh and Taskourt project areas. Therefore, annual benefits of the water supply are estimated at around 0.16 million DH and 0.28 million DH in N'fifikh and Taskourt, respectively in 2020.

b) Cost Estimate

Facility cost of the small-scale water supply system is estimated at 1,000 DH per beneficial person referring to cost estimates of PAGER. Financial construction costs are estimated at 1.8 and 3.0 million DH for N'Fifikh and Taskourt, respectively.

The costs are converted into the economic price with the same manner as dams and irrigation facilities. Annual operation and maintenance cost is estimated at 5% of the facility construction cost. The lifetime of the system is assumed 25 years after the installation. After its lifetime, the whole system is to be replaced.

c) Results of Economic Evaluation

Economic evaluation of the small-scale water supply system has been conducted using the cost of exclusive-use facilities for water supply, without the cost of dam construction, since the water volume used for the water supply is negligibly small

comparing with that for irrigation. EIRR results for N'Fifikh (Upstream) and Taskourt were 6.1 and 6.5% respectively.

5) Other Direct Benefit

Other than benefits discussed above, various effects are expected by the implementation of the projects as listed below:

- Contribution to national food security,
- Reduction of food import and saving foreign exchange holdings,
- Improvement of self-sufficiency and nutritional level of local farmers,
- To narrow the earnings differentials among regions,
- Convenience of rural population by improvement of access roads to the dam sites and the roads may reduce the cost of moving produce from the farm to the consumer,
- Improvement of public health and quality-of-life by supplying better quality water including decrease of water-related disease,
- To ease the water carrying works which have been done by women and children,
- Groundwater recharge and improvement of vegetation, and
- Stabilization of rural farmers' livelihood and prevention of influx of rural population into urban areas.
- The construction works will create the following new job opportunities for skilled and unskilled labors:

  N'Fifikh: 77,000 man-days
  Taskourt: 124,000 man-days
  Timkit: 85,000 man-days
  Azghar: 78,000 man-days

These benefits are very valuable, they are nevertheless virtually impossible to value satisfactorily in monetary terms. In this Study, the benefits are assumed at 10 % of the direct benefit.

6) Indirect Benefit (Economically Induced Benefit)

During construction period, the construction works may fuel various demand for other industries. Meanwhile, after construction works, incremental agricultural production will also arouse various demands for many different industries. Such ripple effects have been estimated as the indirect benefit (economically induced benefit) of the projects. The Detailed Input-Output Table for Morocco, 1990 was prepared by OECD in collaboration with the Ministry of External Affairs of Morocco and World Bank in 1993.

According to the table, an investment for construction sector will induce various production increase in other sectors and it will create approximately 37 % of added value against the investment. On the other hand, an investment for agricultural production will create approximately 12% of added value against the investment in other various sectors. These added value have been estimated as the indirect benefit of the projects. The calculation of the indirect benefit is presented in Supporting Report XVIII.

The Detailed Input-Output Table for Morocco, 1990 is attached in Data Book.

(2) Economic Cost of the Priority Projects

The financial and economic costs including whole components of the priority projects are shown in Table 10.1.4 and the annual economic costs are shown in Table 10.1.5.

Annual operation and maintenance cost is estimated at 0.5% of the direct construction cost of dams and 2% of that of irrigation facilities.

(3) Results of Economic Analysis

The economic analysis of each project has been conducted on the assumption that all the projects will be started immediately and simultaneously for comparative purposes. Overall plan including all the components of the projects has also been economically evaluated according to the implementation schedule.

In all the cases, the projects have been evaluated for both the cases of including and excluding the indirect benefit (economically induced benefit). Cash flow of the projects are presented in Table 10.1.6 and the results are summarized below:

Results of Economic Analysis

Project	EIRR (%)	B/C DR=8%	NPV (Unit: million DH) DR=6%	DR=8%	DR=10%	DR=12%
Without Indirect Benefit						
N'Fifikh	6.8	0.86	24.0	-26.6	-55.4	-72.1
Taskourt	8.1	1.02	146.9	6.5	-73.1	-119.3
Timkit	7.1	0.90	47.9	-27.6	-69.6	-93.3
Azghar	12.2	1.62	242.0	120.9	48.5	3.4
Overall Plan	8.5	1.07	394.6	58.8	-117.7	-210.3
With Indirect Benefit						
N'Fifikh	10.0	1.17	87.4	32.3	-0.3	-20.4
Taskourt	11.4	1.31	282.6	130.3	40.8	-14.0
Timkit	10.4	1.21	140.2	56.6	7.8	-21.8
Azghar	16.6	1.97	317.8	188.7	110.4	60.5
Overall Plan	12.0	1.38	709.8	332.3	122.4	2.0

Note: DR means discount rate applied for calculation of B/C and NPV.

As a result of the economic analyses without indirect benefit, Taskourt and Azghar projects have sufficient economic efficiency with EIRR of more than 8%, which reflects the opportunity cost of capital in Morocco. Especially Azghar Project has higher economic efficiency with EIRR of 12.2% and also the biggest NPV when the discount rate is 8%. The overall plan also has a good economic efficiency with EIRR of 8.5%.

With the indirect benefit, all the projects show favarable economic efficiency with EIRR of more then 10%. Especially Azghar Project has the highest EIRR of 16.6% and the biggest NPV of 188 million DH when the discount rate is 8%. Taskourt Project also has sufficient economic efficiency with EIRR of 11.4% and NPV of 130 million DH. The overall plan also has a favorable result with EIRR of 12% and NPV of 332 million DH.

(4) Sensitivity Analysis

Sensitivity analysis of the economic evaluation has been examined for increase in cost and decrease in benefit. The results of the analysis are shown below:

Sensitivity Analysis (EIRR with Indirect Benefit, %)

Case	N'fifikh (Upstream)	Taskourt	Timkit	Azghar	Overall Plan
a) Base estimate	10.0	11.4	10.4	16.6	12.0
b) Cost increase of 5%	9.3	10.7	9.7	15.8	11.3
c) Cost increase of 10%	8.8	10.1	9.1	15.0	10.7
d) Benefit decrease of 5%	9.3	10.7	9.7	15.3	11.3
e) Benefit decrease of 10%	8.6	10.0	9.0	14.0	10.5
f) Combination of b) and d)	8.7	10.0	9.1	14.5	10.6
g) Combination of c) and e)	7.6	8.8	7.8	12.6	9.3

Even under the worst case, the combination of cost increase of 10% and benefit decrease of 10%, Taskourt and Azghar Projects have sufficient economic efficiency (EIRR more than 8%).

(5) Conclusion of Economic Analysis

The economic analyses and the sensitivity analyses found that all the priority projects have sufficient economic efficiency and are feasible from the economic viewpoint.

10.2 Financial Analysis

10.2.1 General

The financial feasibility of the projects were evaluated from the view point of farmer' s economy. In this connection, the assessment of the amount of water charge to be born by water user was made on preliminary basis. The study on the capability of foreign capital cost repayment was also made on the project level by preparing the cash flow table.

10.2.2 Financial Cost

Based on the current market prices and costs as of April 2000, the financial construction costs of the projects are estimated as shown in Table 10.1.5. In this estimate, the physical contingency of 10% of the capital cost, the price contingency of 3% per annum for both the foreign and local currency portions, the value added tax at the rate of 14% for construction cost and resettlement cost and 20% for consulting services cost are considered to be the direct cost. Annual disbursement schedule of the project cost is presented in Table 10.2.1.

10.2.3 Capacity to Pay

For evaluation of the Project feasibility from the financial aspect of farmers, typical farm budget analyses were made under both " with project" and “without project” conditions. According to the household interview survey, the farmers are classified under three groups by size of farmlands, i.e. small-scale farmer with farmland of 1 ha or less, medium-scale farmer with farmland from 1 ha to 4 ha, and large-scale farmer with more than 4 ha. The farm income under present condition has been estimated as shown in Table 10.2.2 based on information obtained from regional offices for agricultural development. The expected farm income after implementation of the projects has been estimated as shown in Table 10.2.3 using model crops and cropping patterns based on the characteristcs of each project site. The capacity to pay has been calculated by deducting non-agricultural expenditure from the expected farm income with project. Average annual expenditure of household was obtained by the interview survey.

Since the expenditure includes both agricultural and non-agricultural expenditure, it is assumed that half of the expenditure would be non-agricultural expenditure. The results of the calculation is presented in Table 10.2.4 and summarized below:

Capacity to Pay (DH)

Item	Small	Medium	Large
N’Fifikh			
- Average size of farmland	0.9 ha	2.4 ha	14.6 ha
- Capacity to pay (DH)	17,829	58,961	394,285
Taskourt			

- Average size of farmland	0.8 ha	2.6 ha	11.3 ha
- Capacity to pay (DH)	16,241	36,746	293,463
Timkit			
- Average size of farmland	0.4 ha	2.2 ha	8.9 ha
- Capacity to pay (DH)	6,225	59,005	251,614
Azghar			
- Average size of farmland	0.8 ha	2.5 ha	10.0 ha
- Capacity to pay (DH)	20,265	74,015	317,810

10.2.4 Water Charge

When the project facilities are completed, water is released to the farm. But, if the water charge is not collected as before, all the cost of the projects will have to be financed by the Government, and such expenditure will become a heavy burden to the country.

It is generally understood that the water charge is imposed to the water users, and the water charges collected is spent for payment of operation and maintenance (O&M) and replacement cost of facilities incurred to the projects and/or for repayment of the capital cost of the Project.

Morocco has already decided to collect appropriate water charge from the beneficiaries by Code of Agricultural Investment (CIA) but the system has not been fully started yet. According to the code, the beneficial population will have to bear O&M and replacement cost of irrigation facilities, but most of the capital cost will be borne by the Government in the case of small and medium scale water resources development (PMH).

The water charge has been preliminary estimated from O&M and replacement cost by the Study Team. The annual water charge has been set to cover O&M and replacement cost of irrigation facilities for 25 years during the same period. The average annual water charges by scales of farmers have been estimated for each project site. The ratio of the water charge to the capacity to pay has also been calculated as shown in the table below.

The unit water charge of Timkit is costly at 0.33 DH/m^3 and that of Azghar is the cheapest at 0.27 DH/m^3. The small-scale farmers at Timkit has by far the highest ratio of the water charge to their capacity to pay at 24% since the average size of farmland is small at 0.4 ha.

Water Charge to cover O&M and Replacement Cost

Item	N'Fifikh	Taskourt	Timkit	Azghar
1) Volume of developed water by dam (Million m^3)	6.4	24.0	18.8	14.6
2) Annual water charge to be collected (Million DH)	2.0	7.1	6.2	4.0
3) Unit water charge (DH/m^3)	0.31	0.30	0.33	0.27
4) Unit water charge (DH/ha)	3,101	2,617	3,669	2,000

5) Average annual water charge (DH/household)				
- Small-scale farmer	2,791	2,094	1,467	1,600
- Medium-scale farmer	7,442	6,804	8,071	5,000
- Large-scale farmer	45,271	29,572	32,651	20,000
6) Ratio to the average capacity to pay				
- Small-scale farmer	16%	13%	24%	8%
- Medium-scale farmer	13%	11%	14%	7%
- Large-scale farmer	11%	10%	13%	6%

10.2.5 Repayment of Project Cost

The financial evaluation of the projects is made by examining the repayment capability for the capital cost of the projects. For the examination, the financial cash flow statements for each project using the anticipated project revenue and fund requirement is prepared as shown in Table 10.2.5. In the examination of repayment capability, it is assumed that the capital required for the project implementation will be arranged under the following conditions:

- 75% of the capital costs are financed by bilateral or international organization as far as the costs are not non-eligible items. The non-eligible items are costs for land acquisition, house compensation, administration, and any types of taxes and duties.
- The assumed condition of finance is with an interest rate of 2.2% per annum for a repayment period of 30 years including a grace period of 10 years.
- The remaining balance of the capital cost is financed by the budget allacation of the Government without interest and repayment.

10.2.6 Conclusion of Financial Analysis

The water charge, which covers the O&M and replacement costs of the irrigation facilities, will not place a heavy economic burden on the rural farmers in the project sites. In Timkit, since the average size of farming is small the ratio of the water charge to the capacity to pay is rather high.

On the other hand, the annual required fund for implementation of the whole projects and repayment of loan is approximately 100 to 150 million DH as shown in Table 10.2.5. If a soft loan is available, the implementation of the projects and the repayment of the loan will not be a heavy burden on the Government.

CHAPTER 11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

(1) Part I Basic Study

A large part of the rural areas is suffering from severe drought, where both surface and subsurface water resources are insufficient. People living in such areas are not blessed with the public services. Compounding this, some of the areas are subject to inundation due to floods. As a result, the gap in living standards between urban and rural areas is getting wider. Lack of job in the rural area has caused people to flow into the cities, especially in the drought years.

In order to decrease this inequity, a program for constructions of medium-scale dams was launched. In 1994, MOE formulated a national plan of medium-scale dam, in association with MOA and MOI.

To establish long-term strategy for sustainable water resources, MOE nominated 53 medium-scale dam sites in the framework of the national program. Out of them, high priority 25 sites were selected for this Study.

The 25 proposed dam projects for the Study were evaluated from the standpoint of social aspects, technical feasibility, natural environmental impact, social environmental impact and economical viability as discussed in Section 6.1.

Prioritization of these dams has been made from three different levels of a) Zone Level, b) River Basin Level and c) Dam Site Level, and dams were grouped according to their priority into four groups namely, A, B, C and D.

Group A: Highest priority projects for immediate feasibility study and implementation;

Group B: Higher priority projects to be implemented at the next stage;

Group C: Priority projects to be implemented at the next stage, and

Group D: Alternative development plan is to be elaborated.

Finally, the following four dams of group A were selected for further Feasibility Study:

1) No. 5 N'Fifikh
2) No. 9 Taskourt
3) No. 10 Timkit
4) No. 17 Azghar

2) Part II Feasibility Study

a) Natural and Social Conditions

Annual inflows to the proposed dams were estimated and are as shown below.

Inflow to Dam

Project	Reference Station	Period of Data		Ann. Inflow (Mm^3/yr)	
		(yr)	From - to	Average	Range
N'Fifikh	Feddane Taba	58	1939/40-1996/97	13.32	0.15-41.57
Taskourt	S. Bouathmane	62	1935/36-1996/97	44.65	6.41-125.37
Timkit	Tadighoust	36	1961/62-1996/97	10.11 (11.71)*	0.22-86.71 (1.83-88.27)*
Azghar	Dar Hamra	44	1955/56-1998/99	53.21	9.06-125.96

(Note) * : Annual inflow including subsurface flow.

Population of beneficial area in each project is as follows:

Population in the Beneficial Area (as of the year 2000)

Project	Population	Family Numbers	Household Numbers
N'Fifikh	4,360	650	1,040
Taskourt	51,030	7,850*	10,630*
Timkit	17,560 (59,700)	2,140 (4,500)	3,200 (10,190)
Azghar	6,080	580	870

Notes: * : Estimated from Samples, ( ): including beneficiary by groundwater recharge

b) Plan Formulation

The Government intends to implement medium-scale dam projects for water resources development in the rural area aiming at irrigation, domestic water supply, flood damage mitigation, land conservation and job creation. So the plan formulation of the priority four projects in the feasibility study should be made clearly in conformity with the national strategy.

The rural areas where these projects are located have annual mean rainfall ranging from 190 to 450 mm, which is extremely low and are devastated mountainous ones. Further, there is usually not enough available discharge in the rivers for people to maintain their living in the rural areas. So, water resources developments by construction of a medium-scale dam are very necessary to regulate and use the floods that occur a few times annually. Ensuring water resources by a medium-scale dam is also very important, as underground water resources are scarce or almost exhausted in the rural areas and water transfers from other basins is not realistic.

In this regard, the JICA Study Team has proposed to formulate the four projects as follows:

- No.5 N'Fifikh

This project should be implemented mainly so cultivation can resume of the devastated vegetable fields located at the suburbs of big cities such as Casablanca and Rabat. The main components to be constructed are dam facilities, irrigation facilities, and domestic water supply systems, as shown in Tables 8.3.2, 9.1.1, and Figures 9.1.1 to 9.1.3.

An agricultural water users' association (AUEA) will need to be organized for appropriate management of the river water since it is currently managed individually.

- No.9 Taskourt

The main purpose of this project is to develop large-scale irrigation to the existing farmlands located at about 30km downstream the proposed dam considering possibility of the improvement of the social environment for about 1,000 inhabitants living in the proposed reservoir area by providing settlement into a new living area. The main components to be constructed are a dam, rehabilitation of existing irrigation facilities, domestic water supply systems, and social infrastructures in new settlement areas for the inhabitants in the reservoir, as shown in Tables 8.3.2, 9.1.2, and Figures 9.1.4 to 9.1.6.

Although the AUEA has been organized to operate and maintain the existing traditional irrigation system, it is suggested to reorganize it for the new system.

- No.10 Timkit

The main purpose of this dam is to provide irrigation to the three existing oases. The beneficiary areas of this project are the area immediately downstream, and areas about 30km and 40km downstream of the proposed dams, which will help stop the Sahara desert expand to the north. The main components to be constructed are dam facilities, and rehabilitation of existing irrigation facilities, as shown in Table 9.1.3, and Figures 9.1.7 to 9.1.9.

Although the AUEA has been organized to operate and maintain the existing traditional irrigation system, it is suggested to reorganize it for the new system.

- No.17 Azghar

This project should be implemented mainly to develop medium-scale irrigation to the existing farmland, just downstream the proposed dam. The main components to be constructed are dam facilities and irrigation facilities as shown in Table 9.1.4, and Figures 9.1.10 to 9.1.12.

It is necessary to organize an AUEA for appropriate management of the river water.

c) Environmental Impact

Based on the results of the Initial Environmental Examination (IEE) that was conducted in the First Phase of the Study, a more detailed environmental survey was conducted in the Second Phase. The Ministry of Environment, Morocco has proposed to establish an official EIA procedure, but the Government has not authorized the proposal yet. So there is no legal status on the EIA procedure in Morocco at present time. Therefore, JICA guidelines were used in this study, but draft law of Morocco was also respected and fully applied in this study.

Environmental laws, rules, regulations and guidelines that were used as a basis of this environmental study are primarily as follows:

- The protection of environment (draft EIA law) in Morocco (Ministry of Environment, Morocco)
- SIBE (Sites of Biological and Ecological Interests)
- Guidelines for Environmental Considerations on Rivers and Protection of Erosion (JICA)
- Guidelines for Environmental Considerations on Dam Construction (JICA)

It can be said that negative impact on natural environment due to implementation of these four projects are not so serious because these dams are medium-scale and if appropriate countermeasure are made, there will not be any problem in the implementation. Further, river maintenance flow are very few in the rivers where these four projects are located, then if ensuring water resources to be used stably and effectively are made, improvement of natural environment in the downstream of the dams such as restoration of green, etc. can be rather expected.

To evaluate social environmental impacts of dam constructions, the study was intensified for the priority four dam sites with special investigations to identify proper resettlement plans for the dam implementations. These plans were evaluated based on site investigations for both upstream and downstream, people hearing, people land and water rights, existing Moroccan Laws for compensation programs and socio-economic factors. Results of the survey include identification of negative impacts of dam construction for upstream and downstream areas, recommended resettlement plans as well as resettlement costs.

In the case of Taskourt, although about 1,000 inhabitants are forced to be resettled for the dam construction, according to a hearing by the JICA Study Team, they will cooperate with dam construction if they receive proper monetary compensation. Inhabitants living in the proposed reservoir area have been maintaining a nomadic life until now and do not seem to have a great attachment to their ancestral lands. This situation is the same for the other three projects.

d) Priority for the Implementation of the Four Prioritized Projects

In order to judge the priority for the implementation of these four priority projects, the following considerations should be taken into account:

- Irrigation systems of No. 9 Taskourt and No.10 Timkit are existing and these projects shall construct new dam as well as rehabilitation of the irrigation facilities, while No.5 N'Fifikh and No. 17 Azghar shall construct newly both dam and irrigation facilities. As in Morocco the priority is given to rehabilitation projects, No.9 Taskourt and No. 10 Timkit are judged to have higher priority than the other two projects.

- As mentioned in sub-section 8.6.2 of Main Report of this Study, there are two possible method for usage of stored water in the reservoir for irrigation in No.10 Timkit ; 1) directly distributing the usable water to the irrigation field and 2) infiltrating the usable water into underground beneath irrigation field before irrigation usage. Even if whichever method is applied actually, there exists some uncertainty in No.10 Timkit compared to No.9 Taskourt. Then the priority of No.10 Timkit is judged lower than No.9 Taskourt.

- By discussion with regional office of MOA for each project, this Study is proposing cropping pattern that vegetable is very dominant (70 %) for No.5 N'Fifikh, while in other projects, cereal is dominant. In this case as farmers are not familiar with the cropping pattern, No.5 N'Fifikh has some uncertainty comparing with other projects. Then the priority of No.5 N'Fifikh is judged rather lower.

- As mentioned in sub-section 10.1.2 of Main Report, No. 17 Azghar may give negative impacts to the existing Allal Al Fassi and Idris 1er dams located downstream of Azghar dam site. The major negative impacts are losses of hydroelectric power generation and irrigation water supply due to reduction of usable water. Even such negative impact is already considered in economic analysis of this Study, this factor is recognized to make the priority of No.17 Azghar rather lower.

The Moroccan government puts the highest priority on No.9 Taskourt, although more or less 1,000 inhabitants are forced to be resettled, and intends to proceed to its construction ahead of the other three projects.

e) Economic and Financial Evaluation

The economic analysis of each project has been conducted and the results are summarized below:

Results of Economic Analysis

Project	EIRR (%)	B/C DR=8%	NPV (Unit: million DH) DR=6%	DR=8%	DR=10%	DR=12%
Without Indirect Benefit						
N'Fifikh	6.8	0.86	24.0	-26.6	-55.4	-72.1
Taskourt	8.1	1.02	146.9	6.5	-73.1	-119.3
Timkit	7.1	0.90	47.9	-27.6	-69.6	-93.3
Azghar	12.2	1.62	242.0	120.9	48.5	3.4
Overall Plan	8.5	1.07	394.6	58.8	-117.7	-210.3
With Indirect Benefit						
N'Fifikh	10.0	1.17	87.4	32.3	-0.3	-20.4
Taskourt	11.4	1.31	282.6	130.3	40.8	-14.0
Timkit	10.4	1.21	140.2	56.6	7.8	-21.8
Azghar	16.6	1.97	317.8	188.7	110.4	60.5
Overall Plan	12.0	1.38	709.8	332.3	122.4	2.0

Note: DR means discount rate applied for calculation of B/C and NPV.

The economic analyses found that all the priority projects have sufficient economic efficiency and are feasible from the economic viewpoint.

The water charge, which covers the O&M and replacement costs of the irrigation facilities, will not place a heavy economic burden on the rural farmers in the project sites. In Timkit, since the average size of farming is small the ratio of the water charge to the capacity to pay is rather high.

On the other hand, the annual required fund for implementation of the whole projects and repayment of loan is approximately 100 to 150 million DH as shown in Table 10.2.5. If a soft loan is available, the implementation of the projects and the repayment of the loan will not be a heavy burden on the Government.

11.2 Recommendations

(1) Considering the above conclusions, that four priority projects are justified from the aspects of necessities of projects, technical assessment, natural and social environment assessment, and economic and financial evaluation, implementation of them are strongly recommended.

Overall implementation schedule of priority projects and other medium-scale dam projects to be newly identified by Moroccan Government under the long term water resources development plan until the target year 2020 is proposed as stated below.

a) First Step (Implementation of Group A Projects)

Feasibility study for the Group A projects should be finished by the middle of July 2001.

According to the implementation schedule of DGH, implementation agency of medium-scale dams, dam construction of Taskourt is to start within the current five year national development plan (January 2000 to December 2004) and construction of the other three priority dams is to start in the beginning of the next five year national development plan (January 2005 to December 2009). This has been decided considering current social aspects in Morocco.

Further, DGH has already started land acquisition activities for Taskourt since June 2001 and is expected to complete by May 2004. This step should be hurried up so that the detailed design and construction will be completed by November 2008.

b) Second Step (Master Plan for Group B and C Projects)

Review of planning and design for Group C projects and other projects to be newly identified should be made and a prioritization study together with the Group B projects should be made (Master Plan Study). Then based on this master plan study, the highest priority projects (about four in number) will be selected for the next stage implementation by July 2004.

c) Third Step (Implementation for the Priority Projects selected from Group B and C Projects)

Feasibility study for these priority projects in the second step should be carried out, and then their detailed design and construction also should be made by November 2012.

d) Further Steps

The above second and third steps are to be repeated.

The overall implementation schedule is shown in Figure 11.1.1.

(2) Project cost for the four priority projects and the annual disbursement schedules are shown in Tables 10.1.4 and 10.2.1.

The Government will implement the medium-scale dam projects for the water resource development in the rural areas by the target year of 2020 as the long-term water resources development plan. Meanwhile, as described in Section 10.1, economic viability by the direct benefit for the medium-scale dam projects are generally not so high, so the financial plan for each project is rather difficult to establish. It is, however, possible to justify the projects considering their indirect benefit such as economical induced benefit or in view of the social aspects, which are above all the most serious matters in this country. Considering this, the main points to be noted for the financial plan are as follows:

Sources of fund

The following sources of funding for the medium-scale dam projects are conceivable:

- Moroccan Government revenue from various taxes and/or bonds issuance,
- Domestic loan
- Foreign soft loan by Official Development Assistance (ODA) such as JBIC
- Foreign grant by ODA

Combination of the above should be applied to funding for the projects. The Central Government is fully responsible for repayment of foreign soft loan by ODA. Also, the foreign grant by ODA, besides the Moroccan government revenue, should be eagerly applied to the projects with low economic

viability. The project cost may be financed by both a loan and domestic counterpart funds as classified below:

Finance of Projects Cost

Cost Item	External Loan	Domestic Counterpart Fund
1. Construction cost	x	x
2. Engineering service cost	x	x
3. Resettlement cost *)		x
4. Administration cost **)		x
5. Total cost	x	x

Remarks: *) Out of resettlement cost, a part of preparation cost of social infrastructure for resettlement location may be financed by external loan.

**) Administration cost is operational cost of PIO.

For the smooth financial arrangement, the following support by the Central Government is strongly required:

- Tax reduction: This is intended to relieve or exempt income tax, import tax and value added tax (VAT) imposed on implementing agencies. The Ministry of Finance (MOF) is responsible for issuance of special decree to enforce exemption of income tax and VAT to be executed for the medium-scale dam project. MOE is responsible for rendering necessary arrangement with agencies concerned including custom office on behalf of the implementation agency.
- Foreign exchange risk: In case of soft loan procurement from foreign countries, foreign exchange risk arises. Such risk should be basically borne by the Central Government and not imposed on the implementation agencies.

(3) According to present organization of the Government, the implementation agency for medium-scale dam project is DGH, the hydraulic sector of MOE. It is responsible for dam component, and other ministries or agencies are independently responsible for water usage components downstream. For example, MOA is responsible for irrigation component and ONEP for the component of the potable water supply, and so on. For the smooth promotion and implementation of the medium-scale dam projects, a permanent and unified implementation committee comprised of the government staff dispatched from the related ministries and agencies, which should be chaired by DGH, should be established in the central government.

Further, the Government now contemplates that an administrative agency for operation and maintenance, and implementation of the existing and proposed large dams including medium-scale dams is to be established for each hydraulic region. The proposed permanent and unified committee should provide support in various aspects to the administrative agency for each hydraulic region. The administrative agency thus operating in cooperation with the central committee should be fully responsible for construction of the medium-scale dam projects.

The Projects consist of the following components:

Major Components

- Dam
- Irrigation facilities
- Flood damage mitigation
- Watershed management (forestation, check dam)
- Resettlement

Subordinate Components

- Domestic water supply

For the smooth implementation of the Projects, the Government should establish a Project Implementation Office (PIO) consisting of the Government Agencies concerned under the above administrative agency for each hydraulic region. The following government agencies will participate in PIO.

- General Directorate of Hydraulics (DGH), Ministry of Equipment (MOE)
- Ministry of Agriculture, Rural Development, and Maritime Fishery (MOA)
- Ministry of Environment (CSES)
- Direction of Forest and Water (MOA)
- National Office of Potable Water (ONEP)
- Local Administration

Out of the agencies listed above, General Directorate of Hydraulics, Ministry of Equipment would be the secretary of PIO and take overall responsibility for the implementation of the Projects. The proposed organization chart of PIO is shown in Figure 11.3.1.

(4) Environmental Management Plan (EMP) for natural environment and resettlement plan proposed by the JICA Study Team are as follows:

According to the results of the environmental screening during the First Phase, water quality was found to be one of the most important environmental factors to be analyzed. Therefore, the following aspects were carefully addressed and applied for the Environmental Management Plan (EMP).

- Upstream: Eutrophication
- Immediate Downstream: Level of groundwater
- Downstream: Changes in water quality with irrigation

Establishment of Environmental Management Plan (EMP) is the most important practice as a long-term mitigation of the environmental impacts. Practical institutional organization for environmental monitoring and management, environmental parameters and sampling locations for water quality have been determined and proposed. The following recommendations are made on the EMP:

- Environmental Management Unit (EMU) should be established, and the DGH be responsible for the implementation of the EMP.
- Development of tree planting program as a counter measure for erosion problem particularly at Taskourt site is important. This should be included as one of the main components of the EMP.
- Ministry of Forestry should be fully involved into the tree planting program (the Ministry be involved as a regular member of the Steering Committee so that appropriate counterpart be appointed).

The issue of resettlement due to dam construction frequently is a major concern at the moment in not only Japan but also other countries. So the Moroccan government is strongly requested to make proper action on land acquisition including resettlement issues for these four priority projects by both monetary compensation under the current law for land acquisition in Morocco and compensation of new resettlement area using collective lands.

Recommended Resettlement Plans by the JICA Study Team for the four priority projects are as follows:

- No. 5 N'Fifikh

Submerged Area: 31 houses, 38 families, 187 persons

Resettlement Scenarios:

a) Option A: SODEA lands, located downstream of proposed dam（The land is owned by public agricultural company and existing in proposed irrigation area.）

b) Option B: Land purchasing from large-scale vegetable farm located downstream of proposed dam (Private land can be bought using compensation money, but requires negotiating with downstream beneficiaries before starting construction.)

- No. 9 Taskourt

Submerged Area: 154 houses, 205 families, 1,014 persons

Resettlement Scenarios:

a) Group A: 74 families (36%) applying to their own resettlement plans

b) Group B: 62 families (30%) having lands in l'Aazib area and to be settled there (Construction of new social infrastructure facilities are necessary.)

c) Group C: 69 families (34%) having no lands property and to be settled in new lands at downstream irrigation area (Approximately two villages equipped with social infrastructure facilities should be newly constructed.)

- No. 10 Timkit

Submerged Area: 39 houses, 64 families, 342 persons

Resettlement Scenarios:

a) Group A: 60 families (93%) to be settled in Ifegh

b) Group B: 4 families (7%) having own source of income in different region and to be settled there

- No. 17 Azghar

Submerged Area: 6 houses, 10 families, 42 persons

Resettlement Scenarios:

Government compensation in compliance with Moroccan legal standards

(5) Terms of References (TOR) for the details design covering four projects of No.5 N'Fifikh, No.9 Taskourt, No.10 Timkit and No.17 Azghar are proposed to be as follows:

(5.1) Additional / Further study

5.1.1) Review of regulated water volume for all the projects.
Regulated water volume by each dam and available water volume at each intake weir, located downstream of each dam should be reviewed based on floods recorded in the past.

5.1.2) Optimization study for water management for irrigation for all the projects. Cropping pattern, and duty flow to the downstream should be finally decided considering existing water rights and existing irrigation systems.

5.1.3) Recharging effects into underground of not only regulated water by Timkit dam but also surface water of Tanguerfa and Todra river for irrigation in No.10 Timkit should be assessed in detail.

5.1.4) Execution method of land consolidation for all projects should be proposed.

5.1.5) Examination of soil salinity for irrigation areas should be made.

5.1.6) Overall marketing study for agricultural inputs and products in Morocco should be carried out.

(5.2) Additional field investigation

5.2.1) Topographic survey for irrigation intake weir, and profile and cross section survey for irrigation canals (Main only) should be made.

5.2.2) Additional core boring and permeability tests should be made if necessary.

5.2.3) Additional construction material survey and laboratory tests should be made if necessary.

5.2.4) Concrete mixing tests for concrete dam constructed by RCC should be made.

(5.3) Detailed design
The following should be prepared:

5.3.1) Design criteria.

5.3.2) Basic design.

5.3.3) Tender design.

5.3.4) Detailed Design.

(5.4) Reports

Following reports should be prepared:

5.4.1) Inception report

5.4.2) Further study report including supporting reports and data books.

5.4.3) Basic design report and the drawings.

5.4.4) Tender documents.

5.4.5) Detailed design report and the drawings.

5.4.6) Completion reports.

(5.5) Schedule (Tentative)

5.5.1) Additional / Further study; January to December, 2002 (12 months)

5.5.2) Additional field investigation and detailed design; June, 2002 to December 2004 (30 months)

Commencement of these works of 5.5.2) in the above will be subject to the results of the additional further study, and approval of JICA (Tentative) and the Government of Morocco.

Tables

Table 1.1.1: List of JICA Advisory Committee and Persons in Charges in JICA, and Steering Committee in Moroccan Government

Advisory committee

No	Name	Function	Position
1	Mr.Adachi	Leader/Water Resources Development	JICA
2	Mr.Niwa	- ditto -	- ditto -
3	Mr.Shioya	Flood Control	Ministry of Land, Infrastructure and Transportation
4	Mr.Itaya	- ditto -	- ditto -
5	Mr.Nakajima	Agricultural Development	Japan Institute of Irrigation and Drainage
6	Mr.Karashima	Project Implementation Plan	JBIC
7	Mr.Kimura	- ditto -	- ditto -

Persons in Charge in JICA

No	Name	Position
1	Mr.Matsushima	Deputy Director, JICA Tokyo
2	Mr.Nakamoto	Staff, JICA Tokyo
3	Mr.Kageta	Staff, JICA Tokyo
4	Mr. Yoshizawa	Deputy General Manager
5	Miss Nonoyama	Staff, JICA Morocco
6	Mr.Shibata	Staff, JICA Morocco

Steering Committee

No	Name	Position
1	Mr. Mahfoud	General Directorate of Hydraulics
2	Mr. El Gomari	General Directorate of Hydraulics
3	Mrs. Ouarrak	General Directorate of Hydraulics
4	Mr. Nassouh	General Directorate of Hydraulics
5	Mr. Belghiti	Ministry of Agriculture, Rural Development and Maritime Fisheries
6	Mrs. Idder	National Office of Water Suppy
7	Mr. Essaouabi	National Office of Water Suppy

Table 1.2.1: Principal Characteristics of the 25 Damsites Proposed by MOE

No.	Dam Site Name	Damsite Location		Study Level	River Basin	Purposes	Dam Type	Annual Inflow (MCM)	Dam Height (m)	Storage (MCM)	Dam Volume (m^3)	Catchment Area (km^2)	Reservoir Surface Area (ha)	Proposed Irrigation Area (ha)
		Province	Circle											
①	NECKOR	AL HOCEIMA	AL HOCEIMA	APD	Neckor	PE	TERRE	58	36.4	15.6	1,577,500	710	196	-
②	TIZIMELLAL		TARGUIST	APD	Sebou	PE,I	BCR	57.71	78	21.28	150,000	170	91.11	
3	AIT BADDOU	AZILAL	AZILAL	PRE	Oum-er-Rbia	PE	T.Z	93.7	50	52	800,000			-
④	AIN KWACHIYA	BENSLIMANE	S.Y.ZAER	APD	Yquem	I	BCR	7	30	11	78,000	162	180	500
⑤	N' FIFIKH		BENSLIMANE	APD	Nhhkh	I	BCR	26	44	52.5	99,100	606	680	1,200
⑥	TAZARANE	CHAOUEN	BAB BERED	APD	Sebou	I,PE	ENR	16.7	64	9.2	416,100	30	51	
⑦	AMEZMIZ	EL HAOUZ	AMEZMIZ	APD	Tensift	I	BCR	10	72.5	11	241,800	80	55.2	1,200
8	BOULAOUANE		S.BOU OUTTMAN	PRE	Tensift	I	BCR	57	82	56	799,000	565	2.4	2,000
9	TASKOURT		IMIN TANOUT	PRE	Tensift	I	BCR	49	88	106	457,000	439	-	6,900
⑩	TIMKIT	ERRACHIDIA	TINJDAD	APD	Rheris	I,AN	BCR	7.5	56	14	136,500	592	164	2,900
11	TADIGHOUST		TADIGHOUST	PRE	Rheris	I	BCR	35.7	68	54	593,800	2,239	4.5	700
12	TIOUZAGUINE		GOURRAMA	PRE	Guir	I,AEP	BCR	4.73	58.7	10.2	128,000	258	75	
⑬	KHENG GROU	FIGUIG	BENI TAJJIT	APD	Guir	I,AN	BCR	91.5	70	90	310,000	4,900	840	250
⑭	ADAROUCH	IFRANE	AZROU	APD	Sebou	I,AC,AEP	BCR	95	51	48	130,000	630	328	1,500
15	SIDI OMAR	KHEMISSET	MAAZIZ	PRE	Boure	I	BCR	17	59	35	222,000	350	165	1,000
16	TIWINE	OUARZAZATE	OUARZAZATE	PRE	Draa	I,EC	BCR	102	68.5	102.9	405,530	1,540	705	1,500
17	AZGHAR	SEFROU	RIBAT EL KHEIR	PRE	Sebou	I	BCR	53	55	40	299,280	295.14	263.63	1,000
⑱	BOUKARKOUR	SETTAT	BEN AHMED	APD	Mellah	I,AC	BCR	30	59.5	30.1	172,140	1,120	217.5	
19	AOULAI	TAOUNATE	GHAFSAI	PRE	Sebou	I,PE	BCR	247	50	225	310,500	490	710	5,000
20	SIDI ABBOU		AIN AICHA	PRE	Sebou	I	Beton	82.6	30	58	32,000	363	432	4,220
21	SIDI EL MOKHFI		SIDI EL MOKHFI	PRE	Sebou	I,AC	BCR	229	64.5	36.7	-	378	-	3,600
㉒	BOUSFOUL		SIDI EL MOKHFI	APD	Sebou	I,AC,PE	BCR	2	43.5	2	76,000	5.33	19	45
㉓	IGUIN' OUAQA	TAROUDANT	OLD.BERHIL	APD	Sous	PC,AN,I	BCR	7	57	10.5	186,200	161	66.7	300
24	AMOUNT ABDELMOUMEN		-	PRE	Sous	-	-	-	-	-	-			
㉕	SIDI ABDELLAH		TAMALOUKT	APD	Sous	AN,I	TZ	20	69	10.37	2,055,300	233	49.36	900

Notes

1) The mark ○ or APD means F/S level in Morocco
   The mark □ or PRE means Preliminary Study level in Morocco
2) PE : Protection of Landslide、I : Irrigation、AN : Conservation of underground water
   AEP : Portable water、AC : water for livestock、PC : Flood control, EC: Hydro-power
3) TERRE : Homogenous type earthfill dam、BCR : RCC type dam、TZ : Zone type earthfill dam
   ENR : Rockfill type dam、Beton : Concrete gravity type dam

Table 1.3.1: Work Schedule

Work Stage	Major Study Work	Work Period
(1) Preparation work	Data collection and review Preparation of Inception Report (I/R)	Dec. 8 to 22, 1999
(2) First field work in Morocco	Explanation and discussion of I/R Field investigation Collection and analysis of data required for study Review on the previous studies Investigation for Initial Environmental Examination Baseline Survey for Present Agricultural conditions and development Screening criteria of priority project site(s) Formulation of water resources development and water use plans Water demand forecasting Water balance study Preliminary facility plan and design Evaluation of proposed project site(s) in the views of technical, economical, financial and social aspects Preparation of Progress Report (1) Pre-arrangement for technology seminar (1)	Feb. 8 to June 5, 2000
(3) First homework in Japan	Summary of first field investigation and IEE Summary of water resources development plans for proposed project site(s) Summary of project evaluation for proposed project site(s) Summary of selection of priority project(s) Preparation of interim report Preparation of transfer of technology seminar (1)	June 8 to July 22, 2000
(4) Second field work in Morocco	Submission, explanation and discussion of Interim Report Execution of transfer of technology seminar (1) Confirmation of project features for feasibility study Supplemental collection and analysis of data required for feasibility study Topographic survey, geological and soil investigation and river discharge measurement Field investigation for Environmental Impact Assessment water resources development and use plans water demand forecasting and water balance study Optimization study of dam development scale Study on facilities plan and preliminary design Study on construction plan and cost estimate Study on financial plan and fund arrangement Field investigation for Environmental Impact Assessment Preparation of Progress Report (2) Pre-arrangement of technology seminar (2)	Aug. 21 ,2000 to Jan. 25, 2001
(5) Second home work in Japan	Summary of investigation works Finalization of preliminary facility design and construction plan Project cost estimate and disbursement schedule Overall project evaluation Institution, organization and management plan of the project(s) Implementation programme Preparation of draft final report Preparation of transfer of technology seminar (2)	Jan. 29 to Mar. 29, 2001
(6) Third field work in Morocco	Submission, explanation and discussion of draft final report Execution of transfer of technology seminar (2)	Mid May to End of May,
(7) Third home work in Japan	Preparation and submission of Final Report	Early July to Mid of July 2001

Table 1.3.2: List of the JICA Study Team Experts and Their Counterpart Personnel

No.	JICA Study Team	Function	Counterparts Personnel (GOM)	Function
1	Mr.Kawashima (NK)	-Managing Engineer -Water Resources Development Planner	-Mr.Mahfoud (DGH)	-Managing Engineer
2	Mr.Menjo (NG)	-Co.Managing Engineer/Dam Engineer	-Mr.EL Ghomari (DGH) -Mrs.Hajja (DGH)	-Dam Engineer/Geologist -Dam Engineer/Geologist
3	Mr.Jitsuhiro (NK)	-Hydrologist -Flood Control Engineer	-Mr.Benabdelfadil (DGH) -Mrs.Nazik (DGH)	-Hydrologist -Hydrologist
4	Mr.Wada (NK)	-Water Supply Engineer -Rural Electrification Planner	-Mr.Hamzaoui (ONEP)	-Hydraulic Engineer
5	Mr.Zaitsu (NK)	-Agronomist/Soil Scientist	-Mr.Chouraichi (MOA)	-Soil Scientist
6	Mr.Adhikary (NK)	-Agricultural Support and Extension Services	-Mr.Hamda (MOA)	-Agricultural Support and Extension Services
7	Mr.Yatabe (NK)	-Irrigation Planner	-Mr.Belghiti (MOA) -Mr.Karfal (MOA)	-Rural Development Engineer -Hydrogeologist
8	Mr.Suga (NG)	-Geologist	-Mr.Benattia (DGH)	-Geologist
9	Mr.Tanaka (NK)	-Geologist	-Mr.Benattia (DGH)	-Geologist
10	Mr.Suzumura (NK)	-Hydrogeologist		
11	Mr.Kouno (NG)	-Aero. Topo. Surveyor/Ground Topo. Surveyor		
12	Mr.Sasaki (NG)	-Aero. Topo. Surveyor		
13	Mr.Suzuki (NG)	-Facility Planner	-Mr.Ait Zirri (DGH)	-Civil Engineer
14	Mr.Shiose (NG)	-Facility Planner		
15	Mr.Kuwahara (NG)	-Construction Planner -Cost Estimator	-Mr.El Keddadi (DGH)	-Construction Planner
16	Mrs.Bourarach (NK)	-Sociologist	-Mr.Amrani (DGH)	-Agro. Economist
17	Mr.Hasegawa (NK)	-Environmentalist	-Mrs.Hajja (DGH)	-Dam Engineer/Geologist
18	Mr.Maehara (NK)	-Economist -Project Evaluator	-Mr.Amrani (DGH)	-Agro. Economist
19	Mr.Serizawa (NK)	-Interpreter		
20	Mr.Hassan (NK)	-Logistician		

GOM: Government of Morocco
DGH: Directorate General of Hydraulics
ONEP: National Office for Water Supply
MOA: Ministry of Agriculture
NK: Nippon Koei Co Ltd
NG: Nippon Giken Inc.

Table 3.1.1: Population of Provinces and Prefectures in the Study Area

Zone	Population in 1971 (1,000)			Population in 1982 (1,000)			Population in 1994 (1,000)			Annual growth (%) 1971 - 1982			Annual growth (%) 1982 - 1994		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Zone I	887	2,240	3,127	1,325	2,622	3,947	2,094	2,950	5,044	3.7	1.4	2.1	3.9	1.0	2.1
Zone II	2,187	617	2,804	3,306	731	4,037	4,566	727	5,293	3.8	1.6	3.4	2.7	-	2.3
Zone III	1,033	3,583	4,616	1,692	4,201	5,893	2,547	4,624	7,171	4.6	1.5	2.2	3.5	0.8	1.6
Zone IV	179	1,346	1,525	386	1,599	1,985	896	1,739	2,635	7.2	1.6	2.4	7.3	0.7	2.4
Zone V	51	370	421	101	421	522	206	433	639	6.4	1.2	2.0	6.1	0.2	1.7
Total	4,337	8,156	12,493	6,811	9,575	16,386	10,310	10,473	20,783	4.2	1.5	2.5	3.5	0.7	2.0

Source: - Recensement 1994, Population Legale du Maroc, Direction de la Statistique
- Population Legale du Maroc, D' Apres le Recensement General de la Population et de l' Habitat de 1982

Table 3.1.2: Population and Number of Household by Provinces and Prefectures in the Study Area

Provinces and Prefectures	Population in 1994 (1,000)			Household in 1994 (1,000)			Average Size of Family		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Zone I									
SIDI - KACEM	175	471	646	33	71	104	5.3	6.7	6.2
IFRANE	61	67	128	13	11	24	4.7	5.9	5.3
MEKNES EL MENZEH	191	103	294	37	17	53	5.2	6.2	5.5
AL ISMAILIA	274	41	315	54	6	60	5.1	6.8	5.3
EL HAJEB	65	115	180	12	18	30	5.3	6.4	6.0
BOULEMANE	37	125	162	7	20	27	5.1	6.4	6.0
FES JDID - DAR - DBIBAGH	243	14	256	48	2	50	5.1	6.9	5.2
FES - MEDINA	267	18	285	49	3	52	5.4	6.7	5.5
SEFROU	102	135	237	21	22	43	4.9	6.2	5.6
ZOUAGHA - MOULAY.YACOUB	265	117	383	47	16	63	5.7	7.2	6.1
AL HOCEIMA	113	270	383	20	41	61	5.5	6.7	6.3
TAOUNATE	52	577	629	10	89	98	5.4	6.5	6.4
TAZA	206	502	708	36	72	108	5.7	7.0	6.5
CHEFCHAOUEN	43	396	439	8	61	70	5.1	6.5	6.3
Total of Zone I	2,094	2,950	5,044	395	447	842	5.3	6.6	6.0
Zone II									
BENSLIMANE	65	149	213	12	23	35	5.5	6.4	6.1
AIN-CHOCK-HAY HASSANI	438	78	516	79	14	93	5.6	5.6	5.6
AIN SEBAA-HAY MOHAMMADI	521	0	521	92	0	92	5.7	-	5.7
AL - FIDA - DERB SULTAN	387	0	387	73	0	73	5.3	-	5.3
BEN M' SICK-SIDI OTHMANE	688	16	704	116	3	119	5.9	5.8	5.9
CASABLANCA - ANFA	523	0	523	110	0	110	4.8	-	4.8
MACHOUAR CASABLANCA	4	0	4	1	0	1	4.9	-	4.9
MOHAMMADIA	170	0	170	32	0	32	5.4	-	5.4
SIDI BERNOUSSI ZENATA	210	59	269	37	10	47	5.7	5.8	5.7
KHEMISSET	175	311	486	35	50	84	5.0	6.3	5.8
RABAT	623	0	623	127	0	127	4.9	-	4.9
SALE	586	45	632	109	6	116	5.4	7.1	5.5
SKHIRATE TEMARA	176	69	245	32	11	44	5.4	6.0	5.6
Total of Zone II	4,566	727	5,293	854	118	972	5.3	6.2	5.4
Zone III									
KHOURIBGA	295	186	481	54	28	82	5.5	6.6	5.8
SETTAT	236	612	847	44	87	131	5.4	7.1	6.5
EL KELAA DES SRAGHNA	131	551	682	23	78	101	5.7	7.1	6.8
ESSAOUIRA	75	358	434	16	60	76	4.8	6.0	5.7
AL HAOUZ	33	402	435	6	61	67	5.2	6.6	6.4
CHICHAOUA	32	280	312	6	47	53	5.3	5.9	5.9
MARRAKECH-MENARA	333	99	433	62	15	77	5.4	6.4	5.6
MARRAKECH-MEDINA	189	0	189	37	0	37	5.1	-	5.1
SIDI YOUSSEF BEN ALI	157	82	239	27	13	40	5.7	6.4	5.9
EL JADIDA	240	731	971	48	113	161	5.0	6.5	6.0
SAFI	376	447	823	71	68	139	5.3	6.6	5.9
AZILAL	62	393	455	12	57	69	5.0	6.9	6.6
BENI-MELLAL	387	483	870	73	69	141	5.3	7.0	6.2
Total of Zone III	2,547	4,624	7,171	480	696	1,176	5.3	6.6	6.1
Zone IV									
AGADIR-IDA-OU-TANANE	263	103	366	54	17	71	4.9	6.1	5.2
CHTOUKA AIT BAHA	26	214	240	5	38	43	5.0	5.6	5.5
INEZGANE-AIT MELLOUL	262	31	293	52	5	57	5.1	5.8	5.1
OUARZAZATE	142	553	695	22	68	90	6.5	8.1	7.7
TAROUDANNT	134	560	694	25	85	110	5.3	6.6	6.3
TIZNIT	70	278	348	14	49	63	4.9	5.7	5.5
Total of Zone IV	896	1,739	2,636	172	262	434	5.2	6.6	6.1
Zone V									
FIGUIG	51	66	117	10	11	21	5.3	6.0	5.7
ERRACHIDIA	155	367	522	26	51	76	6.1	7.2	6.8
Total of Zone V	206	433	639	35	62	97	5.9	7.0	6.6
Grand Total (Zone I to V)	10,310	10,473	20,783	1,936	1,585	3,522	5.3	6.6	5.9

Source: - Recensement 1994, Population Legale du Maroc, Directionde la Statistique

Table 3.1.3: Population Projection by Provinces and Prefectures in the Study Area

Provinces and Prefectures	Population Census in 1994	Population Projection(1,000)		Annual Average Growth Rate		
		2000	2010	1994-2000	2000-2010	1994-2010
Zone I						
SIDI - KACEM	646	700	779	1.4%	1.1%	1.2%
IFRANE	128	139	159	1.4%	1.4%	1.4%
MEKNES EL MENZEH	294	316	349	1.2%	1.0%	1.1%
AL ISMAILIA	315	340	375	1.3%	1.0%	1.1%
EL HAJEB	180	200	230	1.7%	1.4%	1.5%
BOULEMANE	162	173	193	1.1%	1.1%	1.1%
FES JDID - DAR - DBIBAGH	256	332	486	4.4%	3.9%	4.1%
FES - MEDINA	285	301	323	0.9%	0.7%	0.8%
SEFROU	237	251	269	1.0%	0.7%	0.8%
ZOUAGHA - MOULAY.YACOUB	383	460	618	3.1%	3.0%	3.0%
AL HOCEIMA	383	411	452	1.2%	1.0%	1.0%
TAOUNATE	629	659	692	0.8%	0.5%	0.6%
TAZA	708	745	792	0.9%	0.6%	0.7%
CHEFCHAOUEN	439	505	623	2.4%	2.1%	2.2%
Total of Zone I	5,044	5,532	6,340	1.6%	1.4%	1.4%
Zone II						
BENSLIMANE	213	230	251	1.3%	0.9%	1.0%
AIN-CHOCK-HAY HASSANI	516	629	890	3.3%	3.5%	3.5%
AIN SEBAA-HAY MOHAMMADI	521	582	686	1.9%	1.7%	1.7%
AL - FIDA - DERB SULTAN	387	378	358	-0.4%	-0.5%	-0.5%
BEN M' SICK-SIDI OTHMANE	704	796	908	2.1%	1.3%	1.6%
CASABLANCA - ANFA	523	528	531	0.1%	0.1%	0.1%
MACHOUAR CASABLANCA	4	5	5	4.0%	0.0%	1.5%
MOHAMMADIA	170	205	272	3.2%	2.9%	3.0%
SIDI BERNOUSSI ZENATA	269	299	390	1.8%	2.7%	2.4%
KHEMISSET	486	520	574	1.1%	1.0%	1.1%
RABAT	623	658	699	0.9%	0.6%	0.7%
SALE	632	788	1,118	3.8%	3.6%	3.6%
SKHIRATE TEMARA	245	314	466	4.2%	4.0%	4.1%
Total of Zone II	5,293	5,932	7,148	1.9%	1.9%	1.9%
Zone III						
KHOURIBGA	481	491	497	0.3%	0.1%	0.2%
SETTAT	847	916	989	1.3%	0.8%	1.0%
EL KELAA DES SRAGHNA	682	732	796	1.2%	0.8%	1.0%
ESSAOUIRA	434	441	449	0.3%	0.2%	0.2%
AL HAOUZ	435	460	492	0.9%	0.7%	0.8%
CHICHAOUA	312	324	338	0.6%	0.4%	0.5%
MARRAKECH-MENARA	433	519	687	3.1%	2.8%	2.9%
MARRAKECH-MEDINA	189	184	179	-0.5%	-0.3%	-0.4%
SIDI YOUSSEF BEN ALI	239	291	388	3.3%	2.9%	3.1%
EL JADIDA	971	1,057	1,204	1.4%	1.3%	1.4%
SAFI	823	877	945	1.1%	0.7%	0.9%
AZILAL	455	482	518	1.0%	0.7%	0.8%
BENI-MELLAL	870	953	1,079	1.5%	1.2%	1.4%
Total of Zone III	7,171	7,727	8,561	1.3%	1.0%	1.1%
Zone IV						
AGADIR-IDA-OU-TANANE	366	447	611	3.4%	3.2%	3.3%
CHTOUKA AIT BAHA	240	252	265	0.8%	0.5%	0.6%
INEZGANE-AIT MELLOUL	293	391	638	4.9%	5.0%	5.0%
OUARZAZATE	695	490	566	-5.7%	1.5%	-1.3%
TAROUDANNT	694	748	822	1.3%	0.9%	1.1%
TIZNIT	348	355	365	0.3%	0.3%	0.3%
Total of Zone IV	2,636	2,683	3,267	0.3%	2.0%	1.4%
Zone V						
FIGUIG	117	122	132	0.7%	0.8%	0.8%
ERRACHIDIA	522	562	618	1.2%	1.0%	1.1%
Total of Zone V	639	684	750	1.1%	0.9%	1.0%
Grand Total (Zone I to V)	20,783	22,558	26,066	1.4%	1.5%	1.4%

Source: Projections au 1er juillet de l' annee (evolution de 2000 a 2010), Direction de la Statistique

Table 3.1.4: Economically Active Population in 1994

1994	Economically active population			Inactive population	Not Stated	Total	Unemployment rate
	Employed	Unemployed	Sub-total				
Male	5,652,869	926,877	6,579,746	6,201,400	1,111	12,782,257	14.10%
Female	1,347,542	405,111	1,752,653	11,314,525	404	13,067,582	23.10%
Total	7,000,411	1,331,988	8,332,399	17,515,925	1,515	25,849,839	16.00%

Source: Recensement 1994, les Caracteristiques Socio-economiques et

Demographiques de la Population, Niveau National

Table 3.1.5: Unemployment of Morocco in 1982 and 1994

unit: 1000 persons

	Male			**Female**			**Total**		
	1982	**1994**	**Growth rate (82-94)**	**1982**	**1994**	**Growth rate (82-94)**	**1982**	**1994**	**Growth rate (82-94)**
Urban	232	577	249%	91	343	377%	323	920	285%
Rural	285	350	123%	35	62	177%	320	412	129%
Total	517	927	179%	126	405	321%	643	1,332	207%

Source: Recensement 1994, les Caracteristiques Socio-economiques et Demographiques de la Population, Niveau National.

Table 3.1.6: Gross Domestic Product of Morocco

Year	At Current Market Price				At 1980 Constant Price			
	GDP		GDP Per Capita		GDP		GDP Per Capita	
	Amount (Million DH)	Growth Rate	Amount (DH)	Growth Rate	Amount (Million DH)	Growth Rate	Amount (DH)	Growth Rate
1988	181,583		7,818		101,496		4,370	
1989	193,931	6.8%	8,182	4.7%	104,031	2.5%	4,389	0.4%
1990	213,803	10.2%	8,843	8.1%	107,642	3.5%	4,452	1.4%
1991	242,360	13.4%	9,832	11.2%	115,579	7.4%	4,689	5.3%
1992	242,912	0.2%	9,671	-1.6%	110,920	-4.0%	4,416	-5.8%
1993	249,223	2.6%	9,742	0.7%	109,797	-1.0%	4,292	-2.8%
1994	279,323	12.1%	10,713	10.0%	121,170	10.4%	4,647	8.3%
1995	281,702	0.9%	10,676	-0.3%	113,197	-6.6%	4,290	-7.7%
1996	319,340	13.4%	11,894	11.4%	127,027	12.2%	4,731	10.3%
1997	318,346	-0.3%	11,657	-2.0%	124,168	-2.3%	4,547	-3.9%
1998	341,385	7.2%	12,291	5.4%	132,276	6.5%	4,762	4.7%
Average Annual Growth Rate								
1988 - 1998 (last 10 years)	6.5%		4.6%		2.7%		0.9%	
1994 - 1998 (last 4 years)	5.1%		3.5%		2.2%		0.6%	

Source: Annuaire Statistique du Moroc 1993, 1996, and 1999

Table 3.1.7: Gross Domestic Product of Morocco by Industrial Origin (Million DH, Current Price)

	1988		1989		1990		1991		1992		1993		1994		1995		1996		1997		1998	
	Amount	Distr.	Amount	Distr.	Amount	Distr.	Amount	Distr.	Amount	Distr.	Amount	Distr.	Amount	Distr.	Amount	Distr.	Amount	Distr.	Amount	Distr.	Amount	Distr.
Primary Industry	**31,347**	**17%**	**33,370**	**17%**	**37,675**	**18%**	**48,703**	**20%**	**37,369**	**15%**	**36,602**	**15%**	**51,759**	**19%**	**41,161**	**15%**	**61,634**	**19%**	**49,140**	**15%**	**56,690**	**17%**
Agriculture, forestry, and fishery	31,347	17%	33,370	17%	37,675	18%	48,703	20%	37,369	15%	36,602	15%	51,759	19%	41,161	15%	61,634	19%	49,140	15%	56,690	17%
Secondary Industry	**60,492**	**33%**	**64,335**	**33%**	**70,050**	**33%**	**74,818**	**31%**	**78,523**	**32%**	**80,475**	**32%**	**86,103**	**31%**	**92,931**	**33%**	**99,120**	**31%**	**104,975**	**33%**	**109,266**	**32%**
Mining	5,243	3%	5,172	3%	5,343	2%	5,313	2%	5,073	2%	4,958	2%	5,151	2%	5,060	2%	5,603	2%	7,132	2%	7,217	2%
Energy	14,220	8%	14,067	7%	13,069	6%	15,706	6%	17,359	7%	18,665	7%	21,305	8%	23,722	8%	25,568	8%	26,867	8%	28,106	8%
Manufacturing	31,891	18%	34,554	18%	40,284	19%	41,739	17%	44,050	18%	44,851	18%	47,586	17%	51,715	18%	54,500	17%	56,212	18%	58,497	17%
Building and public works	9,139	5%	10,542	5%	11,354	5%	12,060	5%	12,040	5%	12,000	5%	12,062	4%	12,434	4%	13,449	4%	14,764	5%	15,447	5%
Tertiary Industry	**69,838**	**38%**	**73,417**	**38%**	**80,736**	**38%**	**89,582**	**37%**	**96,041**	**40%**	**99,639**	**40%**	**107,327**	**38%**	**110,531**	**39%**	**117,848**	**37%**	**120,840**	**38%**	**128,195**	**38%**
Commerce and import taxes	35,913	20%	37,769	19%	43,530	20%	49,354	20%	51,168	21%	51,313	21%	55,274	20%	55,780	20%	61,496	19%	62,072	20%	66,103	19%
Transport and communication	12,030	7%	12,735	7%	13,205	6%	13,907	6%	15,408	6%	16,465	7%	16,631	6%	17,508	6%	17,980	6%	18,555	6%	20,102	6%
Other services	21,895	12%	22,912	12%	24,002	11%	26,321	11%	29,465	12%	31,861	13%	35,421	13%	37,243	13%	38,372	12%	40,212	13%	41,991	12%
Sub-total	**161,677**	**89%**	**171,122**	**88%**	**188,462**	**88%**	**213,102**	**88%**	**211,933**	**87%**	**216,716**	**87%**	**245,189**	**88%**	**244,623**	**87%**	**278,602**	**87%**	**274,955**	**86%**	**294,152**	**86%**
Public Administration	**19,906**	**11%**	**22,809**	**12%**	**25,341**	**12%**	**29,258**	**12%**	**30,979**	**13%**	**32,507**	**13%**	**34,134**	**12%**	**37,079**	**13%**	**40,738**	**13%**	**43,391**	**14%**	**47,234**	**14%**
Total	**181,583**		**193,931**		**213,803**		**242,360**		**242,912**		**249,223**		**279,323**		**281,702**		**319,340**		**318,346**		**341,386**	

Source: Annuaire Statistique du Maroc 1993, 1996, and 1999

Table 3.1.8: Growth Rate of GDP by Industrial Origin (Million DH, 1980 Constant Price)

	GDP by Industrial Origin (Million DH on 1980 Constant Price Basis)											Average Annual Growth Rate									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	'88-'89	'89-'90	'90-'91	'91-'92	'92-'93	'93-'94	'94-'95	'95-'96	'96-'97	'97-'98	10 years '88-'98
Primary Industry	**19,885**	**20,798**	**19,760**	**24,048**	**15,163**	**14,457**	**23,333**	**13,078**	**23,280**	**17,120**	**21,166**	**4.6%**	**-5.0%**	**21.7%**	**-36.9%**	**-4.7%**	**61.4%**	**-43.9%**	**78.0%**	**-26.5%**	**23.6%**	**0.6%**
Agriculture, forestry, and fishery	19,885	20,798	19,760	24,048	15,163	14,457	23,333	13,078	23,280	17,120	21,166	4.6%	-5.0%	21.7%	-36.9%	-4.7%	61.4%	-43.9%	78.0%	-26.5%	23.6%	0.6%
Secondary Industry	**29,252**	**28,853**	**31,502**	**31,599**	**32,347**	**32,018**	**33,298**	**34,787**	**36,463**	**38,535**	**39,240**	**-1.4%**	**9.2%**	**0.3%**	**2.4%**	**-1.0%**	**4.0%**	**4.5%**	**4.8%**	**5.7%**	**1.8%**	**3.0%**
Mining	3,983	3,195	3,518	3,115	3,262	3,156	3,426	3,467	3,544	4,088	3,942	-19.8%	10.1%	-11.5%	4.7%	-3.3%	8.5%	1.2%	2.2%	15.3%	-3.6%	-0.1%
Energy	3,360	3,528	3,754	3,928	4,183	4,125	4,448	5,157	5,849	6,276	6,361	5.0%	6.4%	4.6%	6.5%	-1.4%	7.8%	16.0%	13.4%	7.3%	1.3%	6.6%
Manufacturing	17,137	17,031	19,061	19,573	20,099	19,911	20,665	21,429	22,058	22,806	23,360	-0.6%	11.9%	2.7%	2.7%	-0.9%	3.8%	3.7%	2.9%	3.4%	2.4%	3.1%
Building and public works	4,772	5,099	5,169	4,983	4,804	4,827	4,760	4,734	5,012	5,365	5,577	6.9%	1.4%	-3.6%	-3.6%	0.5%	-1.4%	-0.5%	5.9%	7.0%	4.0%	1.6%
Tertiary Industry	**36,929**	**38,077**	**39,807**	**42,113**	**45,068**	**44,076**	**45,357**	**45,059**	**45,992**	**46,744**	**49,406**	**3.1%**	**4.5%**	**5.8%**	**7.0%**	**-2.2%**	**2.9%**	**-0.7%**	**2.1%**	**1.6%**	**5.7%**	**3.0%**
Commerce and import taxes	19,477	20,476	21,936	23,531	24,974	23,549	23,821	23,429	24,468	24,582	26,463	5.1%	7.1%	7.3%	6.1%	-5.7%	1.2%	-1.6%	4.4%	0.5%	7.6%	3.1%
Transport and communication	5,308	5,381	5,697	5,930	6,864	7,083	7,436	7,568	7,777	7,961	8,497	1.4%	5.9%	4.1%	15.8%	3.2%	5.0%	1.8%	2.8%	2.4%	6.7%	4.8%
Other services	12,145	12,220	12,174	12,653	13,230	13,445	14,100	14,062	13,747	14,200	14,446	0.6%	-0.4%	3.9%	4.6%	1.6%	4.9%	-0.3%	-2.2%	3.3%	1.7%	1.8%
Sub-total	**86,065**	**87,728**	**91,070**	**97,760**	**92,578**	**90,551**	**101,988**	**92,924**	**105,735**	**102,399**	**109,811**	**1.9%**	**3.8%**	**7.3%**	**-5.3%**	**-2.2%**	**12.6%**	**-8.9%**	**13.8%**	**-3.2%**	**7.2%**	**2.5%**
Public Administration	**15,521**	**16,303**	**16,572**	**17,819**	**18,342**	**19,246**	**19,182**	**20,273**	**21,292**	**21,769**	**22,465**	**5.0%**	**1.7%**	**7.5%**	**2.9%**	**4.9%**	**-0.3%**	**5.7%**	**5.0%**	**2.2%**	**3.2%**	**3.8%**
Total	**101,586**	**104,031**	**107,642**	**115,579**	**110,920**	**109,797**	**121,170**	**113,197**	**127,027**	**124,168**	**132,276**	**2.4%**	**3.5%**	**7.4%**	**-4.0%**	**-1.0%**	**10.4%**	**-6.6%**	**12.2%**	**-2.3%**	**6.5%**	**2.7%**

Source: Annuaire Statistique du Maroc 1993, 1996, and 1999

Table 4.7.1: List of Government Agencies Related to Water

Activities	MCEF		MOA					MOE			MOI			SCE				MSP		OFFICES			INSTITUATIONS					PRIVATE SECTORS	
	DDF	DCRF	AGR-DDGI	AGR - DAH	DRED	DPV	DPA	DGH-DAH	DGH-DRPE	DMN	DGCL-DEA	DAR	DRSC	DSPR	DRC	DPP	INH	DES	DE	ONEP	ORMVA	ONE	IAV H-II	INR	EMI	EHTP	Contractors	Others
1. Water Resources Developmen																												
Surface Water		C	M,C	I,M				M,RE	M,PL	C,M		M,C			M,C			E,M	C,M	C	C							
Ground Water			I	I,C				C,M	R, C			M,C						E,M	C,M	C	M,C							
River Basins Utilization	I,OM,M							C	C			C																
Sediment Control	C	I,OM,M	C	C				M,OM,C	M,C												M,C							
Groundwater Resources Control			C	C				C, M, PL	M,C												M,C							
2. Water Resources Management																												
Supply and Demand Balance			M,C	M,C	C			C	RE,M,C	C	C		M,C	M,OM,C						C	M,C	I,OM,M	R			C	C	
Water Allocations			C	C				I,C	C,M		C				C					PL, C, RE	M,C							
Experimentation			I,C	I,M,C	M,C										R	M,,C					I,M,C		R,M,C	R,M,	E			
Irrigation			I,PL,C	I,OM,M	M,C	C	C		C							M					I,M,C		R,M,C	R,M,		I	I.M.C	I,OM,M,
Feeding domesticates							C		I,M,C		I,M,C	I,M	I,M,C		M	M,C	M,C	E,M	M	I,OM,M, PL								
Industrial Utilization									C				M,C		M	M				I,OM,M					R			
Hydroelectric Productior									C				M,C							I, OM, M, C		I,M,C						
Dams Maintenance				C				OM, C	C																			
Maintenance of Irrigation Land			OM,M	OM,M,C	C	C	C														I,OM,M							
3. Controls																												
Flood Speed			C					M,OM,C	M,C	M,C		C						M,C										
Flood Quantities			C					M,OM,C	M,C	M,C		C																
Water Quality														R,C	M,C	M,C	C,M,											
Water Draingae											I,M,C		I,OM,	M,C	M,C		C,E			I,OM,M	I,OM,M		R,C				I,OM,M	I,OM,M
4. Agriculture and Environmen																												
Agriculture				C,E	E,C	I,M,E	I,M,C					M,C			C						I,OM,M		E,C	EC				
Technology Transfer			I,M,C	I,E	I,E,C	I,E,M	I,E					C			C						E,M							
Breeding				C	E,C		I,M,E					M,C			C						E,M		I,M,C					
Fishery		I,MO,M										M,C									E,M		E,M,C					
Pesticide					C,M	E,C	E,M,							M,C	M,C	M,C	E,C						E,M,C					
5. Tourism and Rivers Environmenta																												
Lakes and Rivers Preservation		I,M,C										I,M		M,C	M,C													
Eco-tourism and Forest		I,MO,M																										
Biodiversity		I,MO,M												M,C	M,C													

Pl : Planning OM : Operation/Maintenance M : Monitoring RE : Regulation C : Coordination I : Implement E : Framing R : Researh

Table 4.7.2: List of Government Agencies Abbreviations

Abbreviations	French	English
MCEF	**Ministère Chargé des Eaux et Forêts**	**Ministry in Charge of Water and Forests**
DDF	Direction de Développement Forestier	Directorate of Forest Development
DCRF	Direction de la Conservation des Ressources Forestières	Directorate of Forest Resources Conservation
MOA	**Ministère de l'Agriculture, du Développement Rural, et des Pêches** Maritimes	**Ministry of Agriculture, Rural Development and Maritime Fisheries**
AGR	Administration de Genie Rurale	Civil Rural Administration
DDGI	Direction du Développement et de Gestion de l'Irrigation	Directorate of Development and Irrigation Management
DAH	Direction des Aménagements Hydrauliques	Directorate of Hydraulic Development
DERD	Direction de l'Enseignement, de la Recherche, et de Développement	Directorate of Development, Research, and Education
DPV	Direction de la Production Végétale	Directorate of Vegetable Production
DPA	Direction de la Production Animale	Directorate of Animal Production
MOE	**Ministère de l'Equipement**	**Ministry of Equipment**
DGH	Direction Générale de l'Hydraulique	General Directorate of Hydraulic
DAH	Direction des Aménagements Hydrauliques	Directorate of Hydraulic Development
DRPE	Direction de Recherche et de Planification en Eau.	Directorate of Water Research and Planning
DMN	Direction de Météorologie Nationale	Directorate of National Meteorology
MOI	**Ministère de l'intérieur**	**Ministry of Interior**
DGCL	Direction Générale des Collectivités Locales	General Directorate of Local Collectives
DEA	Division des Eaux et d'Assainissement	Division of Water and Sanitation
DAR	Direction des Affaires Rurales	Directorate of Rural Affairs
DRSC	Direction des Régies et des Services Concédés	Directorate of Regis and Concedes Service
SECE	**Secrétariat d'Etat Chargé de l'Environnement**	**Ministry in Charge of Environment**
DSPR	Direction de Surveillance et de la Prévision des Risques.	Directorate of Follow up and Risk Preventation
DRC	Direction de Régulation et de Contrôle	Directorate of Control and Regulation
DPP	Direction de Planning et de Protection	Directorate of Protection and Planning
MSP	Ministère de la santé publique	Ministry of Public Health
INH	Institut National d'Hygiène	National Institute of Hygiene
DES	Direction d'Education Sanitaire	Directorate of Sanitation Education
DEI	Direction d'Epidémiologie et Lutte Contre les Maladies	Directorate of Epidemology and Disease Protection
offices		
ONEP	Office National de l'Eau Potable	National Office of Water Supply
ORMVA	Office Régional de la Mise en Valeur Agricole	Regional Office of Agriculture Development
ONE	Office National d'Electricité	National Office of Electricity
IRF	Instituts De Recherche Et De Formation.	Institute of Research and Education
institutes		
IAV H II	Institut Agronomique et Vétérinaire Hassan II	Institution of Agronomy and Veterinary Hassan II
INRA	Institut National de la Recherche Agronomique	National Institute of Agronomic Research
EMI	Ecole Mohammedia des Ingénieurs	Engineering School of Mohammedia
EHTP	Ecole Hassania des Travaux Publics	Public Works School of Hassania

Table 5.2.1: List of the 53 Medium Scale Dam Sites Proposed by MOE

No.	JICA No.	Site	Province	Objective	Available water (MCM)	Dam Type	Dam Height(m)	Dam Volume (m3)	Reservoir vol. (MCM)	Regularised vol.(MCM)	Study for Dams	Study for Agri-	Autorised by	Others
1	**2**	**TIZMELLAL**	**AL HOCEIMA**	**PS, I**	**57.71**	**RCC**	**78**	**150,000**	**21.28**	**12.5**	**FS**		**MP**	
2	**1**	**NECKOR**		**REG**	**58**	**HF**	**36.4**	**1,577,500**	**15.6**	**-**	**FS**		**MP**	
3		TOUIZGUI REMZ	ASSA ZAG	I, SL	13.5	M	17.7	45,900	78	-			MP	
4	**4**	**AIN KWACHIYA**	**BENSLIMANE**	**I, SP**	**7**	**RCC**	**30**	**78,000**	**11**	**0.6**	**FS**	**PS**	**5YP**	
5		**CHERRAT(1)**	**〃**	**I, SP**	**16**	**RCC**	**29**	**52,000**	**7**	**3**			**MP**	
6	**5**	**N'FIFIKH**	**〃**	**I, SP,SL**	**26**	**RCC**	**44**	**99,100**	**52.5**	**-**	**FS for downstream site, PS for upstream site**	**IS**	**MP,5YP**	**dimension of each items are for downstream site**
7	**6**	**TAZARANE**	**CHAOUEN**	**I, PS**	**16.7**	**CF**	**64**	**446,100**	**9.2**	**7**	**FS**		**MP**	
8	**10**	**TIMKIT**	**ERRACHIDIA**	**I, SG**	**7,5**	**RCC**	**56**	**136,500**	**14**	**-**	**FS**	**IS**	**MP,5YP,PJI**	
9	**12**	**TIOUIZAGUINE(2)**	**〃**	**I, SP**	**4.73**	**RCC**	**58.7**	**128,000**	**10.2**	**-**	**PS**	**IS**	**MP**	
10	**14**	**ADAROUCH**	**IFRANE**	**I, SL,SP**	**95**	**RCC**	**51**	**130,000**	**48**	**16**	**FS**	**PS(e)**	**5YP**	
11		KHANNOUSSA	KHEMISSET	SP	15	RCC	41.5	105,000	22.7	6.8			MP	
12	**7**	**AMEZMIZ**	**EL HAOUZ**	**I, REG**	**10**	**RCC**	**72.5**	**241,800**	**11**	**6**	**FS**	**IS**	**MP**	
13	**18**	**BOUKARKOUR**	**SETIAT**	**I, SP,SL**	**30**	**RCC**	**59.5**	**172,140**	**30.1**	**13.6**	**FS**		**MP**	
14		AIN ABDOUN	TAOUNATE	I, PS	20.87	RCC	57.5	299,900	10.5	9			MP	
15	**22**	**N'OUANTZ**	**BENSLIMANE**	**I, PS**	**2**	**RCC**	**43.4**	**76,000**	**2**	**-**	**FS**	**IS**	**LR**	
16	**23**	**IGUI N'OUAQA**	**TAROUDANT**	**FC,SG,I**	**7**	**RCC**	**57**	**186,200**	**10.5**	**4**	**FS**		**MP**	
17	**25**	**SIDI ABDELLAH**	**〃**	**SG,I**	**20**	**ZF**	**69**	**2,005,300**	**10.37**	**8.2**	**FS**		**MP**	
18	**3**	**AIT ABDDOU**	**AZIRLAL**	**PS**	**93.7**	**ZF**	**50**	**800,000**	**52**	**-**	**PS**	**IS**	**MP**	
19		AIN KSOB	BENSLIMANE	I, SL	12.9	RCC	60	170,000	25	-			MP	
20		MY BOUCHTA	CHEFCHAOUEN	REG	-	RCC	-	-	-	-			MP	
21	**11**	**TADIGHOUST**	**ERRACHIDIA**	**I**	**35.7**	**RCC**	**63**	**504,060**	**37**	**-**	**PS**		**MP**	
22		IGOUZOULANE	ESSAOUIRA	SP	17	RCC	40	930,000	13	-			MP	
23	**13**	**KHENG GROU**	**FIGUIG**	**SG,I**	**91.5**	**RCC**	**70**	**325,000**	**90**	**-**	**FS**	**IS**	**MP**	
24	**15**	**SIDE OMAR**	**KHEMISSET**	**I**	**17**	**RCC**	**59**	**222,000**	**35**	**-**	**PS**	**IS**	**MP**	
25		SIDE AMAR	KHENIFRA	REG	55.8	RCC	47.5	120,000	62.83	28			MP	
26		CHACHA N' MELAL	〃	PS,REG	320	RCC	87.7	542,140	168.3	-			MP	
27	**8**	**BOULAOUANE**	**CHICHAOUAN**	**I**	**57**	**RCC**	**82**	**799,000**	**56**	**28**	**PS**	**IS**	**MP,5YP**	
28	**9**	**TASKOURT**	**〃**	**I**	**49**	**RCC**	**88**	**457,000**	**106**	**-**	**PS(e)**	**IS**	**MP,5YP**	
29	**16**	**TIOUINE**	**OUERZAZATE**	**I, FC**	**102**	**RCC**	**68.5**	**405,530**	**102.9**	**-**	**PS**	**IS**	**MP**	
30	**17**	**AZGHAR**	**SEFROU**	**I**	**53**	**RCC**	**55**	**299,280**	**40**	**-**	**PS**	**IS**	**LR**	
31	**19**	**AOULAI**	**TAOUNATE**	**I, PS**	**247**	**RCC**	**50**	**310,500**	**225**	**99**	**PS**		**MP**	
32	**20**	**SIDI ABBOU**	**〃**	**I**	**82.6**	**RCC**	**30**	**32,000**	**58**	**32**	**PS(e)**		**MP**	
33	**24**	**ABDEL MOUMEN AM(**	**TAROUDANT**	**-**	**-**	**RCC**	**-**	**-**	**-**	**-**	**PS(e)**	**IS**	**MP**	
34		Compensation dam for downstream MANSSOUR EDDAHBI	OUERZAZATE	I	-	NC	20	135000	7.8	-			MP	
35		HERRISSEN	MARRAKECHE	I	10.4	HF	48	335,000	19	-			MP	
36		TILIOUINE	OUERZAZATE	SG	9.5	CF	25	230,000	9.7	-			MP	
37		ALLOUGOUM	TATA	FC	37	CF	30	930,000	28	-			MP	
38		IMI OUZLAGH	〃	SG,I	8.8	CF	37	700,000	10.8	-			MP	
39		TIMALIZANE	MARRAKECHE	I	141	HF	53	1,600,000	20	-			MP	
40	**21**	**SIDI EL MOKHFI**	**TAOUNATE**	**I, SL**	**195**	**RCC**	**65**	**1,500,000**	**26**		**PS**		**PJI**	
41		FOUM LAHCEN	ASSA ZAG	I, SL	30	CF	25	425,000	40	-			MP	
42		IMIZER	MARRAKECHE	I	96	HF	55	1,500,000	60	-			MP	
43		HANEDOUR	OUERZAZATE	I, SL	2.5	RCC	40	100,000	17	-			MP	
44		SARHRO	ERRACHIDIA	I	1	HF	32	400,000	4				PJI	
45		MY BRAHIM	MARRAKECHE	I	34	HF	55	2,425,000	36.4	-			MP	
46		IMEDER	ERRACHIDIA	I	20.5	RCC	31	258,000	38	-			MP	
47		MENZOURA	LARACHE	I, SP	by Province	HF	60	670,000	80	-			MP	
48		EL LIAM	TANGER	SP	34	CF	60	1,200,000	60	-			MP	
49		IMIN TOURZA	OUERZAZATE	I	3.5	CF	30	300,000	45	-			MP	
50		ALILA	TETOUAN	SP	3	HF	25	120,000	4	-			MP	
51		LALLA LOUMA	KENITRA	I	21	HF	25	1,300,000	27	-			MP	
52		OUIZEIT	BOULMANE	I	12.5	RCC	47	120,000	20	-			MP	
53		MSALIT	TATA	FC	34	CF	30	350,000	52	-			MP	

Legend(for objective)
PS ;protection against siltation
I ;irrigarion
SP;supply of potable water
SL;supply of livestock water
SG;supply for ground water
FC;flood control
REG;reguration for downstream dam
PC;

Legend(for dam type)
RCC;roller compacted concrete
NC;normal concrete
HF ;homogeneou fill type
ZF;zoned fill type
CF;concrete facing
M ;masonry

Legend(for study)
FS;feasibility study finished
FSo;feasibility study on going
PS;prelimary study finished
IS;initial preliminary study

Legend (for authorization)
MP;master plan for each main water basin
5FP;5 year plan(1999-2003)
PJI;master plan study by JICA

Table 5.3.1 Reference Evapotranspiration (ETo) for Each Zone (Modified Penman Method)

Zone	Zones I and II		Zone III		Zone IV		Zone V	
Month/Unit	mm	mm/day	mm	mm/day	mm	mm/day	mm	mm/day
January	73	2.45	86	2.87	87	2.91	81	2.69
February	87	3.05	102	3.59	105	3.68	98	3.43
March	134	4.32	155	4.99	157	5.07	150	4.84
April	157	5.24	184	6.13	185	6.17	179	5.98
May	196	6.32	221	7.14	232	7.48	225	7.26
June	233	7.77	247	8.25	256	8.52	250	8.34
July	261	8.42	271	8.76	261	8.43	264	8.52
August	223	7.20	232	7.49	222	7.15	220	7.11
September	174	5.79	184	6.14	180	5.99	179	5.96
October	141	4.54	155	4.99	156	5.03	152	4.92
November	94	3.13	108	3.61	106	3.52	100	3.35
December	70	2.25	85	2.73	84	2.71	79	2.53
Annual Mean	1,843	(60.48)	2,030	(66.69)	2,031	(66.66)	1,977	(64.93)
Monthly Mean	154	(5.04)	169	(5.56)	169	(5.56)	165	(5.41)

Notes:
(1) ETo for Zones I and II is calculated using the meteorological data observed at the Fes-Sais Station.
(2) ETo for Zone III is calculated using the meteorological data observed at the Marrakech Station.
(3) ETo for Zone IV is calculated using the meteorological data observed at the Quarzazate Station.
(4) ETo for Zone V is calculated using the meteorological data observed at the Rachidia Station.
(5) Meteorological data used for the calculation of Eto for each zone are 20 years from 1980 to 1999.

Table 5.3.2 Project Supply Requirement for Each Zone

(Unit : mm/month)

Zone	Zone I				Zone II				Zone III				Zone IV				Zone V			
Month	Etcrop	Po	In	V	Etcrop	Po	In	V	Etcrop	Po	In	V	Etcrop	Po	In	V	Etcrop	Po	In	V
September	12.4	5.0	7.4	14.2	6.7	5.0	1.7	3.3	3.4	1.5	1.9	3.7	6.3	2.4	3.9	7.5	11.7	4.2	7.5	14.4
October	24.7	10.5	14.2	27.3	22.0	10.5	11.5	22.1	19.9	4.3	15.6	30.0	22.4	9.1	13.3	25.6	24.3	10.7	13.6	26.2
November	38.2	25.1	13.1	25.2	38.9	25.1	13.8	26.5	39.9	10.3	29.6	56.9	40.3	8.0	32.3	62.1	37.2	8.9	28.3	54.4
December	49.4	33.2	16.2	31.2	50.9	33.2	17.7	34.0	59.1	11.6	47.5	91.3	56.3	8.0	48.3	92.9	50.6	7.7	42.9	82.5
January	69.2	29.0	40.2	77.3	69.0	29.0	40.0	76.9	84.0	19.8	64.2	123.5	75.6	6.2	69.4	133.5	69.2	6.1	63.1	121.3
February	90.1	30.3	59.8	115.0	86.9	30.3	56.6	108.8	112.1	20.5	91.6	176.1	96.6	12.2	84.4	162.3	92.3	9.8	82.5	158.6
March	110.5	32.5	78.0	150.0	105.9	32.5	73.4	141.1	133.4	35.5	97.9	188.3	114.2	9.1	105.1	202.1	112.5	5.5	107.0	205.8
April	85.2	31.0	54.2	104.2	80.0	31.0	49.0	94.0	100.1	25.1	75.0	144.2	86.6	3.7	82.9	159.4	88.4	6.2	82.2	158.1
May	46.5	22.2	24.3	46.7	43.0	22.2	20.8	40.0	43.5	5.8	37.7	72.5	46.4	3.3	43.1	82.9	48.6	5.1	43.5	83.7
June	28.5	-	28.5	54.8	29.8	-	29.8	57.3	12.5	-	12.5	24.0	30.1	2.8	27.3	52.5	27.8	4.2	23.6	45.4
July	30.2	-	30.2	58.1	33.9	-	33.9	65.2	11.1	-	11.1	21.3	31.3	1.4	29.9	57.5	27.8	-	27.8	53.5
August	21.5	-	21.5	41.3	20.4	-	20.4	39.2	7.3	-	7.3	14.0	18.6	5.4	13.2	25.4	19.3	-	19.3	37.1
Annual Mean	606.4	218.8	387.6	745.3	587.4	218.8	368.6	708.4	626.3	134.4	491.9	945.8	624.7	71.6	553.1	1,063.7	609.7	68.4	541.3	1,041.0

Notes: (1) ETcrop : Crop water requirement

(2) Pe : Effective rainfall

(3) In : Net irrigation requirement

(4) V: Project supply requirement

Table 6.1.1: Result of Evaluation on Social Aspects

		I		II		III		IV		Total Score	Rank
		Project Function and its Conformity with Basic Development		Status in the Government Development Program		Urgency for Project Implementation		Effects on Stabilization of Social Condition			
		Level	Score	Level	Score	Level	Score	Level	Score		
1	NECKOR	B	1	B	1	A	2	C	0	4	B
2	TIZIMELLAL	C	0	B	1	B	1	C	0	2	C
3	AIT BADDOU	B	1	B	1	B	1	C	0	3	C
4	AIN KWACHIYA	A	2	A	2	B	1	A	2	7	A
5	N' FIFIK	A	2	A	2	A	2	A	2	8	A
6	TAZARANE	B	1	B	1	B	1	B	1	4	B
7	AMEZMIZ	A	2	B	1	B	1	B	1	5	B
8	BOULAOUANE	A	2	A	2	B	1	B	1	6	B
9	TASKOURT	A	2	A	2	B	1	A	2	7	A
10	TIMKIT	A	2	A	2	A	2	A	2	8	A
11	TADIGHOUST	B	1	B	1	C	0	A	2	4	B
12	TIOUZAGUINE	B	1	B	1	C	0	B	1	3	C
13	KHENG GROU	B	1	B	1	C	0	A	2	4	B
14	ADAROUCH	B	1	A	2	B	1	B	1	5	B
15	SIDI OMAR	B	1	B	1	C	0	A	2	4	B
16	TIWINE	B	1	B	1	B	1	A	2	5	B
17	AZGHAR	A	2	B	1	A	2	A	2	7	A
18	BOUKARKOUR	B	1	B	1	B	1	A	2	5	B
19	AOULAI	B	1	B	1	B	1	B	1	4	B
20	SIDI ABBOU	B	1	B	1	B	1	B	1	4	B
21	SIDI EL MOKHFI	A	2	B	1	B	1	A	2	6	B
22	N' OUANZ	B	1	B	1	B	1	C	0	3	C
23	IGUIN' OUAQ	A	2	B	1	A	2	B	1	6	B
24	AMOUNT ABDELMOUMEN	A	2	B	1	B	1	B	1	5	B
25	SIDI ABDELLAH	A	2	B	1	A	2	A	2	7	A

Note : Total score and relevant rank

< 4 : C (Poor)
4,5,6 : B (Fair)
7,8 : A (Good)

Table 6.1.2: Result of Evaluation on Technical Feasibilty

		I	II	III	IV	V			
		Dam	Irrigation	Water Supply	Groundwater Restoration	Flood and Sediment Control	Total Score	Level	Insufficient Maturity in Planning and/or Study
1	NECKOR	15				17	32	C	
2	TIZIMELLAL							X	
3	AIT BADDOU	23	6			20	49	B	
4	AIN KWACHIYA	28	22	4		3	57	B	
5	N' FIFIK	25	28	4		7	64	A	
6	TAZARANE	18	31	3		0	52	B	
7	AMEZMIZ	23	31	3		10	67	A	
8	BOULAOUANE	28	31	3		7	69	A	
9	TASKOURT	23	31	3		7	64	A	
10	TIMKIT	30	28	4	3	2	67	A	
11	TADIGHOUST	23	35	4		2	64	A	X
12	TIOUZAGUINE	28	24	8		3	63	A	X
13	KHENG GROU	35	26	4		2	67	A	X
14	ADAROUCH	35	23	7		3	68	A	X
15	SIDI OMAR	30	26	3		3	62	A	
16	TIWINE	28	22	3		5	58	B	X
17	AZGHAR	33	33	4		3	73	A	
18	BOUKARKOUR	35	13	2		5	55	B	X
19	AOULAI	25	20	3		2	50	B	
20	SIDI ABBOU	30	18	3		7	58	B	X
21	SIDI EL MOKHFI	30	20	3		5	58	B	
22	N' OUANZ							X	
23	IGUIN' OUAQ	28	16	4	0	3	51	B	X
24	AMOUNT	30				33	63	A	X
25	SIDI ABDELLAH	20	18	5	0	3	46	B	X

Note: Serious problem is identified. : X

< 40 : C

40 < < 60 : B

60< : A

Table 6.1.3: Results of Environmental Screening for Negative Impacts on Natural Environment

Dam	A[1]	(×2)	B[2]	(×3)	C[3]	(×4)	D[4]	(×1)	Total	Rank*
Sites	No	Points	No	Points	No	Points	No	Points	Points	
1	15	30	5	15	1	4	5	5	54	A
2	18	36	3	9	0	0	8	8	53	A
3	22	44	1	3	0	0	7	7	54	A
4	25	50	0	0	0	0	5	5	55	A
5	21	42	0	0	1	4	9	9	55	A
6	19	38	1	3	0	0	6	6	47	A
7	19	38	3	9	0	0	7	7	54	A
8	18	36	3	9	1	4	6	6	55	A
9	17	34	6	18	0	0	6	6	58	B
10	21	42	0	0	0	0	6	6	48	A
11	19	38	2	6	0	0	8	8	52	A
12	25	50	0	0	0	0	4	4	54	A
13	19	38	3	9	1	4	4	4	55	A
14	19	38	4	12	0	0	8	8	58	B
15	24	48	0	0	1	4	6	6	58	B
16	16	32	5	15	1	4	7	7	58	B
17	22	44	1	3	0	0	5	5	52	A
18	19	38	1	3	0	0	9	9	50	A
19	16	32	4	12	4	16	7	7	67	C
20	19	38	5	15	0	0	6	6	59	B
21	20	40	3	9	3	12	6	6	67	C
22	19	38	0	0	0	0	7	7	45	A
23	18	36	0	0	0	0	6	6	42	A
24	14	28	1	3	0	0	7	7	38	A
25	19	38	2	6	2	8	7	7	59	B

(1) A: Minor impact (No of As x 2 = Points)
(2) B: Moderate impact (No of Bs x 3 = Points)
(3) C: Significant impact (No of Cs x 4 = Points)
(4) D: Impact is unknown (No of Ds x 1 = Points)

* A: Minor impact (< 55 points)
B: Moderate impact (56 – 60)
C: Significant impact (> 61 points

Table 6.1.4: Sites Ranked according to Potential Negative Social Impact

Dam	A[1] (×4)		B[2] (×3)		C[3] (×2)		D[4] (×1)		Total	Rank
Sites	No	Points	No	Points	No	Points	No	Points	Points	
1	12	48	5	15	33	66	7	7	136	H
2	0	0	4	12	26	52	4	4	68	C
3	4	16	11	33	30	60	4	4	103	H
4	0	0	2	6	9	18	2	2	26	A
5*	2	8	9	27	5	10	3	3	38	A
5* *	15	60	6	18	15	30	3	3	111	H
6	0	0	6	18	20	40	3	3	61	C
7	3	12	7	21	21	42	2	2	77	C
8	1	4	1	6	17	34	2	2	46	B
9	1	4	5	15	18	36	3	3	58	B
10	0	0	3	9	11	22	6	6	37	A
11	0	0	0	0	6	12	5	5	17	A
12	0	0	4	12	9	8	6	6	36	A
13	2	8	4	12	17	34	5	5	59	B
14	0	0	0	0	16	32	4	4	36	A
15	0	0	1	3	16	32	2	2	37	A
16	1	4	3	9	6	12	2	2	27	A
17	0	0	0	0	15	30	2	2	32	A
18	0	0	0	0	14	28	2	2	30	A
19	7	28	8	24	8	16	2	2	70	C
20	0	0	8	24	8	16	2	2	42	B
21	0	0	5	15	13	26	2	2	43	B
22	11	44	4	12	8	16	3	3	75	C
23	0	0	3	0	18	36	2	2	47	B
24	8	32	2	6	7	14	2	2	54	B
25	0	0	0	0	14	28	2	2	30	A

Rank-A: Site having a minor negative social impact (< 40)
Rank-B: Site having a moderate negative social impact (40 – 60)
Rank-C: Site having a significant negative social impact (> 60)
Rank-H: Site having critical negative social impact exceeding Class C (> 100)

5* N' Fifikh (Upstream)
5* * N' Fifikh (Downstream)

Table 6.1.5: Results of Economic Analyses

Project	EIRR	B/C	NPV(Unit: million DH)			
	(%)	DR=5%	DR=5%	DR=6%	DR=8%	DR=10%
ZONE I						
No. 6 Tazarane	4.2%	0.89	-24.2	-47.9	-82.3	-105.2
No. 19 Aoulai	9.3%	1.64	441.8	300.5	94.7	-43.8
No. 21 Sidi El Mokhfi	9.1%	1.61	316.2	212.5	61.4	-40.2
No. 17 Azghar	8.1%	1.45	118.8	71.6	3	-43
ZONE II						
No. 4 Ain Kwachiya	6.1%	1.14	14.7	0.7	-19.6	-33.2
No. 5 N'Fifikh (Upper)	7.8%	1.39	60.4	34.2	-3.9	-29.5
No. 15 Sidi Omar	7.2%	1.31	84.4	40.5	-23.4	-66.3
ZONE III						
No. 7 Amezmiz	7.4%	1.35	72.5	37.6	-13	-46.7
No. 8 Boulaouane	6.5%	1.21	36.6	10.8	-26.6	-51.6
No. 9 Taskourt	7.6%	1.37	234.7	129.1	-24	-127.3
ZONE V						
No. 10 Timkit	5.7%	1.09	19.6	-9.3	-24.3	-79.1

Note: DR means discount rate applied for calculation of B/C and NPV.

Table 6.2.1: Result of Prioritization (1/3)

Classification	D				C		A & B						
	Serious Problem in;						Scoring						
Evaluation Factor	Social Aspects	Technical Aspects	Natural Environmental	Social Environmental Aspects	Insufficient Maturity in Planning and/or Study	Low Economic Viability (EIRR less than 5%)	Social Aspects (max. 20)	Technical Feasibility (max.20)	Natural Environmental	Social Environmental Impact (max. 10)	Economic Viability (max. 40)	Total Score	GROUPING
Relevant Chapter	**6.1.1**	**6.1.2**	**6.1.3**	**6.1.4**	**6.1.2**	**6.1.5**	**6.1.1**	**6.1.2**	**6.1.3**	**6.1.4**	**6.1.5**		
No. Name													
Zone I													
1 Neckor				X	-	-	-	-	-	-	-	-	D
2 Tizimellal		X	-	-	-	-	-	-	-	-	-	-	D
6 Tazarane						X	-	-	-	-	-	-	C
19 Aoulai							10	10	0	0	40	60	B
21 Sidi El Mokhfi							10	10	0	5	40	65	B
20 Sidi Abbou					X	-	-	-	-	-	-	-	C
14 Adarouch					X	-	-	-	-	-	-	-	C
17 Azghar							20	20	10	10	20	80	A
Zone II													
4 Ain Kwachiya							20	10	10	10	20	70	B
5 N' fifikh (lower)				X	-	-	-	-	-	-	-	-	D
5 N' fifikh (upper)							20	20	10	10	20	80	A
15 Sidi Omar							10	20	5	10	20	65	B
18 Bourkarkour					X	-	-	-	-	-	-	-	C

Points for Scoring

1 Social Aspects: Good; 20, Fair; 10, Poor; 0

2 Technical Feasibility: Good; 20, Fair; 10, Poor; 0

3 Natural Environmental Impact: Minor Impact; 10, Moderate Impact; 5, Significant Impact; 0

4 Social Environmental Impact: Minor Impact; 10, Moderate Impact; 5, Significant Impact; 0

5 Economic Viability: EIRR more than 8% and NPV (DR=5%) more than 200 mil. DH; 40
EIRR 8%-5%; 20
NPV (DR=5%) less than 200mil. DH; 20

Table 6.2.1: Result of Prioritization (2/3)

Classification	D				C		A & B						
	Serious Problem in;						Scoring						
Evaluation Factor	Social Aspects	Technical Aspects	Natural Environmental	Social Environmental Aspects	Insufficient Maturity in Planning and/or Study	Low Economic Viability (EIRR less than 5%)	Social Aspects (max. 30)	Technical Feasibility (max.20)	Natural Environmental	Social Environmental Impact (max. 10)	Economic Viability (max. 30)	Total Score	GROUPING
Relevant Chapter	6.1.1	6.1.2	6.1.3	6.1.4	6.1.2	6.1.5	6.1.1	6.1.2	6.1.3	6.1.4	6.1.5		
No. Name													
Zone III													
3 Ait Baddou				X	-	-	-	-	-	-	-	-	D
22 N' ouamt		X	-	-	-	-	-	-	-	-	-	-	D
7 Amezmiz							15	20	10	0	15	60	B
8 Boulaouane							15	20	10	5	15	65	B
9 Taskourt							30	20	5	5	15	75	A
Zone IV													
23 Igui N' ouaq					X	-	-	-	-	-	-	-	C
24 Amont Abdelmoumen					X	-	-	-	-	-	-	-	C
25 Sidi Abdellah					X	-	-	-	-	-	-	-	C
16 Tiouine					X	-	-	-	-	-	-	-	C

Points for Scoring

1 Social Aspects: Good; 20, Fair; 10, Poor; 0
2 Technical Feasibility: Good; 20, Fair; 10, Poor; 0
3 Natural Environmental Impact: Minor Impact; 10, Moderate Impact; 5, Significant Impact; 0
4 Social Environmental Impact: Minor Impact; 10, Moderate Impact; 5, Significant Impact; 0
5 Economic Viability: EIRR more than 8% and NPV (DR=5%) more than 200 mil. DH; 30
EIRR 8%-5%; 15
NPV (DR=5%) less than 200mil. DH; 15

Table 6.2.1: Result of Prioritization (3/3)

Classification	D				C		A & B						
	Serious Problem in;						Scoring						
Evaluation Factor	Social Aspects	Technical Aspects	Natural Environmental	Social Environmental Aspects	Insufficient Maturity in Planning and/or Study	Low Economic Viability (EIRR less than 5%)	Social Aspects (max. 40)	Technical Feasibility (max.20)	Natural Environmental	Social Environmental Impact (max. 10)	Economic Viability (max. 20)	Total Score	GROUPING
Relevant Chapter	**6.1.1**	**6.1.2**	**6.1.3**	**6.1.4**	**6.1.2**	**6.1.5**	**6.1.1**	**6.1.2**	**6.1.3**	**6.1.4**	**6.1.5**		
No. Name													
Zone V													
10 Timkit							40	20	10	10	10	90	A
11 Tadighoust					**X**	-	-	-	-	-	-	-	C
12 Tiouzaguine					**X**	-	-	-	-	-	-	-	C
13 Kheng Grou					**X**	-	-	-	-	-	-	-	C

Points for Scoring

1 Social Aspects: Good; 20, Fair; 10, Poor; 0

2 Technical Feasibility: Good; 20, Fair; 10, Poor; 0

3 Natural Environmental Impact: Minor Impact; 10, Moderate Impact; 5, Significant Impact; 0

4 Social Environmental Impact: Minor Impact; 10, Moderate Impact; 5, Significant Impact; 0

5 Economic Viability: EIRR more than 8% and NPV (DR=5%) more than 200 mil. DH; 20
EIRR 8%-5%; 10
NPV (DR=5%) less than 200mil. DH; 10

Table 7.1.1: Monthly Discharge at N'Fifikh

(unit: m^3/s)

Year	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Mean	Total Mm^3
1939 / 40	0.139	0.134	0.598	0.577	2.363	2.618	1.197	1.237	0.415	0.429	0.134	0.134	0.819	25.83
1940 / 41	0.145	0.141	0.623	0.603	2.464	2.730	1.247	1.288	0.431	0.447	0.141	0.141	0.854	26.93
1941 / 42	0.100	0.100	0.266	0.504	0.685	1.118	0.776	0.671	0.338	0.181	0.100	0.100	0.407	12.83
1942 / 43	0.167	0.161	0.429	0.809	1.103	1.797	1.244	1.077	0.547	0.294	0.161	0.161	0.655	20.66
1943 / 44	0.066	0.065	0.067	0.065	0.181	0.058	0.052	0.054	0.052	0.054	0.007	0.007	0.061	1.92
1944 / 45	0.126	0.124	0.126	0.124	0.191	0.121	0.119	0.119	0.119	0.351	0.091	0.091	0.142	4.46
1945 / 46	0.097	0.092	0.253	0.477	0.652	1.065	0.735	0.637	0.321	0.175	0.092	0.092	0.386	12.18
1946 / 47	0.345	0.339	0.345	0.339	0.941	0.307	0.276	0.282	0.276	0.282	0.038	0.038	0.317	10.01
1947 / 48	0.105	0.101	0.271	0.514	0.702	1.142	0.789	0.683	0.349	0.183	0.101	0.101	0.415	13.10
1948 / 49	0.099	0.094	0.257	0.484	0.662	1.082	0.746	0.647	0.326	0.178	0.094	0.094	0.393	12.38
1949 / 50	0.163	0.161	0.163	0.161	0.293	0.154	0.149	0.152	0.149	0.152	0.096	0.096	0.157	4.96
1950 / 51	0.125	0.121	0.326	0.610	0.834	1.356	0.940	0.815	0.413	0.220	0.121	0.121	0.494	15.59
1951 / 52	0.349	0.343	0.349	0.343	0.953	0.311	0.280	0.286	0.280	0.286	0.038	0.038	0.321	10.14
1952 / 53	0.379	0.367	0.379	0.367	1.021	0.330	0.300	0.312	0.300	0.312	0.037	0.037	0.345	10.88
1953 / 54	0.157	0.150	0.402	0.758	1.032	1.679	1.164	1.007	0.513	0.276	0.150	0.150	0.613	19.33
1954 / 55	0.143	0.140	0.374	0.704	0.957	1.561	1.081	0.934	0.474	0.254	0.140	0.140	0.569	17.93
1955 / 56	0.212	0.041	0.909	0.880	3.598	3.984	1.820	1.881	0.630	0.652	0.205	0.205	1.233	38.87
1956 / 57	0.177	0.175	0.177	0.175	0.328	0.165	0.158	0.161	0.158	0.161	0.098	0.098	0.169	5.34
1957 / 58	0.106	0.101	0.278	0.524	0.718	1.168	0.806	0.701	0.357	0.190	0.101	0.101	0.424	13.39
1958 / 59	0.387	0.376	0.387	0.376	1.053	0.342	0.307	0.319	0.307	0.319	0.040	0.040	0.354	11.18
1959 / 60	0.124	0.120	0.318	0.602	0.823	1.335	0.924	0.799	0.407	0.217	0.120	0.120	0.487	15.36
1960 / 61	0.099	0.094	0.256	0.483	0.661	1.080	0.744	0.646	0.325	0.177	0.094	0.094	0.392	12.35
1961 / 62	0.173	0.167	0.444	0.837	1.143	1.859	1.284	1.115	0.566	0.306	0.167	0.167	0.678	21.38
1962 / 63	0.148	0.144	0.639	0.619	2.531	2.801	1.280	1.323	0.443	0.459	0.144	0.121	0.875	27.58
1963 / 64	0.191	0.185	0.495	0.932	1.270	2.065	1.430	1.237	0.630	0.338	0.185	0.185	0.754	23.76
1964 / 65	0.331	0.318	0.331	0.318	0.894	0.291	0.265	0.271	0.265	0.271	0.033	0.033	0.302	9.52
1965 / 66	0.343	0.336	0.343	0.336	0.935	0.305	0.274	0.280	0.274	0.280	0.037	0.037	0.315	9.94
1966 / 67	0.235	0.235	0.235	0.235	0.652	0.209	0.183	0.196	0.183	0.196	0.026	0.026	0.217	6.86
1967 / 68	0.155	0.152	0.406	0.765	1.041	1.695	1.174	1.016	0.517	0.279	0.152	0.152	0.618	19.50
1968 / 69	0.154	0.147	0.658	0.636	2.601	2.880	1.316	1.361	0.457	0.472	0.147	0.147	0.901	28.42
1969 / 70	0.125	0.121	0.327	0.611	0.835	1.359	0.942	0.816	0.414	0.220	0.121	0.121	0.496	15.63
1970 / 71	0.187	0.182	0.807	0.780	3.193	3.535	1.616	1.670	0.559	0.579	0.182	0.182	1.106	34.89
1971 / 72	0.164	0.160	0.427	0.093	1.096	1.779	1.231	1.068	0.541	0.292	0.160	0.160	0.589	18.58
1972 / 73	0.186	0.186	0.186	0.186	0.466	0.093	0.093	0.093	0.093	0.093	0.000	0.000	0.140	4.42
1973 / 74	0.191	0.186	0.496	0.933	1.271	2.067	1.431	1.238	0.630	0.338	0.186	0.186	0.754	23.78
1974 / 75	0.177	0.175	0.177	0.175	0.328	0.165	0.158	0.161	0.158	0.161	0.098	0.098	0.169	5.34
1975 / 76	0.016	0.021	0.034	0.084	0.042	0.207	0.449	0.530	0.203	0.029	0.016	0.009	0.136	4.29
1976 / 77	0.012	0.490	0.037	0.813	1.657	2.071	0.157	0.072	0.056	0.062	0.038	0.032	0.449	14.18
1977 / 78	0.019	0.051	0.088	0.225	0.954	3.593	0.063	0.222	0.107	0.023	0.006	0.004	0.424	13.38
1978 / 79	0.041	0.098	0.078	1.478	3.799	8.603	1.066	0.393	0.257	0.238	0.201	0.125	1.318	41.57
1979 / 80	0.097	0.677	0.178	0.147	0.454	0.173	1.972	0.183	0.138	0.055	0.016	0.002	0.345	10.87
1980 / 81	0.045	0.085	0.388	0.070	0.065	0.042	0.184	0.051	0.036	0.018	0.015	0.015	0.084	2.66
1981 / 82	0.017	0.020	0.019	0.158	0.398	0.349	0.093	0.711	0.029	0.020	0.017	0.015	0.152	4.79
1982 / 83	0.017	0.023	0.084	0.099	0.041	0.418	0.073	0.058	0.047	0.031	0.028	0.022	0.076	2.40
1983 / 84	0.017	0.021	0.226	0.290	0.029	0.019	0.311	0.220	0.416	0.023	0.009	0.008	0.134	4.21
1984 / 85	0.009	0.009	1.310	0.090	0.471	0.107	0.023	0.012	0.031	0.009	0.007	0.008	0.173	5.45
1985 / 86	0.024	0.007	0.370	0.075	0.261	1.321	0.101	0.171	0.009	0.004	0.001	0.001	0.187	5.89
1986 / 87	0.001	0.003	1.407	0.026	0.129	1.042	0.025	0.018	0.004	0.001	0.001	0.002	0.213	6.72
1987 / 88	0.012	0.078	0.323	0.798	0.787	1.745	0.319	0.034	0.029	0.024	0.009	0.002	0.338	10.65
1988 / 89	0.006	0.027	0.197	0.021	0.181	0.259	0.494	0.708	0.008	0.005	0.002	0.001	0.157	4.97
1989 / 90	0.002	0.010	0.755	1.380	0.628	0.034	0.102	0.026	0.016	0.008	0.002	0.001	0.249	7.86
1990 / 91	0.001	0.041	0.070	0.641	0.042	0.833	1.090	0.803	0.048	0.033	0.019	0.015	0.299	9.44
1991 / 92	0.113	0.204	0.046	0.113	0.042	0.092	0.085	0.684	0.109	0.087	0.008	0.008	0.132	4.16
1992 / 93	0.008	0.081	0.080	0.046	0.040	0.012	0.258	0.040	0.012	0.012	0.012	0.012	0.052	1.63
1993 / 94	0.016	0.021	0.034	0.084	0.042	0.207	0.449	0.530	0.203	0.029	0.016	0.009	0.136	4.29
1994 / 95	0.003	0.004	0.040	0.001	0.001	0.001	0.001	0.006	0.001	0.001	0.001	0.001	0.005	0.15
1995 / 96	0.002	0.006	0.350	0.737	4.265	1.022	2.050	0.090	0.127	0.042	0.012	0.004	0.730	23.01
1996 / 97	0.006	0.012	0.042	4.541	3.970	0.160	0.117	0.387	0.043	0.028	0.017	0.011	0.790	24.92
Mean	0.122	0.142	0.339	0.515	1.013	1.188	0.655	0.560	0.261	0.187	0.074	0.071	0.422	13.32
(%)	2.4	2.9	6.6	10.3	20.4	21.6	13.2	10.9	5.3	3.6	1.5	1.4	100.0	

Note: Monthly dischages at N' fifikh dam site were estimated based on monthly discharge data at Feddane Taba station.
The discharge data at Feddane Taba station were estimated as follows:

1) Discharge records at Feddane Taba are available from 1975/76 to 1996/97
2) Monthly discharges from 1939/40 to 1974/75 were estimated in the following procedures:
   (1) Annual average discharges were estimared based on correlation with Rainfall Index for the Atlantic coastal region presented in Master Plan - SBO (Plan Directeur -SBO)
   (2) The annual average discharge was distributed in accordance with monthly runoff patterns at Mellah dam site.
3) Monthly discharges in 1944/45, 1949/50, 1956/58 and 1974/75 were estimated based on correlation with Mellah dam records, since annual average discharges could not be estimated in procedure (2) of 2) due to small rainfall indeces for these years.

Table 7.1.2: Monthly Discharge at Taskourt

(unit: m^3/s)

Year	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Mean	Total Mm^3
1935 / 36	0.012	0.879	0.133	0.063	0.127	1.528	3.212	1.084	0.510	0.205	0.078	0.028	0.651	20.53
1936 / 37	0.008	0.090	0.854	0.887	0.252	0.108	0.036	0.014	1.175	0.177	0.068	0.022	0.310	9.78
1937 / 38	0.003	4.880	1.290	1.224	0.513	0.242	0.109	3.278	0.784	0.320	0.122	0.049	1.073	33.84
1938 / 39	0.016	0.719	0.134	6.400	2.547	4.601	1.545	1.668	0.458	0.193	0.074	0.029	1.518	47.87
1939 / 40	0.007	0.555	0.920	1.224	2.785	4.642	2.473	0.969	0.394	0.159	0.062	0.025	1.163	36.69
1940 / 41	0.195	1.799	1.117	0.430	3.442	1.996	2.005	2.637	0.662	0.272	0.100	0.039	1.220	38.48
1941 / 42	0.137	0.225	3.442	1.060	2.120	4.223	2.678	1.093	0.423	0.173	0.067	0.026	1.283	40.45
1942 / 43	0.237	1.799	7.254	4.132	1.758	0.821	3.664	4.215	3.327	0.994	0.386	0.154	2.400	75.67
1943 / 44	0.086	0.036	0.044	1.117	0.229	1.857	0.480	0.195	0.071	0.522	0.064	0.020	0.383	12.09
1944 / 45	2.703	0.359	1.569	0.728	1.758	0.565	0.203	0.081	0.031	0.008	0.002	0.000	0.664	20.92
1945 / 46	0.000	0.027	0.230	0.077	1.199	0.333	0.546	1.224	0.320	0.129	0.049	0.019	0.346	10.90
1946 / 47	0.937	0.090	1.577	1.331	3.385	4.428	2.070	0.794	1.742	0.343	0.132	0.052	1.387	43.75
1947 / 48	0.016	0.006	0.945	0.196	1.035	1.372	2.506	6.753	4.297	1.446	0.559	0.223	1.607	50.69
1948 / 49	0.092	0.061	0.025	0.787	1.257	2.613	6.145	13.967	6.178	2.604	1.002	0.398	2.916	91.97
1949 / 50	0.163	0.064	0.711	5.496	3.845	1.569	0.566	0.237	0.278	0.074	0.028	0.019	1.092	34.44
1950 / 51	0.986	2.374	0.501	2.350	2.958	2.843	2.514	0.830	0.369	0.151	0.058	0.019	1.325	41.78
1951 / 52	0.348	0.081	2.366	1.972	3.237	1.150	0.446	0.379	0.122	0.048	0.015	0.002	0.845	26.66
1952 / 53	1.996	0.484	0.228	0.377	2.506	1.947	3.927	1.356	0.520	0.213	0.078	0.025	1.134	35.75
1953 / 54	0.005	2.489	1.224	3.319	3.648	2.563	5.496	7.337	2.300	0.945	0.366	0.146	2.487	78.43
1954 / 55	0.060	0.023	2.185	2.383	2.103	3.245	2.440	2.021	0.591	0.245	0.094	0.035	1.271	40.08
1955 / 56	0.014	2.111	0.555	3.122	7.115	10.845	9.366	5.217	3.311	1.134	0.438	0.175	3.578	112.84
1956 / 57	0.069	0.022	0.059	0.053	0.484	0.144	0.158	1.364	0.776	0.207	0.080	0.028	0.287	9.04
1957 / 58	0.008	3.713	3.237	9.941	5.463	3.344	1.208	1.290	1.101	0.640	0.158	0.058	2.520	79.47
1958 / 59	0.021	0.120	0.953	0.681	0.336	1.208	2.317	0.863	1.101	0.261	0.101	0.035	0.663	20.92
1959 / 60	0.529	0.068	1.265	0.485	4.404	1.413	1.668	1.734	0.461	0.772	0.137	0.051	1.080	34.05
1960 / 61	0.021	0.467	0.382	2.843	0.759	0.334	0.334	0.130	0.072	0.026	0.010	0.000	0.453	14.27
1961 / 62	0.010	0.002	0.384	1.109	3.294	1.126	6.762	5.710	3.467	1.191	0.459	0.177	1.983	62.53
1962 / 63	0.664	2.029	4.765	3.927	6.646	12.734	5.036	3.426	4.067	1.076	0.415	0.164	3.686	116.24
1963 / 64	0.067	0.022	0.068	7.682	5.866	2.974	1.388	5.726	1.421	0.587	0.226	0.090	2.176	68.63
1964 / 65	0.033	0.012	0.150	5.118	5.488	9.037	3.886	3.631	1.093	0.449	0.173	0.064	2.389	75.33
1965 / 66	0.021	4.330	8.084	4.888	1.955	0.871	1.282	0.317	0.140	0.058	0.022	0.007	1.836	57.90
1966 / 67	0.016	0.101	5.135	1.323	0.586	3.385	2.539	2.637	0.978	0.384	0.149	0.058	1.418	44.72
1967 / 68	0.030	1.955	15.199	8.544	4.124	4.067	6.195	5.102	1.635	0.675	0.256	0.096	3.975	125.37
1968 / 69	0.036	0.010	2.802	3.664	2.391	7.369	3.360	5.841	2.120	0.863	0.326	0.128	2.369	74.70
1969 / 70	0.049	0.475	4.486	1.692	6.564	3.344	3.015	1.462	0.522	0.215	0.083	0.033	1.819	57.36
1970 / 71	0.007	1.142	0.753	6.260	7.008	4.535	6.039	8.216	5.398	1.931	0.744	0.295	3.528	111.25
1971 / 72	0.117	0.096	4.379	1.282	1.224	6.293	3.442	1.651	0.732	0.302	0.116	0.046	1.602	50.52
1972 / 73	0.205	0.170	1.668	0.994	0.375	0.335	0.904	1.060	0.249	0.100	0.039	0.014	0.508	16.02
1973 / 74	0.006	0.035	1.183	5.069	1.635	4.198	7.468	8.544	3.097	1.298	0.500	0.200	2.758	86.97
1974 / 75	0.077	0.026	0.007	0.007	0.371	0.152	0.082	4.108	1.840	0.610	0.236	0.090	0.632	19.92
1975 / 76	0.031	0.010	0.010	0.254	0.099	1.692	1.865	4.157	4.248	1.183	0.456	0.182	1.176	37.09
1976 / 77	0.429	1.208	0.197	0.994	3.270	1.594	0.633	0.258	0.097	0.039	0.015	0.006	0.727	22.91
1977 / 78	0.662	1.175	2.128	3.368	7.024	3.787	1.454	2.415	0.687	0.288	0.111	0.039	1.919	60.52
1978 / 79	0.012	0.376	0.056	1.865	5.455	3.410	1.199	0.494	0.187	0.073	0.028	0.012	1.089	34.33
1979 / 80	0.000	3.623	0.738	0.283	0.383	3.188	5.800	2.621	0.994	0.409	0.158	0.061	1.514	47.75
1980 / 81	0.026	0.012	2.473	0.493	0.252	0.838	0.629	0.196	0.073	0.029	0.011	0.004	0.413	13.04
1981 / 82	0.000	0.092	0.025	0.037	3.787	1.684	1.068	5.077	4.420	1.290	0.495	0.196	1.512	47.68
1982 / 83	0.080	0.029	1.002	0.349	0.139	1.495	0.394	0.176	0.080	0.032	0.012	0.003	0.306	9.65
1983 / 84	0.002	0.000	2.415	0.532	0.210	0.093	1.446	0.778	0.331	0.136	0.053	0.021	0.501	15.80
1984 / 85	0.006	0.000	0.065	0.015	1.399	1.603	1.316	2.120	2.071	0.516	0.043	0.019	0.759	23.92
1985 / 86	0.018	0.024	0.021	0.036	0.165	0.132	1.263	2.045	1.931	0.244	0.017	0.016	0.495	15.60
1986 / 87	0.015	0.156	0.035	0.012	0.411	0.884	0.255	0.191	0.127	0.397	0.009	0.008	0.203	6.41
1987 / 88	0.016	1.814	2.652	5.411	1.342	4.951	6.441	3.323	2.158	0.960	0.123	0.020	2.421	76.36
1988 / 89	0.015	0.904	12.054	3.250	1.899	1.812	2.278	3.788	2.324	0.808	0.309	0.186	2.456	77.44
1989 / 90	0.052	3.045	2.389	1.232	1.032	0.443	2.567	1.746	1.902	0.612	0.418	0.077	1.301	41.02
1990 / 91	0.017	0.018	0.124	0.144	0.055	0.412	1.298	0.901	0.527	0.091	0.059	0.913	0.381	12.00
1991 / 92	0.157	0.139	0.110	3.566	0.676	1.394	1.647	3.305	2.339	0.574	0.198	0.122	1.186	37.39
1992 / 93	0.196	0.276	0.286	0.875	0.547	1.261	0.790	1.494	0.573	0.287	0.015	0.007	0.545	17.17
1993 / 94	0.009	0.204	0.878	0.729	1.008	1.122	4.927	4.922	1.457	0.348	0.020	0.017	1.302	41.07
1994 / 95	0.019	0.297	0.108	0.040	0.011	0.015	0.039	1.470	0.696	0.193	0.029	0.164	0.257	8.09
1995 / 96	0.063	0.167	0.268	1.237	2.368	2.316	4.166	5.424	2.522	2.153	0.337	0.193	1.761	55.54
1996 / 97	0.086	0.069	0.520	0.627	1.112	1.309	1.127	4.468	3.585	0.822	0.857	0.172	1.226	38.66
Mean	0.192	0.768	1.787	2.090	2.249	2.513	2.453	2.734	1.475	0.540	0.191	0.090	1.416	44.65
(%)	1.1	4.6	10.4	12.5	13.5	13.6	14.7	15.9	8.8	3.1	1.1	0.5	100.0	

Note: 1) From Sep.1935 to Oct.1984: Estimated based on Plan Directeur and basin area ratio
2) From Nov.1984 to Jul.1997: Estimated based on actual records at Sidi Bouathmane by basin area ratio.
3) Aug.1997: Estimated based on average runoff pattern (1985-95) at Sidi Bouthamane.

Table 7.1.3: Monthly Discharge at Timkit

(unit: m^3/s)

Year	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Mean	Total Mm^3
1961 / 62	0.087	0.058	0.767	0.059	0.050	0.050	0.050	0.127	0.204	0.050	0.050	0.050	0.133	4.19
1962 / 63	0.795	0.528	0.159	0.102	0.079	0.066	0.066	0.114	3.829	0.517	0.050	0.050	0.535	16.87
1963 / 64	0.282	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.063	0.050	0.050	0.070	2.21
1964 / 65	1.187	0.050	0.050	0.050	0.050	2.035	0.180	0.278	0.103	0.203	0.151	0.372	0.378	11.94
1965 / 66	0.607	4.641	17.575	4.932	1.095	0.700	0.970	0.956	0.772	0.706	0.411	0.304	2.799	88.28
1966 / 67	0.498	0.325	0.378	0.293	0.262	0.344	0.345	0.260	0.308	0.061	0.051	0.051	0.264	8.32
1967 / 68	0.159	0.498	2.932	0.495	0.422	0.454	0.443	0.643	0.333	0.305	0.261	0.223	0.594	18.73
1968 / 69	0.251	0.254	0.221	0.264	0.199	0.200	0.124	0.103	0.090	0.094	0.146	1.392	0.280	8.83
1969 / 70	0.365	0.113	0.223	0.059	0.075	0.064	0.063	0.066	0.248	0.170	0.065	0.069	0.132	4.15
1970 / 71	0.088	0.069	0.162	0.064	0.063	0.063	0.063	0.397	0.055	0.052	0.052	0.052	0.098	3.09
1971 / 72	0.071	0.234	0.086	0.050	0.050	0.050	0.050	0.832	0.068	0.071	0.067	0.067	0.141	4.44
1972 / 73	0.067	0.070	2.305	0.193	0.165	0.161	0.138	0.147	0.110	0.191	0.172	0.110	0.316	9.98
1973 / 74	0.110	0.110	0.290	0.136	0.094	0.073	0.068	0.130	0.085	0.089	0.094	0.076	0.113	3.56
1974 / 75	0.319	0.069	0.054	0.052	0.051	0.051	0.051	0.822	0.756	0.095	0.059	0.070	0.204	6.43
1975 / 76	0.073	0.076	0.090	0.137	0.111	0.072	0.065	0.101	0.500	0.262	0.206	0.081	0.149	4.69
1976 / 77	0.654	0.241	0.180	0.208	0.304	0.106	0.069	0.073	0.072	0.070	0.059	0.055	0.174	5.49
1977 / 78	0.167	0.095	0.059	0.364	0.066	0.051	0.051	0.051	0.052	0.052	0.052	0.051	0.093	2.93
1978 / 79	0.050	0.111	0.050	0.050	0.253	0.050	0.050	0.050	0.214	0.052	0.050	0.050	0.086	2.73
1979 / 80	0.346	1.878	0.051	0.050	0.094	0.380	1.025	0.632	0.251	0.163	0.172	0.132	0.433	13.65
1980 / 81	0.198	0.230	0.166	0.214	0.138	0.176	0.085	0.073	0.105	0.102	0.102	0.093	0.140	4.42
1981 / 82	0.059	0.059	0.093	0.092	0.086	0.050	0.050	0.082	0.343	0.196	0.050	0.050	0.101	3.18
1982 / 83	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.051	0.159	0.050	0.050	0.106	0.064	2.02
1983 / 84	0.089	0.091	0.052	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.057	1.79
1984 / 85	0.050	0.050	0.148	0.050	0.050	0.050	0.050	0.052	0.203	0.050	0.050	0.050	0.071	2.25
1985 / 86	0.381	0.408	1.558	0.744	0.050	0.050	0.050	0.050	0.050	0.478	0.050	0.329	0.349	11.02
1986 / 87	0.639	1.899	0.050	0.050	0.050	0.050	0.284	0.050	0.278	0.050	0.050	0.050	0.295	9.30
1987 / 88	0.249	0.577	0.524	0.615	0.050	0.050	0.050	0.050	0.124	0.050	0.050	0.050	0.204	6.45
1988 / 89	0.051	1.654	0.406	0.050	0.050	0.879	0.668	0.086	0.055	1.020	0.277	0.837	0.501	15.80
1989 / 90	0.405	0.540	3.503	4.577	1.519	1.188	0.772	0.608	2.687	0.582	0.534	0.584	1.462	46.12
1990 / 91	1.221	0.354	0.234	0.426	0.530	0.554	0.250	0.202	0.267	2.662	0.721	0.761	0.679	21.40
1991 / 92	0.515	0.222	0.121	0.384	0.149	0.162	0.125	0.066	0.064	0.176	0.053	0.050	0.174	5.47
1992 / 93	0.660	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.100	3.16
1993 / 94	0.096	0.138	6.335	0.157	0.428	0.480	0.479	0.562	0.550	0.464	0.410	0.183	0.849	26.77
1994 / 95	0.183	1.093	0.257	0.176	0.138	0.157	0.262	2.017	0.178	0.215	0.131	0.127	0.410	12.94
1995 / 96	0.124	5.633	0.745	0.138	0.130	0.337	0.520	0.204	0.195	0.188	0.181	0.174	0.722	22.75
1996 / 97	0.167	0.161	0.155	0.150	0.145	0.140	0.134	0.126	0.119	0.112	0.106	0.518	0.170	5.36
Mean	0.314	0.630	1.115	0.433	0.200	0.264	0.218	0.284	0.377	0.271	0.143	0.205	0.371	11.71
(%)	7.0	14.4	24.7	9.9	4.6	5.5	5.0	6.3	8.6	6.0	3.3	4.7	100.0	

Note: 1) Inflows to Timkit dam were estimated based on flow records at Tadighoust station by basin area ratio.
2) The above inflows include subsrface flow assumed uniformly at 0.050 thorout a year.

Table 7.1.4: Monthly Discharge at Azghar

(unit: m^3/s)

Year	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Mean	Total Mm^3
1955 / 56	0.120	0.358	0.464	2.814	1.731	5.983	9.470	11.662	7.066	3.303	1.679	0.913	3.778	119.14
1956 / 57	0.543	0.728	0.596	0.767	1.481	0.728	2.207	4.016	3.593	1.084	0.437	0.371	1.383	43.60
1957 / 58	0.054	0.675	1.996	2.431	4.887	4.927	2.497	2.999	2.194	1.084	0.332	0.054	1.992	62.83
1958 / 59	0.002	0.002	0.266	3.276	3.171	2.128	4.108	2.458	2.048	1.256	0.503	0.134	1.615	50.93
1959 / 60	0.054	0.107	0.239	6.710	10.539	6.683	6.683	4.214	2.445	3.065	1.137	0.543	3.527	111.23
1960 / 61	0.279	0.477	0.728	4.676	5.508	5.363	3.646	3.739	1.533	1.150	0.385	0.068	2.280	71.89
1961 / 62	0.041	0.147	1.164	0.873	0.715	0.583	5.653	4.755	1.863	1.164	0.385	0.094	1.457	45.94
1962 / 63	0.000	0.279	2.643	2.141	7.211	10.618	5.468	3.197	8.572	5.231	1.771	1.282	3.994	125.96
1963 / 64	0.900	0.767	0.662	3.937	1.784	1.692	2.841	6.868	2.088	1.230	0.701	0.490	1.995	62.90
1964 / 65	0.517	0.358	0.913	0.966	4.082	4.346	5.891	5.812	2.471	1.626	1.111	0.688	2.384	75.19
1965 / 66	0.754	0.741	0.649	0.490	0.662	0.517	0.649	0.754	0.437	0.094	0.000	0.000	0.478	15.06
1966 / 67	0.028	3.831	1.124	0.371	0.015	0.147	0.371	1.071	0.992	0.596	0.000	0.000	0.717	22.61
1967 / 68	0.000	0.239	0.398	0.952	1.441	3.844	8.479	6.129	4.544	1.996	0.913	0.503	2.445	77.11
1968 / 69	0.252	0.107	1.467	3.831	5.561	8.268	6.525	5.706	3.646	2.629	1.322	0.649	3.299	104.03
1969 / 70	0.517	0.583	1.190	2.167	10.209	3.290	3.290	3.210	1.652	1.005	0.411	0.213	2.312	72.92
1970 / 71	0.213	0.173	0.094	0.186	2.471	2.893	4.069	8.109	7.951	4.346	1.943	1.124	2.793	88.07
1971 / 72	0.794	0.662	1.599	1.547	2.682	5.218	8.875	6.591	4.808	2.722	1.375	0.728	3.118	98.34
1972 / 73	0.767	1.309	0.807	0.860	1.520	3.580	5.746	5.534	2.907	1.441	0.662	0.490	2.123	66.96
1973 / 74	0.120	0.186	0.186	0.371	0.543	1.137	3.739	6.406	5.085	2.180	1.111	0.503	1.798	56.71
1974 / 75	0.385	0.437	0.252	0.081	0.028	1.111	3.092	6.142	4.306	2.326	0.926	0.503	1.630	51.39
1975 / 76	0.239	0.173	0.200	0.385	0.266	2.048	2.775	5.191	7.832	2.577	1.362	0.569	1.966	62.01
1976 / 77	0.464	0.913	1.124	2.709	6.393	7.476	4.650	3.514	1.771	1.071	0.490	0.173	2.533	79.88
1977 / 78	0.292	0.530	0.345	1.018	1.190	3.739	2.973	3.739	2.497	1.269	0.530	0.279	1.517	47.83
1978 / 79	0.015	0.002	0.000	0.200	0.754	5.600	5.772	3.752	1.903	1.045	0.451	0.094	1.604	50.59
1979 / 80	1.560	1.877	2.788	1.626	1.243	1.335	3.039	2.009	2.312	0.662	0.134	0.000	1.548	48.82
1980 / 81	0.000	0.266	0.860	0.451	0.609	1.045	1.481	2.563	1.877	0.715	0.200	0.002	0.835	26.33
1981 / 82	0.000	0.266	0.000	0.000	0.292	0.952	1.599	3.224	2.352	0.926	0.226	0.000	0.816	25.74
1982 / 83	0.000	1.863	0.952	1.481	1.269	1.296	1.494	1.230	0.437	0.015	0.000	0.000	0.836	26.36
1983 / 84	0.000	0.000	0.292	0.490	0.279	0.000	0.622	1.401	1.969	0.913	0.000	0.027	0.502	15.83
1984 / 85	0.030	0.033	0.892	0.385	1.231	0.586	0.728	0.377	1.654	0.223	0.054	0.025	0.519	16.37
1985 / 86	0.024	0.056	0.225	0.301	2.099	7.610	6.828	2.959	0.504	1.440	0.073	0.034	1.806	56.97
1986 / 87	0.070	0.213	0.460	0.147	1.477	8.271	1.199	0.313	0.147	0.105	0.157	0.065	1.002	31.58
1987 / 88	1.234	1.482	1.265	0.383	2.427	2.144	3.745	0.476	0.868	0.163	0.050	0.032	1.186	37.39
1988 / 89	0.028	0.032	0.165	0.128	0.044	0.479	1.315	4.845	0.573	0.291	0.050	0.100	0.665	20.98
1989 / 90	0.588	1.141	1.115	4.407	3.379	0.463	0.186	1.550	0.339	0.038	0.274	0.089	1.140	35.94
1990 / 91	0.400	0.044	0.556	2.390	0.280	2.343	10.318	3.355	0.718	0.253	0.207	0.131	1.751	55.23
1991 / 92	0.555	0.256	0.210	0.167	0.198	0.278	0.902	3.400	0.452	1.191	0.212	0.163	0.661	20.85
1992 / 93	0.069	0.162	0.136	0.523	0.140	0.175	1.365	1.187	1.604	0.099	0.029	0.018	0.462	14.58
1993 / 94	0.012	0.099	2.199	0.404	1.603	5.365	1.880	0.428	0.201	0.053	0.015	0.008	0.990	31.23
1994 / 95	0.171	0.119	0.217	0.047	0.047	0.042	1.600	0.855	0.178	0.101	0.025	0.026	0.287	9.06
1995 / 96	0.045	0.063	0.100	1.704	10.861	5.608	6.249	5.197	2.761	0.863	0.220	0.045	2.800	88.32
1996 / 97	1.051	0.726	0.228	7.695	10.455	1.825	0.797	1.967	0.738	0.217	0.064	0.034	2.166	68.32
1997 / 98	0.769	1.370	2.194	2.728	1.609	3.030	0.557	0.518	0.530	0.225	0.162	0.222	1.147	36.17
1998 / 99	0.242	0.231	0.226	0.258	1.240	0.754	0.993	0.189	0.257	0.120	0.036	0.023	0.380	11.97
Average	0.323	0.547	0.777	1.579	2.628	3.080	3.554	3.491	2.379	1.230	0.503	0.262	1.687	53.21
(%)	1.6	2.8	3.8	7.9	13.2	14.0	17.9	17.0	12.0	6.0	2.5	1.3	100.0	

Note: 1) Sep.1955-Aug.1984: Estimated based on correlation between Ain Timedrine and Dar Harma stations and basin area ratio.
2) Sep.1984-Apr.1999: Estimated from Dar Hamra records by basin area ratio.
3) May-Aug.1999: Estimated based on average runoff pattern at Dar Hamra from 1984/85 to 1997/98.

Table 7.1.5: Probable Flood Discharges

Desctiptions		Return period (year)						
		2	10	20	50	100	1000	10000
No.5 N' FIFIKH								
Basin area (km^2)	: 323							
Time of consentration (hr)	: 7.5							
Base length of hydrograph (hr)	: 18							
Probable discharge (m^3/s)		45.8	140	250	380	490	820	1800
Specific discharge ($m^3/s/km^2$)		0.14	0.43	0.77	1.18	1.52	2.54	5.57
Ratio to Q10yr		0.33	1.00	1.79	2.71	3.50	5.86	12.86
Runoff volume (Mm^3)		1.48	4.54	8.10	12.31	15.88	26.57	58.32
No.9 TASKOURT								
Basin area (km^2)	: 419							
Time of consentration (hr)	: 5							
Base length of hydrograph (hr)	: 15							
Probable discharge (m^3/s)		89.2	400	600	800	900	1700	2300
Specific discharge ($m^3/s/km^2$)		0.21	0.95	1.43	1.91	2.15	4.06	5.49
Ratio to Q10yr		0.22	1.00	1.50	2.00	2.25	4.25	5.75
Runoff volume (Mm^3)		2.41	10.80	16.20	21.60	24.30	45.90	62.10
No.10 TIMKIT								
Basin area (km^2)	: 572							
Time of consentration (hr)	: 3							
Base length of hydrograph (hr)	: 9							
Probable discharge (m^3/s)		84.0	300	500	750	1000	2000	2800
Specific discharge ($m^3/s/km^2$)		0.15	0.52	0.87	1.31	1.75	3.50	4.90
Ratio to Q10yr		0.28	1.00	1.67	2.50	3.33	6.67	9.33
Runoff volume (Mm^3)		1.36	4.86	8.10	12.15	16.20	32.40	45.36
No.17 AZGHAR								
Basin area (km^2)	: 263							
Time of consentration (hr)	: 5							
Base length of hydrograph (hr)	: 15							
Probable discharge (m^3/s)		88.5	200	250	300	400	500	700
Specific discharge ($m^3/s/km^2$)		0.34	0.76	0.95	1.14	1.52	1.90	2.66
Ratio to Q10yr		0.44	1.00	1.25	1.50	2.00	2.50	3.50
Runoff volume (Mm^3)		2.39	5.40	6.75	8.10	10.80	13.50	18.90

Table 7.1.6: Design Values of Reservoir Sedimentation Volume

River system	Candidate dam	BA (km^2)	Ds ($m^3/km^2/yr$)	Vs (Mm^3/yr)
1. MOROCCO NORTH BASINS				
Neckor R.	No.01: Neckor	710	3,333	3.800
2. SEBOU R. BASIN				
Sebou R.				
- Ouerrha R.				
- Aoudour R.	No.06: Tazarane	30	(3,800)	0.114
- Aoulai R.	No.19: Aoulai	490	863	0.430
- Amezetz R.	No.21: Sidi El Mokhf	378	(101)	0.038
- Mengou R.	No.02: Tizimella	170	(2,876)	0.489
- Lebene R.	No.20: Sidi Abbou	363	(2,755)	1.000
- Zloul R.	**No.17: Azghar**	**263**	**(490)**	**0.130**
- Beht R.(Tigriga R.)	No.14: Adarouch	630	(317)	0.200
3. BOUREGREG R. AND CASABLANCA COASTAL BASINS				
Bou Regreg R.(Tabahart R	No.15: Sidi Omar	350	649	0.230
Iqem R.(Khellata R.)	No.04: Ain Kwachiya	162	(105)	0.017
Nefifikh R.	No.05: Lower N' fifikh	606	(100)	0.061
	No.05: Upper N'fifikh	**323**	**(93)**	**0.030**
Mellah R.(Zamrine R.)	No.18: Boukarkour	1,120	(100)	0.112
4. OUM ER RBIA R. BASIN				
Oum Er Rbia R.				
- El Abid R.	No.22: N' ouamt	204	(392)	0.080
- Tessaout R.(Lakhdar R.)	No.03: Ait Baddou	194	1,200	0.250
5. TENSIFT R. AND ESSAOUIRA COASTAL BASINS				
Tensift R.				
- N' fiss R	No.07: Amezmiz	80	280	0.025
- Assif el Ma R.	**No.09: Taskourt**	**419**	**280**	**0.120**
- El Rhira R.	No.08: Boulaouane	565	(283)	0.160
6. SOUSS, MASSA R. BASINS				
Souss R.				
- Issen R.	No.24: Amont Abdel.	938	(161)	0.151
- L' ouaar R.	No.25: Sidi Abdellah	233	430	0.103
- Aguerd R.	No.23: Igui N' ouaq	161	460	0.075
7. GUIR, ZIZ, RHERIS AND DRAA R. BASINS				
Guir R.	No.12: Tiouzaguine	258	(543)	0.140
- Bouanane R.	No.13: Kheng Grou	4,900	333	1.500
Rheris R.	No.11: Tadighoust	2,239	(335)	0.750
- Ferklo R.	**No.10: Timkit**	**572**	**(350)**	**0.200**
Draa R.	No.16: Tiouine	1,540	700	1.000

(Notes)
BA: Basin area,
Ds: Specific annual reservoir sedimentation. Ds in ( ) were calculated from Vs avd BA
Vs: Annual reservoir sedimentation

Table 7.2.1: Administrative Situation of Beneficial Areas

Project Site	Province	Cercle	Caidat	CR/CU	Douar
N' fifikh	Ben Slimane	Ben Slimane	Fdalate	Od Yahia Louta	Bni Karzaz
					Biad
			Ziaida	Mouline Ghaba	Od Tarfaya
				Tlat Ziaida	Mssaada
		Bouznika	Bni Yakhlef	Mansouria	Bni Rached
					Bni Makraz
Taskourt	Chichaoua	Mejjat	Sidi Bou Othmane	Assif El Mal	
			Mejjat	Mejjat	127 douars
				Guemmassa	
			Mzouda	Mzouda	
Timkit	Errachidia	Goulmima		Aghbalou Akerdas	Timkit
					Izoukalen
					Irbiben
					Taghya
				High Farkla	Ait Hamou
					Ait Bzem
					Ait Boutekhsiam
					Tamardout
					Ait Erah
					Ait Aissa
					Ait Bouhadou
					Sidi Yahya (Kmach)
					Ait Assem
					Numero
					Ait Bennacer
					Set
					El Kherbates
					Amllal
					Azyghmouchen
					Bour
					Taghya
					Ait Derouich
					Imelouane
					Ait Said
					Ihendar
					Toughach
					Ait M' hammed
				Low Farkla	Zaouia
					Ait Maamar Lkdim
					Tallalt
					Tayrza
					Tighfart
					Ktaa Elouad
					Ait Ba Omar
					Jdida
					Ksiba
					Dar Amira
					Ait Ourgham
					Kettarat Laytama
					Isilf (Ksar)
					Ait My mamoun
					Ait Ba Maati
					Zizzogharine
		Municipalite			Gardmite
		Tinejdad			Ait Maamar Jdide
					Tighdouine
					Tinjdad Centre
Azghar	Sefrou	Ribat Al Khair	Ribat Al Khair	Ighzrane	Bni Lchaa
					Taghza
					Nass Daoud
					Nass Said
					Tichou Tamallalt
				Od M' koudou	Mghila
		Municipalite	Ribat Al Khair		Zitouna

Note: Since the command areas of the Projects have not been exactly fixed yet, the above mentioned administrative units to be integrated into the benefical areas are provisional

Table 7.2.2: Summary of Interview Survey on Socioeconomic Condition of Beneficiary Areas (1/4)

	Item	N'fifikh		Taskourt		Timkit		Azghar		Total	
		nos.	distr.	nos.	distr.	nos.	distr.	nos.	distr.	nos.	distr.
0	Total Number of Respondents	63		75		77		44		259	
1	Family Structure										
1-1	Number of households live in a house										
	One household	41	65%	62	84%	34	44%	23	52%	160	62%
	More than one household	22	35%	12	16%	43	56%	21	48%	98	38%
1-2	Family size per house										
	1 persons	1	2%	0	0%	0	0%	0	0%	1	0%
	2 persons	1	2%	1	1%	1	1%	4	9%	7	3%
	3 persons	2	3%	4	5%	0	0%	2	5%	8	3%
	4 persons	1	2%	4	5%	0	0%	5	11%	10	4%
	5 persons	9	14%	6	8%	6	8%	1	2%	22	9%
	6 persons	5	8%	10	14%	6	8%	10	23%	31	12%
	7 persons	9	14%	13	18%	6	8%	4	9%	32	12%
	8 persons	16	25%	12	16%	7	9%	4	9%	39	15%
	9 persons	6	10%	4	5%	6	8%	3	7%	19	7%
	10 persons	1	2%	10	14%	8	10%	1	2%	20	8%
	More than 10 persons	12	19%	10	14%	37	48%	10	23%	69	27%
	Average family size	8.4 pers.		7.6 pers.		11.4 pers.		7.4 pers.			
1-3	Average composition of men and women										
	Men	4.3	52%	4.2	55%	5.6	49%	3.8	52%	17.9	52%
	Women	4.0	48%	3.4	45%	5.8	51%	3.5	48%	16.7	48%
2	Economic Activities										
2-1	Major economic activities										
	Agriculture only	33	52%	28	37%	15	19%	19	43%	95	37%
	Agriculture + Employee	4	6%	5	7%	9	12%	11	25%	29	11%
	Agriculture + Commerce	7	11%	5	7%	5	6%	0	0%	17	7%
	Agriculture + Small business	0	0%	4	5%	0	0%	0	0%	4	2%
	Agriculture + Labor	0	0%	31	41%	36	47%	0	0%	67	26%
	Agriculture + Other (incl. more than two kind of work)	19	30%	2	3%	9	12%	14	32%	44	17%
	Non agricultural work only	0	0%	0	0%	3	4%	0	0%	3	1%
2-2	Annual family income (excluding remittance from migrant workers)										
	10,000 DH or less	12	19%	18	24%	49	64%	15	34%	94	36%
	10,001 - 20,000 DH	21	33%	26	35%	15	19%	17	39%	79	31%
	20,001 - 40,000 DH	17	27%	22	29%	8	10%	10	23%	57	22%
	40,001 - 60,000 DH	5	8%	8	11%	3	4%	1	2%	17	7%
	60,001 - 80,000 DH	2	3%	1	1%	2	3%	1	2%	6	2%
	80,001 - 100,000 DH	3	5%	0	0%	0	0%	0	0%	3	1%
	More than 100,000 DH	3	5%	0	0%	0	0%	0	0%	3	1%
	Average income	32,800 DH		20,800 DH		12,600 DH		16,500 DH			
2-3	Annual family income (including remittance from migrant workers)										
	10,000 DH or less	1	2%	7	9%	14	18%	3	7%	25	10%
	10,001 - 20,000 DH	19	30%	24	32%	28	36%	21	48%	92	36%
	20,001 - 40,000 DH	23	37%	29	39%	20	26%	17	39%	89	34%
	40,001 - 60,000 DH	6	10%	13	17%	4	5%	1	2%	24	9%
	60,001 - 80,000 DH	6	10%	2	3%	5	6%	1	2%	14	5%
	80,001 - 100,000 DH	2	3%	0	0%	3	4%	1	2%	6	2%
	More than 100,000 DH	6	10%	0	0%	3	4%	0	0%	9	3%
	Average income	47,900 DH		27,000 DH		32,400 DH		23,700 DH			

Table 7.2.2: Summary of Interview Survey on Socioeconomic Condition of Beneficiary Areas (2/4)

Item	N'fifikh		Taskourt		Timkit		Azghar		Total	
	nos.	distr.	nos.	distr.	nos.	distr.	nos.	distr.	nos.	distr.
2-4 Number of migrant workers										
None	23	37%	27	36%	22	29%	7	16%	79	31%
One person	22	35%	33	44%	36	47%	12	27%	103	40%
Two persons	13	21%	10	13%	13	17%	20	45%	56	22%
Three persons or more	5	8%	5	7%	6	8%	5	11%	21	8%
2-5 Annual family expenditure										
10,000 DH or less	0	0%	17	23%	34	44%	10	23%	61	24%
10,001 - 20,000 DH	57	90%	38	51%	26	34%	19	43%	140	54%
20,001 - 40,000 DH	6	10%	18	24%	12	16%	14	32%	50	19%
More than 40,000 DH	0	0%	2	3%	5	6%	1	2%	8	3%
Average expenditure	15600 DH		17100 DH		16100 DH		16300 DH			
3 Agriculture										
3-1 Size of farmlands										
1.0 ha or less	11	17%	4	5%	43	56%	3	7%	61	24%
1.1 ha - 2.0 ha	11	17%	10	13%	12	16%	12	27%	45	17%
2.1 ha - 4.0 ha	10	16%	16	21%	6	8%	14	32%	46	18%
4.1 ha - 6.0 ha	5	8%	13	17%	10	13%	4	9%	32	12%
6.1 ha - 10 ha	12	19%	15	20%	1	1%	4	9%	32	12%
10.1 ha - 20 ha	8	13%	12	16%	4	5%	7	16%	31	12%
More than 20 ha	6	10%	5	7%	1	1%	0	0%	12	5%
Average size	4.7 ha		7.6 ha		2.6 ha		4.7 ha			
3-2 Condition of farmlands										
Not irrigated (ha)	403	86%	173	30%	97	49%	187	86%	860	59%
Irrigated (ha)	65	14%	399	70%	100	51%	31	14%	595	41%
3-3 Ownership status of farmlands										
Private ownership only	48	76%	30	40%	63	82%	39	89%	180	69%
Tenant only	0	0%	0	0%	0	0%	0	0%	0	0%
Collective ownership only	2	3%	0	0%	0	0%	0	0%	2	1%
Association only	0	0%	1	1%	0	0%	0	0%	1	0%
Private ownership + tenant	8	13%	4	5%	0	0%	3	7%	15	6%
Private + collective ownership	5	8%	16	21%	12	16%	2	5%	35	14%
Private + association ownership	0	0%	8	11%	2	3%	0	0%	10	4%
Other	0	0%	16	21%	0	0%	0	0%	16	6%
3-4 Agricultural land use (ha)										
Hard wheat	121	25%	54	9%	70	34%	73	32%	318	21%
Soft wheat	138	29%	142	23%	10	5%	4	2%	294	19%
Barley	50	10%	304	50%	40	20%	77	33%	471	31%
Maize	11	2%	22	4%	20	10%	0	0%	53	3%
Bersim	0	0%	29	5%	0	0%	0	0%	29	2%
Bean	34	7%	0	0%	3	1%	5	2%	42	3%
Lentille	0	0%	0	0%	0	0%	3	1%	3	0%
PC	33	7%	0	0%	0	0%	0	0%	33	2%
Alfalfa	10	2%	0	0%	15	7%	0	0%	25	2%
Vegetable	23	5%	37	6%	9	4%	0	0%	69	5%
Other	0	0%	25	4%	3	1%	0	0%	28	2%
Fallow	63	13%	0	0%	33	16%	69	30%	165	11%
3-5 Livestock farming										
Number of livestock (head)										
Cattle										
0	16	25%	15	20%	48	63%	37	84%	116	45%
1 - 5	35	56%	51	68%	26	34%	7	16%	119	46%
6 - 10	9	14%	8	11%	2	3%	0	0%	19	7%

Table 7.2.2: Summary of Interview Survey on Socioeconomic Condition of Beneficiary Areas (3/4)

Item	N'fifikh		Taskourt		Timkit		Azghar		Total	
	nos.	distr.	nos.	distr.	nos.	distr.	nos.	distr.	nos.	distr.
more than 10	3	5%	1	1%	0	0%	0	0%	4	2%
Average	3.3 head		2.9 head		1.1 head		0.4 head			
Sheep										
0	31	49%	25	33%	14	19%	22	51%	92	36%
1 - 10	17	27%	12	16%	56	75%	12	28%	97	38%
11 - 20	5	8%	18	24%	5	7%	2	5%	30	12%
21 - 30	4	6%	13	17%	0	0%	4	9%	21	8%
more than 30	6	10%	7	9%	0	0%	3	7%	16	6%
Average	9.9 head		14.2 head		4.8 head		7.6 head			
Horse and donkey										
0	24	38%	34	45%	57	74%	36	82%	151	58%
1 - 5	39	62%	41	55%	20	26%	8	18%	108	42%
more than 5	0	0%	0	0%	0	0%	0	0%	0	0%
Average	0.8 head		0.9 head		0.3 head		0.3 head			
Goat										
0	63	100%	69	92%	65	84%	33	75%	230	89%
1 - 5	0	0%	5	7%	4	5%	5	11%	14	5%
more than 5	0	0%	1	1%	8	10%	6	14%	15	6%
Average	0 head		0.3 head		2.3 head		7.7 head			
4 Flood and Erosion Damage										
Reference year:	Year 1996		Year 1999		Year 1979		Nearly no flood			
4-1 Inundation depth (Houses)										
No inundation	59	94%	75	100%	55	71%	43	98%	232	90%
Less than 50 cm	1	2%	0	0%	7	9%	0	0%	8	3%
50 – 99 cm	1	2%	0	0%	7	9%	1	2%	9	3%
100 – 199 cm	1	2%	0	0%	4	5%	0	0%	5	2%
200 – 299 cm	0	0%	0	0%	4	5%	0	0%	4	2%
300 cm or more	1	2%	0	0%	0	0%	0	0%	1	0%
4-2 Inundation depth (Farmlands)										
No inundation	37	59%	57	76%	21	27%	41	93%	156	60%
Less than 50 cm	17	27%	0	0%	16	21%	1	2%	34	13%
50 – 99 cm	7	11%	0	0%	11	14%	2	5%	20	8%
100 cm or more	2	3%	18	24%	29	38%	0	0%	49	19%
4-3 Area of inundation (Farmlands)										
No inundation	37	60%	56	75%	45	58%	41	93%	179	69%
0.2 ha or less	4	6%	4	5%	22	29%	0	0%	30	12%
0.21 - 0.4 ha	3	5%	3	4%	1	1%	0	0%	7	3%
0.41 - 0.6 ha	6	10%	2	3%	3	4%	1	2%	12	5%
0.61 - 0.8 ha	3	5%	1	1%	1	1%	0	0%	5	2%
0.81 - 1 ha	7	11%	5	7%	3	4%	0	0%	15	6%
more 1 ha	2	3%	4	5%	2	3%	2	5%	10	4%
4-4 Agricultural damage by inundation (Nos. of farmers)										
Hard wheat	5	20%	2	6%	15	25%	2	67%	24	20%
Soft wheat	5	20%	0	0%	0	0%	0	0%	5	4%
Barley	0	0%	11	34%	11	18%	1	33%	23	19%
Maize	0	0%	3	9%	3	5%	0	0%	6	5%
Bean	7	28%	0	0%	1	2%	0	0%	8	7%
Bersim	0	0%	1	3%	0	0%	0	0%	1	1%
PC	4	16%	0	0%	0	0%	0	0%	4	3%
Alfalfa	0	0%	5	16%	11	18%	0	0%	16	13%
CM(Vegetable)	4	16%	2	6%	3	5%	0	0%	9	7%
Olive	0	0%	7	22%	0	0%	0	0%	7	6%

Table 7.2.2: Summary of Interview Survey on Socioeconomic Condition of Beneficiary Areas (4/4)

Item	N'fifikh		Taskourt		Timkit		Azghar		Total	
	nos.	distr.	nos.	distr.	nos.	distr.	nos.	distr.	nos.	distr.
Orange	0	0%	1	3%	0	0%	0	0%	1	1%
Dates	0	0%	0	0%	13	21%	0	0%	13	11%
Other	0	0%	0	0%	4	7%	0	0%	4	3%
Fallow field	0	0%	0	0%	0	0%	0	0%	0	0%
4-5 Erosion of farmlands										
No erosion	47	75%	58	77%	50	65%	40	91%	195	75%
1,000 m2 or less	6	10%	8	11%	26	34%	0	0%	40	15%
1,001 – 2,000 m2	8	13%	3	4%	0	0%	0	0%	11	4%
2,001 - 3,000 m2	2	3%	0	0%	0	0%	0	0%	2	1%
3,001 m2 or more	0	0%	6	8%	1	1%	4	9%	11	4%
4-6 Agricultural damage by erosion (Nos. of farmers)										
Hard wheat	3	19%	2	6%	4	10%	2	50%	11	12%
Soft wheat	1	6%	0	0%	0	0%	0	0%	1	1%
Barley	0	0%	11	34%	2	5%	2	50%	15	16%
Maize	0	0%	3	9%	3	8%	0	0%	6	7%
Bean	0	0%	0	0%	0	0%	0	0%	0	0%
Bersim	0	0%	1	3%	0	0%	0	0%	1	1%
PC	2	13%	0	0%	0	0%	0	0%	2	2%
Alfalfa	2	13%	5	16%	5	13%	0	0%	12	13%
CM (Vegetable)	2	13%	2	6%	1	3%	0	0%	5	5%
Olive	0	0%	7	22%	3	8%	0	0%	10	11%
Almond	0	0%	0	0%	4	10%	0	0%	4	4%
Orange	0	0%	1	3%	0	0%	0	0%	1	1%
Dates	0	0%	0	0%	13	33%	0	0%	13	14%
Other	0	0%	0	0%	4	10%	0	0%	4	4%
Fallow field	6	38%	0	0%	0	0%	0	0%	6	7%

Table 7.2.3: General Features of the Existing Irrigation Network of the Taskourt Area

	Length	Dominant surface (ha)				Potential
	(km)	Perennial	Seasonal	Flood	Total	flow (l/s)
Taslimant	12.5	193.5	75	432	700.5	max 500
Targa	12.3	50	236	50	336	max 300
Tamatoust	13.5	68.5	1829	2580	4638.5	max 1000
Taourdast	18	160				max 120
Chouaihiya	11	31	287	80	398	max 300
Afroukh	12	22.5	462	106	590.5	max 300
Aseoul	12	63	993	2874	3930	max 500
Jdida	8					60 /800
Laaouar	5	-	110	304	414	800 to 1000
Ait Bella et Bourekba	7.2	-	-	412	412	800 to 1000
Tafchtalt	4	34	-	-	34	max 50
Tadraouit	9.5	97	431.5	120	648.5	max 500
Igouramane	11.2	187.5	87	-	274.5	max 100
Tazerdakht	17	-	320	1857.5	2177.5	max 1500
Ouled Aissa	6.5	-	252	310	562	max 1000
El Hararcha	5	-	40	866	906	max 800
Sbait	5.2	-	-	361	361	max 800
Total		907.0	5,122.5	10,352.5	16,383.0	
Oued Piemont, Oued Bou Zouga +Other sources		270.5	397	1703	2370.5	
Total		1,177.50	5,519.50	12,055.50	18,753.50	

Table 7.2.4: General Features of the Existing Network in the Timkit Area

River name (Oued)	Canal name (Seguia)	Canal length (m)	Command area (ha)	Water right (m^3/s)
Ifegh		3600	200	0.035
Chaaba	Ait Ferah	2400	45	1.000
	Ait Labzem	2000	75	1.500
	Tairza	2000	55	1.500
Tanguera	Talalt	1400	40	1.500
	Tighert	2700	175	2.000
Todrha L.B	Asrir	2500	120	1.000
	Ait Hammou	2500	130	1.000
Todrha R.B	Ait Assem	5500	220	1.000
	Lahini	3700	250	1.000
Felka	Chitam	9100	690	1.000
		37400	2000	

Notes: L.B; Left Bank
R.B; Right Bank

Table 7.2.5: Major Economic Activities and Family Income in the Study Area

Particulars	N'Fifikh (No.5) Household N=63 (%)	Taskourt (No.9) Household N=75 (%)	Timkit (No.10) Household N=77 (%)	Azghar (No.17) Household N=44 (%)
Economic Activities				
-Agricultural Activities Only	52.0	37.0	19.0	43.0
-Agricultural and Other Side Jobs (Employment, Commerce/Small Business etc.)	48.0	63.0	77.0	57.0
-Non Agricultural Activities Only	0.0	0.0	4.0	0.0
Total	100.0	100.0	100.0	100.0

Average Annual Family Income

	N'Fifikh DH/Annum	Share (%)	Taskourt DH/Annum	Share (%)	Timkit DH/Annum	Share (%)	Azghar DH/Annum	Share (%)
-Agricultural Income Including Non Agricultural Activities	32,800	68.5	20,800	77.0	12,600	38.9	16,500	69.6
-Remittance from Migrant Workers	15,100	31.5	6,200	23.0	19,800	61.1	7,200	30.4
Total	47,900	100.0	27,000	100.0	32,400	100.0	23,700	100.0

Note: Agricultural activities/income include livestock production/income

Source: Household Interview Survey on Socioeconomic Conditions of Beneficiary Areas, 2000

Table 7.2.6: Program of Electrification for Villages around the Project

Taskourt Dam

Status	Year	Commune : Assif El Mal	
		Village	**Location**
Electrified		Imin Ouassif	between dam and irrigation area
		Sidi Bou Otmane	
		Dar Akimah	witin irrigation area
PERG2	2000 - 2002	Ait Abaid	within irrigation area
		Ifrane	
		Jorf	
		Taloutint	
		Ajmani	
		Tigourar	
		Dar N' mes	
PERG3	2002 - 2004	Taskourt	between dam and irrigation area
		Anebdour	
		Bonou	within irrigation area
		Tafroukht	
PERG4	2004 - 2006	Imin Ighzer	between dam and irrigation area
PERG5	2006 - 2008	Taddart	near irrigation area

Status	Year	Commune : Adassil	
		Vilage	**Location**
Electrified		Adassil Centre	upstream of reservoir
		Majdid	
		Quaidat	
PERG2	2000 - 2002	Tignarine	upstream of reservoir
PERG3	2002 - 2004	Azmou	within reservoir
		Tiderguine	
		Assais	
		Kerni	
		Tiliwa	
		Talborjt	
		Imin Eikha	
		Talat Nemti	
		Zawyat Hemti	
		Ighermane	near reservoir
		Tikht	
		Tighoula	
		Tagadirt	
		Agaolir	
		Aoammer	
		Zwalil	
		Iberdatene	
PERG4	2004 - 2006	Tawtirt	upstream of reservoir
		Ighzer	within reservoir

Azghar Dam

Status	Year	Commune : Ighazrane	
		Village	**Location**
Electrified		Ifrah	north of Ribat El Kheir
		Sidi Bonaza	
PERG2	2000 - 2002	Tsaout Ou Araar	within irrigation area
		Tichout	
		Nass Said Jbel	
		Taghza Lamrouj	
		Ekarbousse	
		Ouled Nacer	near irrigation area
		Tahiyante	north of Ribat E.K.
PERG3	2002 - 2004	(none)	
PERG4	2004 - 2006	Batha	upstream of reservoir
		Beni Souhane	
		Od Mimoune	
		Sidi Yahia	near irrigation area
		Tirbitinr	(other location)
		Taounte Ouaarar	
PERG5	2006 - 2008	Ansem	within irrigation area
		Ihanoune	upstream of reservoir
		El Mesreh	
		Beni Abbad	
		Matine	
		Ahmmar	(other location)
		Faj Azrar	
		Ain Mediouna 1	
		Ain Mediouna 2	
		Nasdaoud	
		Ait Mhamed	
		Igli	

Table 8.1.1: Calculation Sheet for Project Water Requirement for N'Fifikh Upstream Area

Factors in estimating water requirement	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Total
					(In case dependable rainfall is 4 out of 5 years)								
1. Reference crop evapotranspiration, ETo: (1)	177.0	152.8	105.6	83.1	89.3	101.7	151.9	183.3	223.2	243.3	261.3	220.4	
2. Crop coefficient, kc: (2)	0.15	0.18	0.33	0.51	0.67	0.69	0.56	0.40	0.28	0.33	0.30	0.18	
3. Crop evapotranspiration, ETcrop (3): (1)· (2)	26.6	27.5	34.8	42.4	59.8	70.2	85.1	73.3	62.5	80.3	78.4	39.7	680.6
4. Dependable rainfall 4 out of 5 years or 80% probability: (4)	3.3	21.7	32.4	44.1	38.7	30.2	26.3	22.7	7.8	2.9	0.3	0.1	320.5
5. Cropped area: (5)	0.28	0.4	0.50	0.85	0.85	0.70	0.70	0.80	0.75	0.42	0.42	0.42	
6. Effective rainfall, (6): Pe=(4)· (5)· fraction	-	6.5	12.2	28.1	24.7	15.9	13.8	13.6	-	-	-	-	114.8
7. Net irrigation requirement, In: (7)=(3)-(6)	26.6	21.0	22.6	14.3	35.1	54.3	71.3	59.7	62.5	80.3	78.4	39.7	565.8
8. Project water requirement , V: (8)=(7)/0.52	51.2	40.4	43.5	27.5	67.5	104.4	137.1	114.8	120.2	154.4	150.8	76.3	1,088.1
					(In case dependable rainfall is 1 out of 5 years)								
9. Dependable rainfall 1 out of 5 years or 20% probability: (9)	6.1	40.0	60.0	81.5	71.6	55.9	48.7	42.0	14.5	5.3	0.5	0.3	426.4
10. Effctive rainfall, Pe: (10) =(5)· (9)· fraction	-	12.0	22.5	54.3	45.6	29.3	25.6	25.2	-	-	-	-	214.5
11. Net irrigation requirement, In: (11)=(3)-(10)	26.6	5.5	12.3	-	14.2	40.9	59.5	48.1	62.5	80.3	78.4	39.7	478.0
12. Project water requirement, V: (12)/0.52	51.2	29.8	23.7	-	27.3	78.7	114.6	92.5	120.2	154.4	150.8	76.3	919.5

Table 8.1.2: Calculation Sheet for Project Water Requirement for Taskourt Area

Factors in estimating water requirement	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Total
					(In case dependable rainfall is 4 out of 5 years)								
1. Reference crop evapotranspiration, ETo: (1)	179.7	155.9	105.9	84.0	87.3	105.0	157.2	185.1	231.9	255.6	261.3	221.7	
2. Crop coefficient, kc: (2)	0.12	0.11	0.23	0.43	0.68	0.86	0.80	0.49	0.22	0.19	0.20	0.16	
3. Crop evapotranspiration, ETcrop (3): (1)· (2)	21.60	17.10	24.30	36.10	59.40	90.30	125.80	90.70	51.00	48.60	52.30	35.50	652.7
4. Dependable rainfall 4 out of 5 years or 80% probability: (4)	9.0	31.2	26.2	23.4	43.2	36.6	43.8	40.0	18.3	7.5	0.5	3.2	282.9
5. Cropped area: (5)	0.21	0.20	0.46	0.87	0.90	0.90	0.91	0.95	0.73	0.33	0.30	0.27	
6. Effective rainfall, Pe:(6)=(4)· (5)· fraction	-	4.7	9.0	15.3	29.2	24.7	29.9	28.5	10.0	-	-	-	151.3
7. Net irrigation requirement, In: (7)=(3)-(6)	21.6	12.4	15.3	20.8	30.2	65.6	95.9	62.2	41.0	48.6	52.3	35.5	501.4
8. Project water requirement , V: (8)=(7)/0.52	41.5	23.8	29.4	40.0	58.1	126.1	184.4	119.6	78.8	93.5	100.6	68.3	964.1
					(In case dependable rainfall is 1 out of 5 years)								
9. Dependable rainfall 1 out of 5 years or 20% probability: (9)	14.2	49.1	41.1	36.7	67.9	57.5	68.9	62.9	28.8	11.7	0.8	5.0	444.6
10. Effctive rainfall, Pe: (10) =(9)· (5)· fraction	2.2	7.4	14.2	23.9	45.8	38.8	47.0	44.8	15.8	-	-	-	
11. Net irrigation requirement, In: (11)=(3)-(10)	19.4	9.7	10.1	12.2	13.6	51.5	78.8	45.9	35.2	48.6	52.3	35.5	412.8
12. Project water requirement, V: (11)/0.52	37.3	18.7	19.4	23.5	26.2	99.0	151.5	88.3	67.7	93.5	100.6	68.3	794.0

Table 8.1.3: Calculation Sheet for Project Water Requirement for Ifegh Area in Timkit

Factors in estimating water requirement	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Total
					(In case dependable rainfall is 4 out of 5 years)								
1. Reference crop evapotranspiration, ETo: (1)	178.8	152.4	100.4	28.5	80.7	98.0	150.0	179.4	225.1	250.2	264.1	220.4	
2. Crop coefficient, kc: (2)	0.19	0.27	0.39	0.51	0.71	0.84	0.75	0.47	0.24	0.19	0.16	0.16	
3. Crop evapotranspiration, ETcrop (3): (1)· (2)	34.0	41.1	39.2	40.0	57.3	82.3	112.5	84.3	54.0	47.5	42.3	35.3	669.8
4. Dependable rainfall 4 out of 5 years or 80% probability: (4)	4.2	10.7	8.9	7.7	6.1	9.8	5.5	6.2	5.1	4.2	1.5	1.8	71.7
5. Cropped area: (5)	0.35	0.39	0.66	0.94	0.90	0.90	0.93	0.91	0.65	0.33	0.27	0.28	
6. Effective rainfall, Pe:(6)=(4)· (5)· fraction	-	3.1	4.4	5.4	-	6.6	-	-	-	-	-	-	19.5
7. Net irrigation requirement, In: (7)=(3)-(6)	34.0	38.0	34.8	34.6	57.3	75.7	112.5	84.3	54.0	47.5	42.3	35.3	650.3
8. Project water requirement , V: (8)=(7)/0.58	58.6	65.5	60.0	59.7	98.8	130.5	194.0	145.3	93.1	81.9	72.9	60.9	1,121.2
					(In case dependable rainfall is 1 out of 5 years)								
9. Dependable rainfall 1 out of 5 years or 20% probability: (9)	9.7	24.1	20.5	17.7	14.0	22.4	12.8	14.3	11.8	9.7	3.4	4.1	164.5
10. Effctive rainfall, Pe: (10) =(9)· (5)· fraction	-	7.2	10.1	12.7	9.5	15.1	8.9	9.8	-	-	-	-	73.3
11. Net irrigation requirement, In: (11)=(3)-(10)	34.0	33.9	29.1	27.3	47.8	67.2	103.6	74.5	54.0	47.5	42.3	35.3	596.5
12. Project water requirement, V: (11)/0.58	58.6	58.4	50.2	47.1	82.4	115.9	178.6	128.4	93.1	81.9	72.9	60.9	1,028.4

Table 8.1.4: Calculation Sheet for Project Water Requirement
For Tinejdad Area in Timkit

Factors in estimating water requirement	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Total
						(In case dependable rainfall is 4 out of 5 years)							
1. Reference crop evapotranspiration, ETo: (1)	178.8	152.4	100.4	78.5	80.7	98.0	150.0	129.4	225.1	250.2	264.1	220.4	
2. Crop coefficient, kc: (2)	0.23	0.29	0.38	0.47	0.64	0.28	0.24	0.50	0.28	0.23	0.20	0.20	
3. Crop evapotranspiration, ETcrop (3): (1)· (2)	41.1	44.2	38.2	36.9	51.6	76.4	111.0	89.7	63.0	57.5	52.8	44.1	706.5
4. Dependable rainfall 4 out of 5 years or 80% probability: (4)	4.2	10.7	8.9	7.7	6.1	9.8	5.5	6.2	5.1	4.2	1.5	1.8	71.7
5. Cropped area: (5)	0.45	0.45	0.66	0.95	0.90	0.90	0.93	0.95	0.74	0.42	0.38	0.38	
6. Effective rainfall, Pe:(6)=(4)· (5)· fraction		3.6	4.4	5.5		6.6							20.1
7. Net irrigation requirement, In: (7)=(3)-(6)	41.1	40.6	33.8	31.4	51.6	69.8	111.0	89.7	63.0	57.5	52.8	44.1	686.4
8. Project water requirement , V: (8)=(7)/0.75	54.8	54.1	45.1	41.9	68.8	93.1	148.0	120.0	84.0	76.7	70.4	58.8	915.6

Table 8.1.5: Calculation Sheet for Project Water Requirement for Chitam Area in Timkit

Factors in estimating water requirement	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Total
						(In case dependable rainfall is 4 out of 5 years)							
1. Reference crop evapotranspiration, ETo: (1)	178.8	152.4	100.4	78.5	80.7	98.0	150.0	129.4	225.1	250.2	264.1	220.40	
2. Crop coefficient, kc: (2)	0.11	0.11	0.23	0.45	0.72	0.91	0.86	0.52	0.21	0.15	0.12	0.11	
3. Crop evapotranspiration, ETcrop (3): (1)· (2)	19.7	16.8	23.1	35.3	58.1	89.2	129.0	93.3	47.3	37.5	31.7	24.2	605.2
4. Dependable rainfall 4 out of 5 years or 80% probability: (4)	4.2	10.7	8.9	7.7	6.1	9.8	5.5	6.2	5.1	4.2	1.5	1.8	
5. Cropped area: (5)	0.20	0.20	0.48	0.92	0.95	0.95	0.98	1.00	0.74	0.28	0.23	0.20	
6. Effective rainfall, Pe:(6)=(4)· (5)· fraction	-	1.6	3.2	5.3	-	7.0	-	-	-	-	-	-	17.1
7. Net irrigation requirement, In: (7)=(3)-(6)	19.7	15.2	19.9	30.0	58.1	82.2	129.0	93.3	47.3	37.5	31.7	24.2	588.1
8. Project water requirement , V: (8)=(7)/0.75	26.3	20.3	26.5	40.0	77.4	109.6	172.0	124.4	63.1	50.0	42.3	32.3	784.1

Table 8.1.6: Calculation Sheet for Project Water Requirement for Azghar Area

Factors in estimating water requiremen	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Total
(In case dependable rainfall is 4 out of 5 years)													
1. Reference crop evapotranspiration, E'	173.7	140.7	93.9	69.8	73.5	86.5	133.9	157.2	195.9	233.1	261.0	223.2	
2. Crop coefficient, kc: (2)	0.10	0.09	0.25	0.46	0.67	0.86	0.92	77.00	0.39	0.14	0.13	0.12	
3. Crop evapotranspiration, ETcrop (3):	17.4	12.7	23.5	32.1	49.2	73.6	123.2	121.0	76.4	32.6	33.9	26.8	622.4
4. Dependable rainfall 4 out of 5 years or 80% probability: (4)	22.5	27.2	50.3	49.2	51.4	56.4	51.3	48.7	36.4	12.5	3.9	4.0	413.8
5. Cropped area: (5)	0.20	0.22	0.49	0.95	1.00	0.96	0.95	0.95	0.99	0.70	0.26	0.23	
6. Effective rainfall, Pe:(6)=(4)· (5)· ftac	3.4	4.5	18.5	35.1	38.6	40.6	36.6	34.7	27.0	6.6	-	-	
7. Net irrigation requirement, In: (7)=(3	14.0	8.2	5.0	-	10.6	33.0	86.6	86.3	49.4	26.0	33.9	26.8	379.8
8. Project water requirement , V: (8)=(7	26.9	15.8	9.6	-	20.4	63.5	166.5	166.0	95.0	50.0	65.2	51.5	730.4
(In case dependable rainfall is 1 out of 5 years)													
9. Dependable rainfall 1 out of 5 years or 20% probability: (9)	34.3	41.5	76.7	75.0	78.3	86	78.2	74.2	55.5	19.0	5.9	6.0	630.6
10. Effctive rainfall, Pe: (10) =(9)· (5)·afr	5.1	6.8	28.2	53.4	58.7	61.9	55.7	52.9	41.2	10.0	-	-	373.9
11. Net irrigation requirement, In: (11)=(	12.3	5.9	-	-	-	11.7	67.5	68.1	35.2	22.6	33.9	26.8	284.0
12. Project water requirement, V: (11)/0.	23.7	11.3	-	-	-	22.5	129.8	131.0	67.7	43.5	65.2	51.5	546.2

Table 8.1.7: Summary of Respective Irrigation Areas for each Project

Project		Existing (without dam)		Plan (with dam)					
		Potential area [(1)] (ha)	Crop Intensity (%)	Study area [(2)] (ha)	Gross area [(3)] (ha)	Net irrigation area [(4)] (ha)	Average irrigation area[(5)] (ha)	Crop Intensity (%)	Annual Regulated Water Volume by dam (MCM)
No. 5 N' Fifikh Up-		1,250	91	1,250	1,000	590	645	100	6.4
No. 9 Taskourt		8,000	96	6,000	4,500	2,500	2,713	100	24
No. 10 Timkit	Ifegh	300	96	300	240	240	240	105	2.7
	Tinejdad	2,835	84	2,835	2,298	888	1,173	105	6.14
	Chitam	690	14	690	522	222	277	100	(including
	Total	3,825		3,825	3,060	1,350	1,690		8.84
No. 17 Azghar		2,350	82	2,350	2,350	2,000	2,000	110	28
Total		15,425		13,425	10,910	6,440	7,048		67.24

(1) Potential area: Soil survey has been conducted.
(2) Study area has been delineated by both parties, MOA and the Study Team, at the stage of aerial photo-mapping.
(3) Gross area is defined as the entire project area that covers not only irrigation area but also areas for infrastructures and buildings as well as areas for expected extension of irrigation.
(4) Net irrigation area is defined as the area that is irrigated by the water requirement estimated based on the dependable rainfall of 80% probability.
(5) Average irrigation area is defined as the area that is obtained by long term year simultaneous calculation for reservoir operation and irrigation

Table 8.3.1 Classification of Groundwater and Surface Water Quality at Each Sampling Site

Sampling Site*		Temp	pH	Cond	DO	Odor	Color	BOD	COD	PT	PO_4	TN	NH_4	NO_3	SO_4	Cl	Ca	Mg	F	Fe	Mn	Zn	TC
N'fifikh	S 1	16	7.5	1447	8.57	0	5	1.51	13.44	0.113	0.027	0.18	0.03	1.88	266	255	148	81.4	0.55	0.308	0.058	< 0.01	340
	S 2	16.5	7.55	2315	10.7	0	10	1.29	15.36	0.143	0.033	0.38	0.082	38.5	216	557	140	163.5	0.5	< 0.1	< 0.02	< 0.01	770
	G 1	23	7.2	1695	-	0	< 5	-	-	-	-	-	-	2.136	-	-	196	86.1	-	-	-	-	-
	G 2	22	7.35	2625	-	0	< 5	-	-	-	-	-	-	1.55	-	-	138	156.8	-	-	-	-	-
	G 3	24	7.05	1465	-	0	< 5	-	-	-	-	-	-	0.393	-	-	200	40.8	-	-	-	-	-
Taskourt	S 1	16.5	7.15	668	8.56	0	0	0.9	< 7.5	0.105	0.036	0.21	0.04	6.25	147	20	104	34.3	0.8	< 0.1	< 0.02	< 0.01	10
	S 2	22.5	8.15	734	13.15	0	0	1.2	11.52	0.105	0.018	0.3	0.069	3.37	197	29	96	40.7	0.42	< 0.1	< 0.02	< 0.01	18
	G 1	21	7.45	710	-	0	< 5	-	-	-	-	-	-	3.842	-	-	116	42.1	-	-	-	-	-
	G 2	19.5	7.45	1262	-	0	< 5	-	-	-	-	-	-	5.75	-	-	140	83.8	-	-	-	-	-
	G 3	22.5	10.95	3111	-	1	10	-	-	-	-	-	-	55.8	-	-	325	7.4	-	-	-	-	-
Timkit	S 1	17	7.4	2158	9.95	0	0	0.9	7.68	0.095	0.034	0.25	0.057	20.77	409	425	172	89.2	0.55	< 0.1	< 0.02	< 0.01	110
	G 1	21.5	7.2	1619	-	0	< 5	-	-	-	-	-	-	21.72	-	-	165	74.2	-	-	-	-	-
	G 2	23.5	7.05	2026	-	0	< 5	-	-	-	-	-	-	11.54	-	-	190	105.8	-	-	-	-	-
	G 3	22	7.15	2687	-	0	< 5	-	-	-	-	-	-	0.067	-	-	232	143.2	-	-	-	-	-
Azghar	S 1	10	7.5	450	9.65	0	0	0.61	< 7.5	0.122	0.024	0.34	0.07	22.8	24	24	80	18.4	0.45	< 0.1	< 0.02	< 0.01	110
	S 2	11.5	7.65	450	9.25	0	0	0.81	< 7.5	0.11	0.024	0.25	0.053	7	22	34	60	20.4	0.3	< 0.1	< 0.02	0.019	190
	S 3	13	7.45	443	9.33	0	0	0.89	< 7.5	0.105	0.038	0.21	0.048	7.75	28	26	76	19.9	0.35	< 0.1	< 0.02	0.02	0
	S 4	14.5	7.7	440	9.1	0	0	0.89	< 7.5	0.1	0.042	0.29	0.068	7	30	26	68	20.7	0.35	< 0.1	< 0.02	< 0.01	40
	G 1	18.5	8.6	461	-	0	< 5	-	-	-	-	-	-	6.113	-	-	44	48.4	-	-	-	-	-
	G 2	18.5	7.65	669	-	0	< 5	-	-	-	-	-	-	0.986	-	-	116	40.1	-	-	-	-	-
	G 3	18.5	7.6	692	-	1	10	-	-	-	-	-	-	5.466	-	-	104	39.3	-	-	-	-	-

*) Location of sampling site is shown in Figures XVI 2.1.1 to 2.1.4 of Supporting Report XV.

Table 8.3.2: Preliminary Project Features of Small-scale Water Supply System

Item	Unit	N'Fifikh	Taskourt		
Village		Tlet Ziaida	Dar Akimakh	Tamatoust	Tiguemi Oumrhar
Commune		Ziaida	Assif El Mal	Mzouda	Mzouda
Population	person				
1994		824	575	549	539
2000		1120	760	(292)	552
2020		1300	900	700	700
Consumption					
Daily	m^3/day	26	18	14	14
Annual	m^3/year	9,490	6,570	5,110	5,110
Water Source		N' Fifikh River	Seguia Tadraouit	Seguia Tamatoust	Seguia Taourdast
Reservoir Volume	m^3	26	18	14	14
Number of Stand Pipes	nos	4	3	3	3
Project Cost	mil DH	1.80	1.20	0.90	0.90

Table 8.4.1: Preliminary Project Features of Mini-hydro Power Station

Item	Unit	Taskourt		Azghar
		NWL 1020m	NWL 995m	
Specifications				
Installed capacity	kW	710	460	50
Maximum discharge	m^3/s	1.5	1.5	1.0
Reservoir water level	m	1020	995	854
Turbine center level	m	950	950	847.5
Gross head	m	70.0	45.0	6.5
Maximum effective head	m	64.4	41.4	6.0
Generated energy	GWh	2.06	1.22	0.09
Powerhouse building				
Type		Open	Open	Open
Turbine				
Type		Cross-flow	Cross-flow	Cross-flow
Transmission line				
Line voltage	V	22,000	22,000	22,000
Wire length	km	1.0	1.0	2.5
Project Cost				
Powerhouse building	mil. DH	2.6	1.9	0.3
Generating equipment	mil. DH	11.0	8.3	1.8
Transmission line	mil. DH	0.1	0.1	0.4
Total	mil. DH	13.7	10.3	2.5
Unit Construction Cost				
per kWh	DH/kWh	4.9	6.2	19.3

Note Unit construcion cost per kWh is calculated by cost that covers actual work, overhead and profit of the contractor, and physical contingency only.

Table 8.5.1: Basic Data and Criteria for Water Balance Study

Item			N'Fifikh		Taskourt	Timkit	Azghar
			Upstream	Downstream			
Basic Data							
Discharge	Annual average	Mm^3/year	13.32	11.4	44.65	11.71	53.21
	Period		39/40 to 96/97	39/40 to 96/97	35/36 to 96/97	61/62 to 96/97	55/56 to 98/99
Sedimentation	Annual average	Mm^3/year	0.03	0.04	0.12	0.20	0.13
Precipitation	Annual average	mm/year	323.4	323.4	366.0	186.4	446.8
	Period		76/77 to 99/00	76/77 to 99/00	89/90 to 99/00	64/65 to 99/00	82/83 to 99/00
Evaporation	Annual average	mm/year	1,545	1,545	1,412	2,115	1,484
	Basis (referred station)		SMBA	SMBA	Lalla Takerkoust	Hassan Addakhil	Idris Premier
Elevation-Area/Volume Curve			1:5,000 map	1:5,000 map	1:5,000 map	1:5,000 map	1:5,000 map
Water Demand	Annual	m^3/ha/year	8,247	5,712	9,641	11,212	7,304
Maintenance flow		Mm^3/year	not considered	not considered	not considered	not considered	not considered
Calculation Criteria							
Duration of simultaneous calculation			39/40 to 96/97	39/40 to 96/97	35/36 to 96/97	61/62 to 96/97	55/56 to 98/99
Design period for sedimentation volume			50	50	50	20	50
Guarantee of Supply			- Frequency of deficit year (annual deficit more than 15%) is less than 20%. - Maximum annual deficit is less than 50%.				
Operation method			- 100% of water requirement is taken between H.W.L. and M.O.W.L.-1. - 68% of water requirement is taken between M.O.W.L.-1 and M.O.W.L.-2. - 50% of water requirement is taken between M.O.W.L.-2 and M.W.L. - No water is taken below M.W.L.				

Table 8.5.2: Result of Water Balance Study

Normal Water Level	Regulated Volume	Average Deficiency Rate	Frequency of Deficit Year	Maximum Annual Deficit	Average Water Use	Average Evaporation	Average Spillout
EL. m	Mm^3	%	%	%	Mm^3	Mm^3	Mm^3
N' Fifikh Dam (upstream)							
228	1.2	5.8	15.5	49.8	1.13	0.45	11.74
230	2.5	6.4	17.2	49.8	2.34	0.55	10.43
235	4.3	6.8	13.8	45.1	4.01	0.87	8.45
240	5.5	6.4	15.5	49.4	5.15	1.31	6.87
245	6.4	6.5	19.0	50.0	5.98	1.79	5.54
250	7.1	7.0	19.0	50.0	6.60	2.22	4.45
N' Fifikh Dam (downstream)							
13	2.0	2.6	3.4	48.2	1.95	1.06	8.41
15	2.7	7.6	20.7	48.5	2.50	1.21	7.70
20	4.0	8.3	20.7	49.4	3.67	1.64	6.09
25	4.6	7.0	19.0	49.4	4.28	2.14	4.96
30	5.1	6.6	19.0	50.0	4.76	2.56	4.00
35	5.4	6.0	20.7	50.0	5.07	2.90	3.39
Taskourt Dam							
976	8.0	7.3	14.5	40.7	7.41	0.57	36.66
986	19.0	7.2	19.4	47.0	17.63	0.76	26.24
991	22.0	7.2	14.5	50.1	20.42	0.90	23.29
995	24.0	6.7	14.5	46.2	22.40	1.02	21.18
1005	28.0	7.3	14.5	48.2	25.94	1.41	17.19
1020	34.0	6.6	21.0	50.0	31.76	2.02	10.95
1030	37.0	6.2	19.4	50.0	34.71	2.46	7.87
1040	38.5	6.2	19.4	50.0	36.13	2.86	6.42
Timkit Dam							
1245	2.7	8.5	19.4	50.0	2.47	1.60	7.60
1250	3.8	8.5	19.4	50.0	3.48	2.54	5.67
1255	4.0	8.3	19.4	50.0	3.67	3.68	4.34
1260	4.3	9.2	19.4	50.0	3.91	5.22	2.57
Azghar Dam							
850	9.0	8.6	20.0	45.0	8.23	0.81	44.19
852	12.5	6.4	20.5	45.1	11.70	0.91	40.65
854	14.6	5.6	18.2	41.7	13.79	1.02	38.48
860	23.0	7.3	13.6	49.4	21.33	1.40	30.70
865	28.0	7.5	15.9	42.6	25.90	1.81	25.85
870	32.5	7.9	18.2	50.0	29.92	2.29	21.48
875	36.0	8.0	20.5	50.0	33.11	2.82	17.90
880	39.0	9.0	20.5	50.0	35.50	3.33	15.17

Table 9.1.1: Principal Features of No.5 N'Fifikh

Description			Remark
A. Dam			
1 General			
Province		Ben Slimane	
River		Oued Daliya	
Coordinate of dam site	Xl1	345,640	Location: direct distance 25km from Ben Slimane
	Yl1	311,800	
	Xr2	345,700	
	Yr2	312,200	
2 Hydrology			
Catchment area	km2	323.00	
Annual mean rainfall	mm	323.00	
Annual mean run-off	Mm3	13.32	
3 Reservoir			
Gross storage	m3	19,200,000.00	
Effective storage	m3	17,700,000.00	
Dead storage	m3	1,500,000.00	30,000m3/yr. x 50yrs
Reservoir surface area	ha	173.60	
Elevation of flood water level (FWL)	m	248.64	Hd=3.64m
Elevation of normal water level (NWL)	m	245.00	
Elevation of low water level (LWL)	m	225.50	
4 Dam Body			
Geology of foundation		Alternation of sandstone & Pelitic stone (Devonian to Carboniferous)	
Type of dam		Center-cored rock fill	
Elevation of dam crest	EL	251.50	Freeboard above FWL 2.86
Elevation of dam foundation	EL	204.00	above NWL 6.50
Height from proposed foundation	m	47.50	
Length of dam crest	m	325.00	
Upstream slope		1:2.50	
Downstream slope		1:2.00	
Width of dam crest	m	6.00	
Seismic intensity		0.10	(100yr.acceleration=42gal)
Embankment quantity (total)	m3	678,400.00	
Core	m3	142,500.00	
Filter & drain + Gravel, rock	m3	515,600.00	
Rip rap	m3	20,300.00	
5 Spillway			
Location		Right bank	
Geology of foundation		Sandstone & Pelitic stone of CL-CM	
Design inflow discharge (10,000yr)	m3/s	1,800.00	
Design outflow discharge(10,000yr)	m3/s	1,668.00	
Type of weir		Non gated side channal	
Weir length /width		120m x 25m	
Design overflow depth	m	3.64	
Type of stilling basin		Hydraulic jump type	
6 Intake/Outlet			
Type		Inclined conduit D600mm slide gate x 2	
Intake location		Left bank	
Capacity	m3/s	1.61	
Outlet pipe		D1000mm x 270m	
Discharge control valve		D1000mmJFG	
Raw water facilities		D300mm pipe and D300 sluice valve	
7 Diversion			
Type		Cofferdam/Culvert	
Design inflow discharge(20yr/50yr)	m3/s	250.0/380.0	
Design outflow discharge(20yr/50yr)	m3/s	236.1/271.0	
Cofferdam crest elevation	m	226.50	
Upstream water level(20yr/50yr)	m	221.1/226.2	
Culvert location		Left abutment	
Culvert section/length		5m x 5m / 300m	
8 Dam Construction Cost			
1.Direct cost			
1.1 Diversion works	MDH	18.07	
1.2 Foundation excavation	MDH	7.65	
1.3 Foundation treatment	MDH	3.56	
1.4 Dam embankment	MDH	11.56	
1.5 Spill way	MDH	70.49	
1.6 Intake works	MDH	3.66	
1.7 Gate and pipe	MDH	8.56	
1.8Overhed and profit of contractor	MDH	19.60	
Sub-total	MDH	143.15	
2.Physical contingency	MDH	14.32	
3.Price contingency	MDH	36.20	
Total	MDH	193.67	
4.Value added tax(14%)	MDH	27.11	
Ground total	MDH	220.70	325 DH/m3
B. Irrigation			
9 Service Area			
Service area (Net)	ha	1,000.00	
10 Irrigation Construction Cost			
1.Direct cost			
1.1 Main canal	MDH	12.82	
1.2 Structures	MDH	21.29	
1.3Overhed and profit of contractor	MDH	2.39	
Sub-total	MDH	36.50	
2.Physical contingency	MDH	3.65	
3.Price contingency	MDH	9.23	
Total	MDH	49.38	
4.Value added tax(14%)	MDH	6.91	
Ground total	MDH	56.30	56,300 DH/ha

Table 9.1.2: Principal Features of No.9 Taskourt

Description			Remark
A. Dam			
1 General			
Province		Marrakech	
River		Oued Al Mal	
Coordinate of dam site	Xl1	206,800.00	Location: sidi Bou Othmane
	Yl1	69,900.00	
	Xr2	206,900.00	
	Yr2	69,600.00	
2 Hydrology			
Catchment area	km2	419.00	
Annual mean rainfall	mm	366.00	
Annual mean run-off	Mm3	44.65	
3 Reservoir			
Gross storage	m3	25,100,000.00	
Effective storage	m3	19,100,000.00	
Dead storage	m3	6,000,000.00	120,000m3/yr. x 50yrs
Reservoir surface area	ha	124.73	
Elevation of flood water level (FWL)	m	998.95	Hd=3.95m
Elevation of normal water level (NWL)	m	995.00	
Elevation of low water level (LWL)	m	973.00	
4 Dam Body			
Geology of foundation		Schist	(Ordovician)
Type of dam		Concrete gravity by RCC	
Elevation of dam crest	EL	1,000.50	Freeboard above FWL 1.55
Elevation of dam foundation	EL	927.00	above NWL 5.50
Height from proposed foundation	m	73.50	
Length of dam crest	m	225.00	
Upstream slope		1:0.20	
Downstream slope		1:0.84	
Width of dam crest	m	5.00	
Seismic intensity		0.12	(100yr.acceleration=102gal)
Dam concrete quantity (total)	m3	415,000.00	
Conventional concrete	m3	100,300.00	
RCC concrete	m3	314,700.00	
5 Spillway			
Location		Center of dam body	
Geology of foundation		Schist	
Design inflow discharge(1,000yr/10,000yr)	m3/s	1,700/2,300	
Design outflow discharge(1,000yr/10,000yr)	m3/s	1,569/2,138	
Type of weir		Non gate straight crest	
Weir length and width		100m x 80m	
Design overflow depth(1,000yr/10,000yr)	m	3.95/4.85	
Type of stilling basin		Hydraulic jump type	
6 Intake/Outlet			
Type		Intake tower	
		W2.5XH3.0m slide gate x 2	
Intake location		Right side of dam body	
Capacity	m3/s	6.76	
Outlet pipe		D2000mm x 125 m	
Discharge control valve		D2000mm JFG	
Raw water facilities		D300mm pipe and D300 sluice valve	
7 Diversion			
Type		Cofferdam/Buried culvert	
Design inflow discharge(10yr/20yr)	m3/s	400.0/600.0	
Design outflow discharge(10yr/20yr)	m3/s	339.7/474.2	
Cofferdam crest elevation	m	962.50	
Upstream water level(10yr/20yr)	m	955.4/962.3	
Culvert location		Right side of river	
Culvert section/length		7.2m x 7.2m/270m	
8 Dam Construction Cost			
1.Direct cost			
1.1 Diversion works	MDH	5.21	
1.2 Foundation excavation	MDH	17.22	
1.3 Foundation treatment	MDH	9.69	
1.4 Dam embankment	MDH	175.85	
1.5 Spill way	MDH	2.05	
1.6 Intake works	MDH	2.41	
1.7 Gate and pipe	MDH	12.40	
1.8Overhed and profit of contractor	MDH	50.55	
Sub-total	MDH	275.38	
2.Physical contingency	MDH	27.54	
3.Price contingency	MDH	69.63	
Total	MDH	372.55	
4.Value added tax(14%)	MDH	52.16	
Ground total	MDH	424.60	1023 DH/m3
B. Irrigation			
9 Service Area			
Service area (Net)	ha	4,500	
10 Irrigation Construction Cost			
1.Direct cost			
1.1 Main canal	MDH	38.55	
1.2 Structures	MDH	84.54	
1.3Overhed and profit of contractor	MDH	8.62	
Sub-total	MDH	131.71	
2.Physical contingency	MDH	13.17	
3.Price contingency	MDH	33.32	
Total	MDH	178.20	
4.Value added tax(14%)	MDH	24.94	
Ground total	MDH	203.10	45,100 DH/ha

Table 9.1.3: Principal Features of No.10 Timkit

Description			Remark
A. Dam			
1 General			
Province		Errachidia	
River		Assif N' ifle	
Coordinate of dam site	Xr1	507,335.00	Location: Tinjdid
	Yr1	515,200.00	
	Xl2	507,550.00	
	Yl2	515,500.00	
2 Hydrology			
Catchment area	km2	572.00	
Annual mean rainfall	mm	186.00	
Annual mean run-off	Mm3	10.11	
3 Reservoir			
Gross storage	m3	27,500,000.00	
Flood storage	m3	20,000,000.00	
Effective storage	m3	3,500,000.00	
Dead storage	m3	4,000,000.00	200,000m3/yr. x 20yrs
Reservoir surface area	ha	172.50	
Elevation of flood water level (FWL)	m	1,258.12	Hd=2.32m
Elevation of surcharge water level (SWL)	m	1,255.80	
Elevation of normal water level (NWL)	m	1,245.00	
Elevation of low water level (LWL)	m	1,240.30	
4 Dam Body			
Geology of foundation		Limestone	(Lower Jurassic)
Type of dam		Concrete gravity by RCC	
Elevation of dam crest	EL	1,259.50	Freeboard above FWL 1.38
Elevation of dam foundation	EL	1,195.00	above NWL 14.50
Height from proposed foundation	m	64.50	
Length of dam crest	m	210.00	
Upstream slope		1:0.20	
Downstream slope		1:0.86	
Width of dam crest	m	5.00	
Seismic intensity		0.10	(100yr.acceleration=88gal)
Dam concrete quantity (total)	m3	227,600.00	
Conventional concrete	m3	44,900.00	
RCC concrete	m3	182,700.00	
5 Spillway			
Location		Center of dam body	
Geology of foundation		Limestone	
Design inflow discharge(1,000yr/10,000yr	m3/s	2,000/2,800	
Design outflow discharge(1,000yr/10,000yr)	m3/s	426/826	
Type of weir		Non gate straight crest	
Weir length	m	60.00	
Design overflow depth(1,000yr/10,000yr)	m	2.32/3.61	
Type of stilling basin		Hydraulic jump type	
6 Intake/Outlet			
Type		Intake tower	
		D400mm slide gate x 1	
Intake location		Right side of dam body	
Capacity	m3/s	0.45	
Outlet pipe		D600 mm x 60 m	
Discharge control valve		D300mmJFG	
Flood control gate		4m x 4m slide gate and pressure conduit	
Raw water facilities		D400mm pipe and D400 sluice valve	
Sediment flush pipe		D800mm	
7 Diversion			
Type		Cofferdam/Buried culvert	
Design inflow discharge(10yr/20yr)	m3/s	300.0/500.0	
Design outflow discharge	m3/s	300.0/348.4	
Cofferdam crest elevation	m	1,230.50	
Upstream water level	m	1,217.8/1,230.2	
Culvert location		Left side of river	
Culvert section/length		6.0mm x 6.00mm/200m	
8 Dam Construction Cost			
1.Direct cost			
1.1 Diversion works	MDH	3.32	
1.2 Foundation excavation	MDH	10.50	
1.3 Foundation treatment	MDH	17.67	
1.4 Dam embankment	MDH	85.70	
1.5 Spill way	MDH	0.99	
1.6 Intake works	MDH	0.59	
1.7 Gate and pipe	MDH	3.44	
1.8 Sabo dam works	MDH	18.86	
1.9 Overhead and profit of contractor	MDH	21.31	
Sub-total	MDH	162.38	
2.Physical contingency	MDH	16.24	
3.Price contingency	MDH	41.06	
Total	MDH	219.68	
4.Value added tax(14%)	MDH	30.75	
Ground total	MDH	250.30	1,100 DH/m3
B. Irrigation			
9 Service Area			
Service area (Net)	ha	3,060	
10 Irrigation Construction Cost			
1.Direct cost			
1.1 Main canal	MDH	15.89	
1.2 Structures	MDH	89.07	
1.3Overhed and profit of contractor	MDH	7.35	
Sub-total	MDH	112.31	
2.Physical contingency	MDH	11.23	
3.Price contingency	MDH	28.41	
Total	MDH	151.95	
4.Value added tax(14%)	MDH	21.27	
Ground total	MDH	173.20	56,600 DH/ha

Table 9.1.4: Principal Features of No.17 Azghar

Description			Remark
A. Dam			
1 General			
Province		Sefrou	
River		Oued Zloul	
Coordinate of dam site	Xr1	598,750.00	Location: Sefrou
	Yr1	3,573,500.00	
	Xl2	599,103.00	
	Yl2	3,570,500.00	
2 Hydrology			
Catchment area	km2	263.00	
Annual mean rainfall	mm	447.00	
Annual mean run-off	Mm3	53.21	
3 Reservoir			
Gross storage	m3	11,700,000.00	
Effective storage	m3	5,200,000.00	
Dead storage	m3	6,500,000.00	130,000m3/yr. x 50yrs
Reservoir surface area	ha	118.27	
Elevation of flood water level (FWL)	m	856.89	Hd=2.89m
Elevation of normal water level (NWL)	m	854.00	
Elevation of low water level (LWL)	m	848.50	
4 Dam Body			
Geology of foundation		Marl	(Lower Liassic)
Type of dam		Center-cored rock fill	
Elevation of dam crest	EL	859.50	Freeboard above FWL 2.61
Elevation of dam foundation	EL	817.00	above NWL 5.50
Height from proposed foundation	m	42.50	
Length of dam crest	m	325.00	
Upstream slope		1:2.80	
Downstream slope		1:2.40	
Width of dam crest	m	6.00	
Seismic intensity		0.12	(100yr.acceleration=66gal)
Embankment quantity (total)	m3	769,800.00	
Core	m3	130,900.00	
Filter & drain + Gravel, rock	m3	615,800.00	
Rip rap	m3	23,100.00	
5 Spillway			
Location		Right bank	
Geology of foundation		Marl of CM-CH	
Design inflow discharge(10,000yr)	m3/s	700.00	
Design outflow discharge(10,000yr)	m3/s	592.00	
Type of weir		Non gated side channel	
Weir length and width		60m x 15m	
Design overflow depth(10,000yr)	m	2.89	
Type of stilling basin		Hydraulic jump with roller bucket	
6 Intake/Outlet			
Type		Composite type inclined tower D1000mmslide gate x 1	
Intake location		Left bank	
Capacity	m3/s	2.60	
Outlet pipe		D1000 mm x 480 m	
Discharge control valve		D1000mm Sleeve valve	
Raw water facilities		D300mm pipe and D300 sluice valve	
Sediment flush pipe		D800mm	
7 Diversion			
Type		Cofferdam/Culvert	
Design inflow discharge(20yr/50yr)	m3/s	250.0/300.0	
Design outflow discharge(20yr/50yr)	m3/s	212.6/221.6	
Cofferdam crest elevation	m	835.00	
Upstream water level(20yr/50yr)	m	831.5/834.7	
Culvert location		Right side of Riverbed	
Culvert section/length		5m x 5m / 240m	
8 Dam Construction Cost			
1.Direct cost			
1.1 Diversion works	MDH	19.36	
1.2 Foundation excavation	MDH	9.59	
1.3 Foundation treatment	MDH	5.42	
1.4 Dam embankment	MDH	16.03	
1.5 Spill way	MDH	35.29	
1.6 Intake works	MDH	1.21	
1.7 Gate and pipe	MDH	12.42	
1.8Overhed and profit of contractor	MDH	13.18	
Sub-total	MDH	112.50	
2.Physical contingency	MDH	11.25	
3.Price contingency	MDH	28.45	
Total	MDH	152.20	
4.Value added tax(14%)	MDH	21.30	
Ground total	MDH	173.40	225 DH/m3
B. Irrigation			
9 Service Area			
Service area (Net)	ha	2,000	
10 Irrigation Construction Cost			
1.Direct cost			
1.1 Main canal	MDH	12.22	
1.2 Structures	MDH	56.32	
1.3Overhed and profit of contractor	MDH	4.80	
Sub-total	MDH	73.34	
2.Physical contingency	MDH	7.33	
3.Price contingency	MDH	18.55	
Total	MDH	99.22	
4.Value added tax(14%)	MDH	13.89	
Ground total	MDH	113.10	56,600 DH/ha

Table 9.2.1: Construction Volume of Dam and Irrigation Facilities (1/2)

	Work Item	Unit	Qauntity			
			No.5 N'Fifikh	No.9 Taskourt	No.10 Timkit	No.17 Azghar
	A. Dam					
1	River Diversion Works					
	Excavation / hauling, soil & gravel	m^3	2,800	-	-	53,400
	- ditto -, rock	m^3	24,200	-	-	22,900
	Backfill,soil	m^3	300	-	-	0
	Embankment, soil	m^3	64,600	-	-	34,100
	Reinforced concrete	m^3	12,984	3,614	2,660	13,320
	Plain concrete (Plugging)	m^3	5,000	2,592	1,615	6,000
	Form work	m^2	5,860	3,154	2,169	6,000
2	Foundation Excavatior					
	Excavation / hauling, soil & gravel	m^3	123,900	102,300	73,400	211,100
	- ditto -, rock	m^3	49,000	139,800	92,500	46,900
3	Foundation Treatment Works					
	Curtain grouting work	m	3,146	6,437	13,193	4,791
	Consolidation grouting work	m	-	2,041	1,649	-
4	Dam Emnbankment					
	Impervious zone	m^3	142,500	-	-	130,900
	Filter and Transition zone	m^3	515,600	-	-	615,800
	Rip-rap	m^3	20,300	-	-	23,100
	Inner concrete	m^3	-	314,715	182,725	-
	Outer concrete	m^3	-	99,135	44,000	-
	Rinforced concrete	m^3	-	1,152	909	-
	Tie rod	ton	-	39	31	-
5	Spillway					
	Excavation / hauling, soil & gravel	m^3	343,300	-	-	156,000
	- ditto -, rock	m^3	85,800	-	-	39,000
	Backfill,soil	m^3	54,600	-	-	26,600
	Reinforced concrete	m^3	59,665	1,980	1,052	29,390
	Form work	m^2	24,405	2,840	1,522	22,565
6	Outlet Works					
	Reinforced concrete	m^3	1,260	2,360	615	1,099
	Plain concrete	m^3	4,642	-	-	324
	Form work	m^2	394	2,674	1,281	1,430
7	Gate and Pipe					
	Slide gate	pcs	2	2	2	2
	Steel pipe	m	280	73	50	260
	Jet flow gate	pcs	1	1	1	1
	Sleeve valve	pcs	-	-	-	1
	Flow meter	pcs	1	1	1	1
8	Sabo Dam					
	Excavation / hauling, soil & gravel	m^3	-	-	25,500	-
	- ditto -, rock	m^3	-	-	25,500	-
	Sabo dam body	m^3	-	-	47,815	-

Table 9.2.1: Construction Volume of Dam and Irrigation Facilities (2/2)

	Work Item	Unit	Qauntity			
			No.5 N'Fifikh	No.9 Taskourt	No.10 Timkit	No.17 Azghar
	B. Irrigation Facilities					
1	Main Canal					
	Main Canal	m	9,200	21,600	-	13,545
	Branch Canal (1)	m	9,250	15,280	-	2,580
	Branch Canal 2	m	-	-	-	5,515
	Branch Canal 3	m	-	-	-	2,670
	Main Feeder Canal 1	m	2,500	-	-	-
	Main Feeder Canal 2	m	4,450	-	-	-
	Flume Canal (rehabilitation)	m	-	-	3,600	-
	Masonry Canal (rehabilitation)	m	-	-	34,900	-
2	Structures					
	Head work (Diversion)	pcs	3	1	12	-
	Syphon	pcs	9	1	-	20
	Drop	m	-	4,790	-	875
	Offtake	pcs	32	18	-	50
	Spill way	pcs	4	6	-	7
	Check	pcs	8	-	-	13
	Aqueduct	pcs	1	-	-	-
	Cross Drain	pcs	63	102	-	60
	Bridge	pcs	25	37	-	26
	Box culvert	m	-	-	-	65
	On-farm facilities	ha	1,000	4,500	3,060	2,000
	Well	pcs	-	-	37	-
	River channel	m	-	-	5,000	-

Table 9.2.2: Dam Construction Period (1/4)

AT; Agitator Truck BM; Boring Machine CD; Crawler Drill CP; Concrete Pump DT; Dump Truck GM; Grout Pump RD; Ripperdozer TR; Tamping Roller
BD; Bulldozer C; Compresser CM; Concrete Mixing Plant DJ; Drill Jumbo G; Generator GP; Grout Pump TC; Truck Crane TS; Tractor Shovel

	Work Item	Unit	Quantity	Critical Equipment	Production Rate /hour	Production Rate /day	Working Days	Working Rate	Construction Days	Set no.	Construction Period day	Construction Period month	Other Equipments 1st	no.	2nd	no.	3rd	no.	4th	no.	5th	no.
I N'	Fifik																					
1	River Diversion Works										163	6										
	Excavation / hauling, soil & grave	m3	2,800	BD 44t	206.3	1,155.3	2.4	1.20	2.9	1	3		TS 5.4m3	1	DT 32t	4						
	- ditto -, rock, ripping	m3	19,360	RD 32t	174.5	977.2	19.8	1.20	23.8	1	24		BD 32t	2	TS 5.4m3	1	DT 32t	4				
	- ditto -, rock, blasting	m3	4,840	CD 150kg	-	168.0	28.8	1.20	34.6	1	35		BD 32t	1	TS 5.4m3	1	DT 32t	1				
	Reinforced concrete	m3	12,984	AT 4.4m3	6.9	38.6	336.0	1.20	403.2	4	101		CM 1.5m3* 2	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	DT 4t	1
2	Foundation Excavation										92	4										
	Excavation / hauling, soil & grave	m3	123,900	BD 44t	206.3	1,155.3	107.2	1.20	128.6	3	43		TS 5.4m3	3	DT 32t	12						
	- ditto -, rock, ripping	m3	39,200	RD 32t	174.5	977.2	40.1	1.20	48.1	2	25		BD 32t	4	TS 5.4m3	2	DT 32t	8				
	- ditto -, rock, blasting	m3	9,800	CD 150kg	-	168.0	58.3	1.20	70.0	3	24		BD 32t	1	TS 5.4m3	1	DT 32t	1				
3	Foundation Treatment Works																					
	Curtain grouting work	m	3,146	GP 7.8kw	-	8.5	370.1	1.20	444.1	2	223	8	BM 5.5kW	1	GM 2.2kW	2	G 60kVA	1				
4	Dam Emnbankment										469	16										
	Impervious zone	m3	142,500	TR 30t	80.7	451.9	315.3	1.20	378.4	1	379		BD 21t	1								
	Others	LS	1								90											
5	Spillway										540	18										
	Excavation / hauling, soil & grave	m3	343,300	BD 44t	206.3	1,155.3	297.2	1.20	356.6	3	119		TS 5.4m3	3	DT 32t	12						
	- ditto -, rock, ripping	m3	68,700	RD 32t	174.5	977.2	70.3	1.20	84.4	2	43		BD 32t	4	TS 5.4m3	2	DT 32t	8				
	- ditto -, rock, blasting	m3	17,100	CD 150kg	-	168.0	101.8	1.20	122.2	2	62		BD 32t	1	TS 5.4m3	1	DT 32t	1				
	Reinforced concrete	m3	59,665	CM 1.5m3* 2	40.5	226.8	263.1	1.20	315.7	1	316		AT 4.4m3	6	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	TC 25t	1
6	Outlet Works										245	9										
	Reinforced concrete	m3	1,260	AT 4.4m3	6.9	38.6	32.6	1.20	39.1	1	40		CM1.5m3* 2	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	DT 4t	1
	Gate and pipe installatior	LS	1								60		TC 25t	1	DT 4t	1						
	Plain concrete (plugging)	m3	4,642	AT 4.4m3	6.9	38.6	120.1	1.20	144.1	1	145		CP 1.5m3* 2	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1		

Table 9.2.2: Dam Construction Period (2/4)

AT; Agitator Truck BM; Boring Machine CD; Crawler Drill CP; Concrete Pump DT; Dump Truck GM; Grout Pump RD; Ripperdozer TR; Tamping Roller
BD; Bulldozer C; Compresser CM; Concrete Mixing Plant DJ; Drill Jumbo G; Generator GP; Grout Pump TC; Truck Crane TS; Tractor Shovel

	Work Item	Unit	Quantity	Critical Equipment	Production Rate /hour	Production Rate /day	Working Days	Working Rate	Construction Days	Set no.	Construction Period day	Construction Period month	Other Equipments 1st	no.	2nd	no.	3rd	no.	4th	no.	5th	no.
II	Taskourt																					
1	River Diversion Works										143	5										
	Excavation, Cutoff wall	LS	1							1	30		BD 44t	1	BH 1.2m3	1	TS 5.4m3	1	DT 32t	2		
	Reinforced concrete	m3	3,614	AT 4.4m3	6.9	38.6	93.5	1.20	112.2	1	113		CM 2.0m3* 3	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	TC 25t	1
2	Foundation Excavation										223	8										
	Excavation / hauling, soil & grave	m3	102,300	BD 44t	206.3	1,155.3	88.5	1.20	106.2	2	54		TS 5.4m3	2	DT 32t	8						
	- ditto -, rock, ripping	m3	111,840	RD 32t	174.5	977.2	114.4	1.20	137.3	2	69		BD 32t	4	TS 5.4m3	2	DT 32t	8				
	- ditto -, rock, blasting	m3	27,960	CD 150kg	-	168.0	166.4	1.20	199.7	2	100		BD 32t	1	TS 5.4m3	1	DT 32t	1				
3	Foundation Treatment Works										744	25										
	Curtain grouting work	m	6,437	GP 7.8kw	-	8.5	757.3	1.20	908.8	2	455		BM 5.5kW	1	GM 2.2kW	2	G 60kVA	1				
	Consolidation grouting work	m	2,041	GP 7.8kw	-	8.5	240.1	1.20	288.1	1	289		CD 150kg	1	GM 2.2kW	1	G 60kVA	1				
4	Dam Emnbankment										898	30										
	Concrete	m3	415,002	CM 2.0m3* 3	98.6	552.2	751.6	1.15	867.2	1	868		DT 10t	15	TS 2.0m3	1	G 100kVA	1	TC 25t	1		
	Others	LS	1								30											
5	Outlet Works										235	8										
	Reinforced concrete	m3	2,360	AT 4.4m3	6.9	38.6	61.1	1.20	73.3	1	74		CM 2.0m3* 3	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	DT 4t	1
	Gate and pipe installation	LS	1								80		TC 25t	1	DT 4t	1						
	Plain concrete (plugging)	m3	2,592	AT 4.4m3	6.9	38.6	67.1	1.20	80.5	1	81		CM 2.0m3* 3	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1		

Table 9.2.2: Dam Construction Period (3/4)

AT; Agitator Truck BM; Boring Machine CD; Crawler Drill CP; Concrete Pump DT; Dump Truck GM; Grout Pump RD; Ripperdozer TR; Tamping Roller
BD; Bulldozer C; Compresser CM; Concrete Mixing Plant DJ; Drill Jumbo G; Generator GP; Grout Pump TC; Truck Crane TS; Tractor Shovel

	Work Item	Unit	Quantity	Critical Equipment	Production Rate /hour	Production Rate /day	Working Days	Working Rate	Construction Days	Set no.	Construction Period day	Construction Period month	Other Equipments 1st	no.	2nd	no.	3rd	no.	4th	no.	5th	no.
III	Timkit																					
1	River Diversion Works										152	6										
	Excavation, Cutoff wall	LS	1							1	75		BD 44t	1	BH 1.2m3	1	TS 5.4m3	1	DT 32t	2		
	Reinforced concrete	m3	2,660	AT 4.4m3	6.9	38.6	68.8	1.11	76.4	1	77		CM 1.0m3* 2	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	TC 25t	1
2	Foundation Excavation										183	7										
	Excavation / hauling, soil & gravel	m3	73,400	BD 44t	206.3	1,155.3	63.5	1.11	70.6	2	36		TS 5.4m3	2	DT 32t	8						
	- ditto -, rock, ripping	m3	74,000	RD 32t	174.5	977.2	75.7	1.11	84.1	1	85		BD 32t	2	TS 5.4m3	1	DT 32t	4				
	- ditto -, rock, blasting	m3	18,500	CD 150kg	-	168.0	110.1	1.11	122.3	2	62		BD 32t	1	TS 5.4m3	1	DT 32t	1				
3	Foundation Treatment Works										683	23										
	Curtain grouting work	m	13,193	GP 7.8kw	-	8.5	1,552.1	1.11	1,724.6	3	575		BM 5.5kW	2	GM 2.2kW	3	G 60kVA	1				
	Consolidation grouting work	m	1,649	GP 7.8kw	-	8.5	194.0	1.11	215.6	2	108		CD 150kg	1	GM 2.2kW	2	G 60kVA	1				
4	Dam Emnbankment										773	26										
	Inner concrete	m3	226,725	CM 1.0m3* 2	58.4	327.0	693.3	1.07	742.8	1	743		DT 10t	5	TS 2.0m3	1	G 100kVA	1	TC 25t	1		
	Others	LS	1								30											
5	Outlet Works										152	6										
	Reinforced concrete	m3	615	AT 4.4m3	6.9	38.6	15.9	1.07	17.0	1	17		CM 1.0m3* 2	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	DT 4t	1
	Gate and pipe installation	LS	1								90		TC 25t	1	DT 4t	1						
	Plain concrete (plugging)	m3	1,615	AT 4.4m3	6.9	38.6	41.8	1.07	44.8	1	45		CM 1.0m3* 2	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1		
6	Sabo Dam										316	11										
	Excavation / hauling, soil & gravel	m3	25,500	BD 44t	206.3	1,155.3	22.1	1.20	26.5	2	14		TS 5.4m3	2	DT 32t	8						
	- ditto -, rock, ripping	m3	20,400	RD 32t	174.5	977.2	20.9	1.20	25.1	1	26		BD 32t	2	TS 5.4m3	1	DT 32t	4				
	- ditto -, rock, blasting	m3	5,100	CD 150kg	-	168.0	30.4	1.20	36.5	2	19		BD 32t	1	TS 5.4m3	1	DT 32t	1				
	Masonry	m3	47,815	BH 0.6m3	-	100.0	478.2	1.07	512.4	2	257		CM 0.5m3* 1	1	G 100kVA	1						

Table 9.2.2: Dam Construction Period (4/4)

AT; Agitator Truck BM; Boring Machine CD; Crawler Drill CP; Concrete Pump DT; Dump Truck GM; Grout Pump RD; Ripperdozer TR; Tamping Roller
BD; Bulldozer C; Compresser CM; Concrete Mixing Plant DJ; Drill Jumbo G; Generator GP; Grout Pump TC; Truck Crane TS; Tractor Shovel

	Work Item	Unit	Quantity	Critical Equipment	Production Rate /hour	Production Rate /day	Working Days	Working Rate	Construction Days	Set no.	Construction Period day	Construction Period month	Other Equipments 1st	no.	2nd	no.	3rd	no.	4th	no.	5th	no.
IV	Azghar																					
1	River Diversion Works										216	8										
	Excavation / hauling, soil & gravel	m3	53,400	BD 44t	206.3	1,155.3	46.2	1.20	55.4	1	56		TS 5.4m3	1	DT 32t	4						
	- ditto -, rock, ripping	m3	18,320	RD 32t	174.5	977.2	18.7	1.20	22.4	1	23		BD 32t	2	TS 5.4m3	1	DT 32t	4				
	- ditto -, rock, blasting	m3	4,580	CD 150kg	-	168.0	27.3	1.20	32.8	1	33		BD 32t	1	TS 5.4m3	1	DT 32t	1				
	Reinforced concrete	m3	13,320	AT 4.4m3	6.9	38.6	344.7	1.20	413.6	4	104		CM 1.5m3* 2	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	DT 4t	1
2	Foundation Excavation										229	8										
	Excavation / hauling, soil & gravel	m3	211,100	BD 44t	206.3	1,155.3	182.7	1.30	238.3	2	120		TS 5.4m3	2	DT 32t	8						
	- ditto -, rock, ripping	m3	37,520	RD 32t	249.2	1,395.5	26.9	1.30	35.1	1	36		BD 32t	2	TS 5.4m3	1	DT 32t	4				
	- ditto -, rock, blasting	m3	9,380	CD 150kg	-	168.0	55.8	1.30	72.8	1	73		BD 32t	1	TS 5.4m3	1	DT 32t	1				
3	Foundation Treatment Works																					
	Curtain grouting work	m	4,791	GP 7.8kw	-	8.5	563.6	1.30	735.1	2	368	13	BM 5.5kW	1	GM 2.2kW	2	G 60kVA	1				
4	Dam Emnbankment										438	15										
	Impervious zone	m3	130,900	TR 30t	80.7	451.9	289.7	1.20	347.6	1	348		BD 21t	1								
	Others	LS	1								90											
5	Spillway										353	12										
	Excavation / hauling, soil & gravel	m3	156,000	BD 44t	206.3	1,155.3	135.0	1.30	176.1	2	89		TS 5.4m3	2	DT 32t	8						
	- ditto -, rock, ripping	m3	31,200	RD 32t	174.5	977.2	31.9	1.30	41.6	1	42		BD 32t	2	TS 5.4m3	1	DT 32t	4				
	- ditto -, rock, blasting	m3	7,800	CD 150kg	-	168.0	46.4	1.30	60.5	2	31		BD 32t	1	TS 5.4m3	1	DT 32t	1				
	Reinforced concrete	m3	29,390	AT 4.4m3	6.9	38.6	760.6	1.25	950.8	5	191		CM 0.5m3* 1	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	TC 25t	1
6	Outlet Works										262	9										
	Reinforced concrete	m3	1,099	AT 4.4m3	6.9	38.6	28.4	1.25	35.5	1	36		CM 1.5m3* 2	1	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1	DT 4t	1
	Gate and pipe installation	LS	1								90		TC 25t	1	DT 4t	1						
	Plain concrete (plugging)	m3	10,220	CM 0.5m3* 1	16.8	94.1	108.6	1.25	135.8	1	136		AT 4.4m3	3	TS 2.0m3	1	G 100kVA	1	CP 100m3/h	1		

Table 9.2.3: Construction Schedule

Site	Work		Volume	Unit	1st year	2nd year	3rd year	4th year
No.5 N' fifik	Preparatory Work and Access Road etc.		1	LS				
	River Diversion		200	m				
	Dam	Excavation	172,900	m^3				
		Foudation Treatment	3,150	m				
		Embankment	678,400	m^3				
	Spillway		59,700	m^3				
	Intake and Outlet		1	LS				
	Others		1	LS				
	Irrigation Facilities		1	LS				
No.9 Taskourt	Preparatory Work and Access Road etc.		1	LS				
	River Diversion		52	m				
	Dam	Excavation	242,100	m^3				
		Foudation Treatment	8,500	m				
		Embankment	415,000	m^3				
	Spillway		-	m^3				
	Intake and Outlet		1	LS				
	Others		1	LS				
	Irrigation Facilities		1	LS				
No.10 Timkit	Preparatory Work and Access Road etc.		1	LS				
	River Diversion		43	m				
	Dam	Excavation	165,900	m^3				
		Foudation Treatment	14,800	m				
		Embankment	227,600	m^3				
	Spillway		-	m^3				
	Intake and Outlet		1	LS				
	Sabo Dam		47,800	m^3				
	Others		1	LS				
	Irrigation Facilities		1	LS				
No.17 Azghar	Preparatory Work and Access Road etc.		1	LS				
	River Diversion		240	m				
	Dam	Excavation	258,000	m^3				
		Foudation Treatment	4,800	m				
		Embankment	746,700	m^3				
	Spillway		29,400	m^3				
	Intake and Outlet		1	LS				
	Others		1	LS				
	Irrigation Facilities		1	LS				

Table 9.3.1: Basic Cost of Labor

No.	Description	Spec	Basic Cost (DH/day)
L1	Foreman	-	172.70
L2	Skilled Labor	-	79.90
L3	Common Labor	-	79.90
L4	Scaffolding Man	-	110.90
L5	Carpenter	-	110.90
L6	Reinforcement Worker	-	79.90
L7	Welder	-	117.60
L8	Plaster	-	110.90
L9	Mason	-	110.90
L10	Painter	-	98.20
L11	Electrician	-	117.60
L12	Mechanic	-	135.70
L13	Rock Driller	-	110.90
L14	Plumber	-	110.90
L15	Plant Operator	-	152.70
L16	Operator A	Heavy Equipment	152.70
L17	Operator B	Light Equipment	98.00
L18	Driver	-	98.00

Table 9.3.2: Basic Cost of Material (1/3)

No.	Description	Spec	Unit	Basic Cost (DH)
M1	Cement	-	ton	850
M2	Fine Aggregate	-	m^3	480
M3	Coarse Aggregate	5-15mm	m^3	320
M4	Coarse Aggregate	15-25mm	m^3	320
M5	Crusher Run	0-40mm	m^3	240
M6	Rubble	-	m^3	144
M7	Deformed Steel Bar	-	ton	10,200
M8	Gasoline	-	lit	9.09
M9	Diesel	-	lit	6.1
M10	Oil	-	lit	19.2
M11	Asphalt Mixture	-	ton	6,000
M12	Gunpowder	for blasting	kg	9.3
M13	Detonator	-	pcs	17
M14	Block	L;35cm	m^3	144
M15	Concrete Block	0.2* 0.2* 0.4m	pcs	5.82
M16	Brick	0.15* 0.2* 0.4m	pcs	5.16
M17	Plywood	15mm	m^2	204
M18	Timber	Plank	m^3	3,600
M19	Scaffolding Board	240* 4,000mm	pcs	3,500
M20	Form Oil	20m2/lit	lit	36
M21	Nail	-	kg	11
M22	Binding Wire	-	kg	10
M23	Wire	D8mm	m	12
M24	Barbed Wire	# 14, 50mm	m	68
M25	Gabion	-	m^3	500
M26	Channel Steel	100mm	ton	6,800
M27	Angle Steel	50* 50* 5mm	ton	7,000
M28	H Beam	200mm	ton	6,700
M29	Steel Water Tank	2,000lit	pcs	25,000
M30	Semicircular Pipe	D600< =800mm	m	750
M31	Semicircular Pipe	D300< =400mm	m	250
M32	Steel Pipe	D800, t;6mm	m	2,268
M33	Steel Pipe	D600, t;6mm	m	1,540

Table 9.3.2: Basic Cost of Material (2/3)

No.	Description	Spec	Unit	Basic Cost (DH)
M34	PC Pipe PC10	D400, 7m	m	85
M35	PC Pipe PC10	D600, 7m	m	170
M36	PC Pipe PC10	D800, 7m	m	250
M37	RC Pipe	D300< =400mm	m	150
M38	RC Pipe	D500< =600mm	m	425
M39	RC Pipe	D600< =800mm	m	550
M40	RC Pipe	D800< =1,200mm	m	750
M41	PVC Pipe	10Bar, D110mm	m	88.67
M42	PVC Pipe	10Bar, D160mm	m	151.67
M43	PVC Pipe	10Bar, D200mm	m	235
M44	PVC Pipe	10Bar, D250mm	m	438.33
M45	PVC Pipe	10Bar, D3150mm	m	698.33
M46	Asbestos Pipe	D100mm, 5m	pcs	720
M47	Asbestos Pipe	D150mm, 5m	pcs	1110
M48	Asbestos Pipe	D200mm, 5m	pcs	1765
M49	Asbestos Pipe	D250mm, 5m	pcs	2270
M50	Asbestos Pipe	D300mm, 5m	pcs	2895
M51	Sluice Valve	D100mm	pcs	173
M52	Sluice Valve	D200mm	pcs	334
M53	Sluice Valve	D250mm	pcs	495
M54	Sluice Valve	D300mm	pcs	743
M55	Butterfly Valve	D100mm	pcs	672
M56	Butterfly Valve	D200mm	pcs	1,815
M57	Butterfly Valve	D250mm	pcs	6,504
M58	Butterfly Valve	D300mm	pcs	7,740
M59	Survey Pole	4M stainless	pcs	16,000
M60	Helmet	-	pcs	51
M61	Boot	-	pcs	77
M62	Rope	9mm	kg	250
M63	Fire Extinguisher	Powder, p;6kg	pcs	780
M64	Light	300w10m code	pcs	750
M65	Gas Cutter	-	pcs	210
M66	Electric Drill	300w10m code	pcs	15,000

Table 9.3.2: Basic Cost of Material (3/3)

No.	Description	Spec	Unit	Basic Cost (DH)
M67	Electric Saw	-	pcs	600
M68	Welding Rod	240pcs	pcs	500
M69	Admixture	-	kg	45
M70	Cross Bit	D65mm	pcs	350
M71	Rod	D38mm, L=3m	pcs	1,240
M72	Shank Lod	D38mm	pcs	2,319
M73	Diamond Bit	D46mm, 12ct	pcs	1,330
M74	Diamond Leaming Shell	D46mm, 4ct	pcs	185
M75	Core Tube	D46single, 1.5m	pcs	2,700
M76	Core Lifter	D46mm	pcs	2,700
M77	Boring Lod	D40.5mm, L=3m	pcs	1,240
M78	Electric Power Charge	40A	kwh	4,500
M79	Water Stop	PVC, B=300mm	m	300
M80	Net Fence	H=1.5m	m	1,200
M81	RC Pipe	D< =100mm	m	32
M82	RC Pipe	D100< =200mm	m	42.5
M83	RC Pipe	D200< =300mm	m	100
M84	RC Pipe	D400< =500mm	m	225
M85	RC Pipe	D1,200< =1,300mm	m	900
M86	Semicircular Pipe	D< =100mm	m	32.5
M87	Semicircular Pipe	D100< =200mm	m	42.5
M88	Semicircular Pipe	D200< =300mm	m	150
M89	Semicircular Pipe	D400< =500mm	m	350
M90	Semicircular Pipe	D500< =600mm	m	500
M91	Semicircular Pipe	D800< =1,200mm	m	900
M92	Timber	Square	m^3	130
M93	Timber	Log L=2m	kg	1
M94	Timber	Log L=3m	kg	1.1
M95	Timber	Log L=4m	kg	1.2
M96	Timber	Log L> 4m	kg	1.5
M97	Sleeve	38mm	pcs	998
M98	Metal Crown	D46mm	pcs	400
M99	Injection Pipe (inner)	D46mm, 1.5m	pcs	322
M100	Injection Pipe (outer)	D46mm, 1.5m	pcs	322

Table 9.3.3: Basic Cost of Equipment

No.	Description	Spec	Basic Cost (DH/day)
E1	Bulldozer	44t	6,730
E2	Bulldozer	32t	5,050
E3	Bulldozer	21t	4,500
E4	Bulldozer	11t	2,050
E5	Swamp Bulldozer	16t	2,640
E6	Ripperdozer	44t	4,490
E7	Ripperdozer	32t	3,670
E8	Tractor Shovel	5.4m^3	6,080
E9	Tractor Shovel	3.2m^3	2,400
E10	Tractor Shovel	2.0m^3	1,570
E11	Backhoe	1.2m^3	5,820
E12	Backhoe	0.6m^3	2,590
E13	Backhoe w/slope bucket	0.6m^3	2,590
E14	Backhoe	0.4m^3	1,660
E15	Breaker (attachment)	0.6m^3	1,218
E16	Dump Truck	32t	5,140
E17	Dump Truck	10t	1,320
E18	Dump Truck	7t	940
E19	Dump Truck	4t	520
E20	Dump Truck (Tunnel)	14t	3,320
E21	Tamping Roller	30t	4,910
E22	Road Roller	10-12t	880
E23	Vibrating Roller	15-18t	2,700
E24	Vibrating Roller	11t	2,500
E25	Vibrating Roller	600kg	170
E26	Tire roller	8-20t	1,020
E27	Vibratory Compactor	90kg	36
E28	Tamper	60kg	45
E29	Motor Grader	3.1m, 115ps	2,560
E30	Pick Hammer	-	9
E31	Jack Hammer	20kg	50
E32	Leg Drill	40kg	70
E33	Crawler Drill	150kg(Oil)	5,930
E34	Boring Machine (Rotary)	5.5kw	304
E35	Air Compressor	5m^3/min	269
E36	Air Compressor	10m^3/min	547
E37	Ventilation Fun	400m^3/min	258
E38	Grouting Pump	7.8kw	220
E39	Grouting Pump	4.4kw	145
E40	Grouting Mixer	5.5kw	187
E41	Grouting Mixer	2.2kw	114
E42	Concrete Mixer	0.5m2	2,050
E43	Concrete Mixing Plant	1.5m^3* 2	8,290
E44	Concrete Mixing Plant	3.0m^3* 2	11,610
E45	Crushing Plant	576m3/d,100t/h	9,170
E46	Generator	60kVA	319
E47	Generator	100kVA	421
E48	Generator	150kVA	622
E49	Agitator Truck	4.4-4.5m3	1,160
E50	Concrete Pumping Car	90-110m3/h	4,740
E51	Truck Crane	25t	4,600
E52	Finisher (Asphalt)	2.4-4.5m	4,020
E53	Welding Machine	300A	17
E54	Watering Truck	5.5-6.5t	850
E55	Grout Central Plant	150l/min	1,358
E56	Grout Injection Gauge	120l/min	1,066
E57	Grout Data Recorder	-	505
E58	Screen	1500* 3500	870
E59	Concrete Mixer	0.5m3	1,025
E60	Generator	10kVA	128

Remarks
All Equipement in this table can be procured in Morocco

Table 9.3.4: Cost Estimate Table

		Cost Amount (1,000DH)														
		No.5 N'Fifikh			No.9 Taskourt			No.10 Timkit			No.17 Azghar			Total		
		Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
A	Dam	H=47.5m, Vol.=678,400m3			H=73.5m, Vol.=415,000m3			H=64.5m, Vol.=227,600m3			H=42.5m, Vol.=769,800m3					
	1 River Diversion Works	6,325	11,745	18,070	1,823	3,384	5,207	1,161	2,156	3,317	6,776	12,588	19,364	16,085	29,873	45,958
	2 Foundation Excavation	2,676	4,971	7,647	6,025	11,196	17,221	3,673	6,826	10,499	3,356	6,234	9,590	15,730	29,227	44,957
	3 Foundation Treatment Works	1,245	2,313	3,558	3,392	6,300	9,692	6,183	11,484	17,667	1,897	3,522	5,419	12,717	23,619	36,336
	4 Dam Emnbankment	4,041	7,515	11,556	61,548	114,308	175,856	29,996	55,708	85,704	5,606	10,425	16,031	101,191	187,956	289,147
	5 Spillway	24,670	45,820	70,490	716	1,331	2,047	347	643	990	12,352	22,941	35,293	38,085	70,735	108,820
	6 Outlet Works	1,283	2,383	3,666	842	1,565	2,407	208	386	594	422	783	1,205	2,755	5,117	7,872
	7 Gate and Pipe	2,998	5,566	8,564	4,340	8,059	12,398	1,203	2,235	3,438	4,347	8,072	12,419	12,888	23,932	36,820
	(8 Sabo Dam, No.10 Timkit only)	-	-	-	-	-	-	6,601	12,261	18,862	-	-	-	6,601	12,261	18,862
	Sub-total	43,238	80,313	123,551	78,686	146,143	224,828	49,372	91,699	141,071	34,756	64,565	99,321	206,052	382,720	588,772
	8 Overhead and Profit of Contractor	6,860	12,742	19,602	17,692	32,860	50,552	7,457	13,850	21,307	4,612	8,566	13,178	36,621	68,018	104,639
	Sub-total (Direct Construction Cost)	50,098	93,055	143,153	96,378	179,003	275,380	56,829	105,549	162,378	39,368	73,131	112,499	242,673	450,738	693,411
	9 Physical Contingency (10%)	5,010	9,306	14,316	9,638	17,900	27,538	5,683	10,555	16,238	3,937	7,313	11,250	24,268	45,074	69,342
	Sub-total (1-9)	55,108	102,361	157,469	106,016	196,903	302,918	62,512	116,104	178,616	43,305	80,444	123,749	266,941	495,812	762,753
	10 Price Contingency (3%/year)	12,668	23,530	36,198	24,370	45,263	69,633	14,370	26,689	41,059	9,955	18,492	28,447	61,363	113,974	175,337
	Sub-total (1-10)	67,776	125,891	193,667	130,386	242,166	372,551	76,882	142,793	219,675	53,260	98,936	152,196	328,304	609,786	938,090
	11 Value Added Tax (14%)	9,489	17,625	27,114	18,254	33,903	52,157	10,764	19,991	30,755	7,456	13,851	21,307	45,963	85,370	131,333
	Grand Total	77,200	143,500	220,700	148,600	276,000	424,600	87,600	162,700	250,300	60,700	112,700	173,400	374,100	694,900	1,069,000
	Unit Cost (DH/m3)			325			1,023			1,100			225			
B	Irrigation Facilities	Area=1,000ha			Area=4,500ha			Area=3,060ha			Area=2,000ha					
	1 Miain Canal	6,410	6,410	12,820	19,276	19,276	38,552	7,946	7,946	15,892	6,111	6,111	12,222	39,743	39,743	79,486
	2 Structures	10,647	10,647	21,294	42,268	42,268	84,536	44,535	44,535	89,070	28,159	28,159	56,318	125,609	125,609	251,218
	Sub-total	17,057	17,057	34,114	61,544	61,544	123,088	52,481	52,481	104,962	34,270	34,270	68,540	165,352	165,352	330,704
	3 Overhead and Profit of Contractor	1,194	1,194	2,388	4,308	4,308	8,616	3,674	3,674	7,348	2,399	2,399	4,798	11,575	11,575	23,150
	Sub-total (Direct Construction Cost)	18,251	18,251	36,502	65,852	65,852	131,704	56,155	56,155	112,310	36,669	36,669	73,338	176,927	176,927	353,854
	4 Physical Contingency (10%)	1,825	1,825	3,650	6,585	6,585	13,170	5,616	5,616	11,232	3,667	3,667	7,334	17,693	17,693	35,386
	Sub-total (1-9)	20,076	20,076	40,152	72,437	72,437	144,874	61,771	61,771	123,542	40,336	40,336	80,672	183,045	183,045	366,090
	5 Price Contingency (3%/year)	4,617	4,617	9,234	16,661	16,661	33,322	14,207	14,207	28,414	9,277	9,277	18,554	44,762	44,762	89,524
	Sub-total (1-10)	24,693	24,693	49,386	89,098	89,098	178,196	75,978	75,978	151,956	49,613	49,613	99,226	227,807	227,807	455,614
	6 Value Added Tax (14%)	3,457	3,457	6,914	12,474	12,474	24,948	10,637	10,637	21,274	6,946	6,946	13,892	33,514	33,514	67,028
	Grand Total	28,150	28,150	56,300	101,570	101,570	203,100	86,610	86,610	173,200	56,550	56,550	113,100	272,880	272,880	545,760
	Unit Cost (DH/ha)			56,300			45,100			56,600			56,600			
C	Total of Dam and Irrigation			277,000			627,700			423,500			286,500			1,614,760

Table 10.1.1: Alternative Plans Subject to Economic Evaluation

Project	Alternative	Dam (Annual water resources development)	Irrigation type	Net irrigable area with 80% probability (ha)	Net irrigable area with 20% probability (ha)	Annual average irrigable area (ha)	Net irrigation development area (ha)	Gross irrigation development area (ha)	Applied cropping pattern	Remarks
a	b	c	d	e	f	g	h	I	j	k
N' fifikh (upstream)	NU1	Proposed plan (6.4 Mm3)	Gravity: 100 %	780	1,000	853	1,000	1,250	Improved cropping pattern proposed by JICA team	
	NU2	- ditto -	- ditto -	810	1,030	886	1,030	1,290	Existing cropping pattern	
	NU3	- ditto -	- ditto -	590	740	645	1,000	1,250	To enhance vegetable cultivation	
	NU4	- ditto -	Gravity: 50 % Mechanical: 50 %	900	1,170	984	1,170	1,460	Improved cropping pattern proposed by JICA team	
	NU5	- ditto -	Gravity 100% with pump	780	1,000	853	1,000	1,250	Improved cropping pattern proposed by JICA team	To irrigate farmlands on the left bank just downstream of the dam
N' fifikh (downstream)	ND1	Intake weir and pumping station	Mechanical: 100 % with pump	210	260	228	260	330	Improved cropping pattern proposed by JICA team	Mechanical irrigation only.
	ND2	Small dam at proposed weir location	Mechanical: 100 % with pump	470	590	510	590	740	- ditto -	- ditto -
Taskourt	TA1	Proposed plan (36 Mm3)	Gravity: 100 %	3,530	4,500	3,831	4,500	6,000	Improved cropping pattern proposed by JICA team	Perennial: 900 ha Seasonal: remaining area
	TA2	- ditto -	Gravity: 50 % Mechanical: 50 %	4,060	5,100	4,406	5,100	6,000	- ditto -	- ditto -
	TA3	Small dam (24 Mm3)	Gravity: 100 %	2,500	3,150	2,713	4,500	6,000	- ditto -	- ditto -
	TA4	- ditto -	Gravity: 50 % Mechanical: 50 %	2,880	3,620	3,126	4,500	6,000	- ditto -	- ditto -
Timkit	TI1	Proposed plan	Gravity: 100% with pump wells	1,110 + 240 in Ifegh	-	1,450 +240 in Ifegh	3,060	3,825	Improved cropping pattern proposed by JICA team	To irrigate farmlands with sub-surface and surface water except Ifegh irrigated by surface water.
	TI2	- ditto -	- ditto -	1,460 +240 in Ifegh	-	1,330 +240 in Ifegh	3,060	3,825	- ditto -	To irrigate farmlands with sub-surface water except Ifegh irrigated by surface water.
Azghar	AZ1	Proposed plan (28 Mm3)	Gravity: 100 %	2,000	-	2,000	2,000	2,350	Improved cropping pattern proposed by JICA team	Negative benefit will be taken into account.

Table 10.1.2: Annual Agricultural Benefit of Alternative Plans

Project	Alternative plans	Location within the Project	Annual average irrigable area (ha)	Benefit without Project		Benefit with Project		Incremental net benefit with Project (million DH)
				Unit benefit (DH/ha)	Total benefit (million DH)	Unit benefit (DH/ha)	Total benefit (million DH)	
a	b	c	d	e	f = d x e	g	h = d x g	i = h - f
N' fifikh (upstream)	NU1	Upstream	853	2,267	1.9	18,053	15.4	13.5
	NU2	Upstream	886	2,267	2.0	8,369	7.4	5.4
	NU3	Upstream	645	2,267	1.5	29,758	19.2	17.7
	NU4	Upstream	984	2,267	2.2	18,053	17.8	15.6
	NU5	Upstream	853	2,267	1.9	18,053	15.4	13.5
N' fifikh (downstream)	ND1	Downstream	228	2,181	0.5	16,114	3.7	3.2
	ND2	Downstream	510	2,181	1.1	16,114	8.2	7.1
Taskourt	TA1	Perennial irrigation area	900	12,420	11.2	22,330	20.1	8.9
		Seasonal & flood irri. area	2,931	138	0.4	22,330	65.4	65.0
		Total	3,831	-	11.6	-	85.5	73.9
	TA2	Perennial irrigation area	900	12,420	11.2	22,330	20.1	8.9
		Seasonal & flood irri. area	3,506	138	0.5	22,330	78.3	77.8
		Total	4,406	-	11.7	-	98.4	86.7
	TA3	Perennial irrigation area	900	12,420	11.2	22,330	20.1	8.9
		Seasonal & flood irri. area	1,813	138	0.3	22,330	40.5	40.2
		Total	2,713	-	11.5	-	60.6	49.1
	TA4	Perennial irrigation area	900	12,420	11.2	22,330	20.1	8.9
		Seasonal & flood irri. area	2,226	138	0.3	22,330	49.7	49.4
		Total	3,126	-	11.5	-	69.8	58.3
Timkit	TI1	Ifeg	240	7,710	1.9	27,260	6.5	4.6
		Tinejdad	1,173	8,876	10.4	25,554	30.0	19.6
		Chtam	277	2,752	0.8	16,844	4.7	3.9
		Total	1,690	-	13.1	-	41.2	28.1
	TI2	Ifeg	240	7,710	1.9	27,260	6.5	4.6
		Tinejdad	1,075	8,876	9.5	25,554	27.5	18.0
		Chtam	255	2,752	0.7	16,844	4.3	3.6
		Total	1,570	-	12.1	-	38.3	26.2
Azghar	AZ1	Whole area	2,000	165	0.3	29,278	58.6	58.3

Table 10.1.3: Results of Economic Evaluation of Irrigation Alternative Plans (Agricultural Benefit Only)

Project	Alter-native	EIRR	B/C	NPV (Unit: Million DH)				Remarks
			DR=8%	DR=6%	DR=8%	DR=10%	DR=12%	
N'fifikh (upstream)	**NU1**	4.5%	0.62	-39.1	-69.8	-86.3	-95.1	
	NU2	-0.7%	0.24	-137.6	-140.1	-138.8	-135.6	
	NU3	6.1%	0.77	2.2	-41.7	-66.4	-80.4	
	NU4	3.6%	0.55	-77.9	-109.0	-124.9	-132.6	
	NU5	3.9%	0.58	-54.5	-81.3	-95.3	-102.3	
N'fifikh (downstream)	**ND1**	4.5%	0.65	-8.0	-13.9	-17.0	-18.6	
	ND2	2.9%	0.50	-44.4	-55.5	-60.8	-63.0	
Taskourt	**TA1**	7.2%	0.91	128.2	-59.1	-164.0	-223.6	
	TA2	6.2%	0.79	25.5	-174.7	-283.7	-343.0	
	TA3	7.3%	0.91	85.9	-36.2	-104.5	-143.3	
	TA4	5.9%	0.76	-9.8	-138.5	-207.8	-244.6	
Timkit	**TI1**	6.2%	0.80	8.9	-55.1	-89.9	-108.9	
	TI2	5.7%	0.74	-13.6	-70.8	-101.4	-117.6	
Azghar	**AZ1**	10.6%	1.38	175.1	73.7	13.8	-23.1	After adjustment of the negative benefit to downstream reservoirs.

Table 10.1.4: Financial and Economic Project Cost (1/2)

Cost Item	F.C. (million DH)		L.C. (million DH)		Total financial	Total economic
	Financial cost	Economic cost	Financial cost	Economic cost	cost (million DH)	cost (million DH)
N'fifikh (Upstream)						
1. Construction cost						
1.1 Dam and appurtenant facilities	93.0	93.0	50.1	43.1	143.1	136.1
1.2 Irrigation facilities	18.3	18.3	18.2	15.7	36.5	34.0
1.3 Water supply system	0.0	0.0	1.4	1.2	1.4	1.2
2. Resettlement cost	0.0	0.0	3.3	2.8	3.3	2.8
3. Engineering services cost	8.2	8.2	4.5	4.5	12.7	12.7
4. Administration cost	0.0	0.0	9.2	8.7	9.2	8.7
5. Physical contingency	12.0	12.0	8.7	7.6	20.7	19.6
Sub-total of (1.- 5.)	131.5	131.5	95.4	83.6	226.9	215.1
6. Price Contingency	25.7	0.0	18.6	0.0	44.3	0.0
Sub-total of (1.- 6.)	157.2	131.5	114.0	83.6	271.2	215.1
7. Value Added Tax	0.0	0.0	38.9	0.0	38.9	0.0
Total of (1.- 7.)	157.2	131.5	152.9	83.6	310.1	215.1
Taskourt						
1. Construction cost						
1.1 Dam and appurtenant facilities	179.0	179.0	96.4	82.9	275.4	261.9
1.2 Irrigation facilities	65.9	65.9	65.8	56.6	131.7	122.5
1.3 Water supply system	0.0	0.0	2.4	2.1	2.4	2.1
2. Resettlement cost	0.0	0.0	28.5	24.6	28.5	24.6
3. Engineering services cost	18.6	18.6	10.1	10.1	28.7	28.7
4. Administration cost	0.0	0.0	21.9	20.6	21.9	20.6
5. Physical contingency	26.4	26.4	22.5	19.7	48.9	46.1
Sub-total of (1.- 5.)	289.9	289.9	247.6	216.6	537.5	506.5
6. Price Contingency	55.8	0.0	45.2	0.0	101.0	0.0
Sub-total of (1.- 6.)	345.7	289.9	292.8	216.6	638.5	506.5
7. Value Added Tax	0.0	0.0	91.6	0.0	91.6	0.0
Total of (1.- 7.)	345.7	289.9	384.4	216.6	730.1	506.5
Timkit						
1. Construction cost						
1.1 Dam and appurtenant facilities	105.5	105.5	56.8	48.8	162.3	154.3
1.2 Irrigation facilities	56.2	56.2	56.1	48.2	112.3	104.4
2. Resettlement cost	0.0	0.0	6.4	5.5	6.4	5.5
3. Engineering services cost	12.5	12.5	6.7	6.7	19.2	19.2
4. Administration cost	0.0	0.0	14.0	13.2	14.0	13.2
5. Physical contingency	17.4	17.4	14.0	12.2	31.4	29.6
Sub-total of (1.- 5.)	191.6	191.6	154.0	134.6	345.6	326.2
6. Price Contingency	43.2	0.0	34.3	0.0	77.5	0.0
Sub-total of (1.- 6.)	234.8	191.6	188.3	134.6	423.1	326.2
7. Value Added Tax	0.0	0.0	60.8	0.0	60.8	0.0
Total of (1.- 7.)	234.8	191.6	249.1	134.6	483.9	326.2
Azghar						
1. Construction cost						
1.1 Dam and appurtenant facilities	73.1	73.1	39.4	33.9	112.5	107.0
1.2 Irrigation facilities	36.7	36.7	36.6	31.5	73.3	68.2
2. Resettlement cost	0.0	0.0	5.1	4.4	5.1	4.4
3. Engineering services cost	8.5	8.5	4.5	4.5	13.0	13.0
4. Administration cost	0.0	0.0	9.5	9.0	9.5	9.0
5. Physical contingency	11.8	11.8	9.5	8.3	21.3	20.1
Sub-total of (1.- 5.)	130.1	130.1	104.6	91.6	234.7	221.7
6. Price Contingency	25.9	0.0	20.4	0.0	46.3	0.0
Sub-total of (1.- 6.)	156.0	130.1	125.0	91.6	281.0	221.7
7. Value Added Tax	0.0	0.0	40.4	0.0	40.4	0.0
Total of (1.- 7.)	156.0	130.1	165.4	91.6	321.4	221.7

Table 10.1.4: Financial and Economic Project Cost (2/2)

Cost Item		F.C. (million DH)		L.C. (million DH)		Total financial cost (million DH)	Total economic cost (million DH)
		Financial cost	Economic cost	Financial cost	Economic cost		
TOTAL							
1.	Construction cost						
1.1	Dam and appurtenant facilities	450.6	450.6	242.7	208.7	693.3	659.3
1.2	Irrigation facilities	177.1	177.1	176.7	152.0	353.8	329.1
1.3	Water supply system	0.0	0.0	3.8	3.3	3.8	3.3
2.	Resettlement cost	0.0	0.0	43.3	37.3	43.3	37.3
3.	Engineering services cost	47.8	47.8	25.8	25.8	73.6	73.6
4.	Administration cost	0.0	0.0	54.6	51.5	54.6	51.5
5.	Physical contingency	67.6	67.6	54.7	47.8	122.3	115.4
	Sub-total of (1.- 5.)	743.1	743.1	601.6	526.4	1,344.7	1,269.5
6.	Price Contingency	150.6	0.0	118.5	0.0	269.1	0.0
	Sub-total of (1.- 6.)	893.7	743.1	720.1	526.4	1,613.8	1,269.5
7.	Value Added Tax	0.0	0.0	231.7	0.0	231.7	0.0
	Total of (1.- 7.)	893.7	743.1	951.8	526.4	1,845.5	1,269.5

Note: 1. Price level: as of April 2000, US$1.0 = 10.68 DH, J. Yen100 = 9.90 DH

2. F.C. means foreign currency portion and L.C. means local currency portion

3. Engineering service fee is estimated as 7 % of total construction cost

4. Administration cost is estimated as 5 % of construction cost and resettlement cost.

5. Physical contingency: 10% of all items

6. Price contingency: 3% per annum for all items

7. Value added tax: 20% for engineering services and 14% for all other items

Table 10.1.5: Breakdown of Annual Cost (Economic Price, million DH)

Cost Item		Year in Order								Total cost
		1st	2nd	3rd	4th	5th	6th	7th	8th	(million DH)
N'fifikh (Upstream)										
1.	Construction cost									
1.1	Dam and appurtenant facilities	-	32.7	69.4	34.0	-	-	-	-	136.1
1.2	Irrigation facilities	-	6.8	17.0	10.2	-	-	-	-	34.0
1.3	Water supply system	-	-	-	1.2	-	-	-	-	1.2
2.	Resettlement cost	1.4	1.4	-	-	-	-	-	-	2.8
3.	Engineering services cost	-	2.9	6.4	3.4	-	-	-	-	12.7
4.	Administration cost	0.1	2.0	4.3	2.3	-	-	-	-	8.7
5.	Physical contingency	0.2	4.6	9.7	5.1	-	-	-	-	19.6
	Total of (1.- 5.)	1.7	50.4	106.8	56.2	-	-	-	-	215.1
Taskourt										
1.	Construction cost									
1.1	Dam and appurtenant facilities	-	28.8	60.2	86.4	86.5	-	-	-	261.9
1.2	Irrigation facilities	-	-	24.5	61.3	36.7	-	-	-	122.5
1.3	Water supply system	-	-	-	-	2.1	-	-	-	2.1
2.	Resettlement cost	12.3	12.3	-	-	-	-	-	-	24.6
3.	Engineering services cost	-	2.1	6.3	11.0	9.3	-	-	-	28.7
4.	Administration cost	0.6	2.1	4.2	7.4	6.3	-	-	-	20.6
5.	Physical contingency	1.3	4.5	9.5	16.6	14.2	-	-	-	46.1
	Total of (1.- 5.)	14.2	49.8	104.7	182.7	155.1	-	-	-	506.5
Timkit										
1.	Construction cost									
1.1	Dam and appurtenant facilities	-	26.2	33.9	50.9	43.3	-	-	-	154.3
1.2	Irrigation facilities	-	-	20.9	52.2	31.3	-	-	-	104.4
2.	Resettlement cost	2.8	2.7	-	-	-	-	-	-	5.5
3.	Engineering services cost	-	2.0	4.0	7.7	5.5	-	-	-	19.2
4.	Administration cost	0.1	1.4	2.7	5.2	3.8	-	-	-	13.2
5.	Physical contingency	0.3	3.2	6.2	11.6	8.3	-	-	-	29.6
	Total of (1.- 5.)	3.2	35.5	67.7	127.6	92.2	-	-	-	326.2
Azghar										
1.	Construction cost									
1.1	Dam and appurtenant facilities	-	25.7	40.7	40.6	-	-	-	-	107.0
1.2	Irrigation facilities	-	13.6	34.1	20.5	-	-	-	-	68.2
2.	Resettlement cost	2.2	2.2	-	-	-	-	-	-	4.4
3.	Engineering services cost	-	2.9	5.5	4.6	-	-	-	-	13.0
4.	Administration cost	0.1	2.1	3.7	3.1	-	-	-	-	9.0
5.	Physical contingency	0.2	4.7	8.4	6.8	-	-	-	-	20.1
	Total of (1.- 5.)	2.5	51.2	92.4	75.6	-	-	-	-	221.7
Overall Plan										
1.	Construction cost									
1.1	Dam and appurtenant facilities	-	-	-	28.8	144.8	230.4	212.0	43.3	659.3
1.2	Irrigation facilities	-	-	-	-	44.9	133.3	119.6	31.3	329.1
1.3	Water supply system	-	-	-	-	-	-	3.3	-	3.3
2.	Resettlement cost	-	-	12.3	18.7	6.3	-	-	-	37.3
3.	Engineering services cost	-	-	-	2.1	14.1	26.9	25.0	5.5	73.6
4.	Administration cost	-	-	0.6	2.4	9.7	18.1	16.9	3.8	51.5
5.	Physical contingency	-	-	1.3	5.2	22.0	40.9	37.7	8.3	115.4
	Total of (1.- 5.)	-	-	14.2	57.2	241.8	449.6	414.5	92.2	1,269.5

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (1/10)

N'fifikh - Upstream

Unit: million DH

Year in order	Year	Benefit					Cost											Net Cash Flow
							Investment								O/M	Replace-ment	Total Cost	
		Agri-culture	Flood & erosion control	water supply	Other direct benefit	Total Benefit	Dam	Irrigation	Water supply	Resettle-ment	Engr. services	Adminis-tration	Physical contingency	Sub-total				
1	2001	0.0	0.00	0.00	0.00	0.0	0.0	0.0		1.4		0.1	0.2	1.7	0.0		1.7	-1.7
2	2002	0.0	0.00	0.00	0.00	0.0	32.7	6.8		1.4	2.9	2.0	4.6	50.4	0.0		50.4	-50.4
3	2003	0.0	0.00	0.00	0.00	0.0	69.4	17.0			6.4	4.3	9.7	106.8	0.0		106.8	-106.8
4	2004	0.0	0.00	0.00	0.00	0.0	34.0	10.2	1.2		3.4	2.3	5.1	56.2	0.0		56.2	-56.2
5	2005	8.5	0.12	0.14	0.88	9.6								0.0	1.6		1.6	8.1
6	2006	11.5	0.12	0.15	1.18	12.9								0.0	1.6		1.6	11.4
7	2007	14.3	0.12	0.15	1.46	16.1								0.0	1.6		1.6	14.5
8	2008	14.3	0.12	0.15	1.46	16.1								0.0	1.6		1.6	14.5
9	2009	15.4	0.12	0.15	1.57	17.2								0.0	1.6		1.6	15.7
10	2010	15.6	0.12	0.15	1.58	17.4								0.0	1.6		1.6	15.9
11	2011	16.6	0.12	0.15	1.69	18.6								0.0	1.6		1.6	17.0
12	2012	17.7	0.12	0.15	1.80	19.8								0.0	1.6		1.6	18.2
13	2013	17.7	0.12	0.15	1.80	19.8								0.0	1.6		1.6	18.2
14	2014	17.7	0.12	0.15	1.80	19.8								0.0	1.6		1.6	18.2
15	2015	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
16	2016	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
17	2017	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
18	2018	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
19	2019	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
20	2020	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
21	2021	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
22	2022	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
23	2023	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
24	2024	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
25	2025	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
26	2026	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
27	2027	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
28	2028	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
29	2029	17.7	0.12	0.16	1.80	19.8								0.0	1.6	12.3	13.9	5.9
30	2030	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
31	2031	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
32	2032	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
33	2033	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
34	2034	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
35	2035	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
36	2036	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
37	2037	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
38	2038	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
39	2039	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
40	2040	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
41	2041	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
42	2042	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
43	2043	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
44	2044	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
45	2045	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
46	2046	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
47	2047	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
48	2048	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
49	2049	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
50	2050	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
51	2051	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
52	2052	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
53	2053	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2
54	2054	17.7	0.12	0.16	1.80	19.8								0.0	1.6		1.6	18.2

EIRR= 6.8%

B/C = 0.86 (at discount rate: 8%)

NPV= -26.6 (at discount rate: 8%)

NPV= 24.0 (at discount rate: 6%)

NPV= -55.4 (at discount rate: 10%)

NPV= -72.1 (at discount rate: 12%)

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (2/10)

N'fifikh - Upstream (including Indirect Benefit)

Unit: million DH

Year in order	Year	Benefit						Cost											Net Cash Flow
								Investment								O/M	Replace-ment	Total Cost	
		Agri-culture	Flood & erosion control	water supply	Other direct benefit	Indirect Benefit	Total Benefit	Dam	Irrigation	Water supply	Resettle-ment	Engr. services	Adminis-tration	Physical contingency	Sub-total				
1	2001	0.0				0.0	0.0	0.0	0.0		1.4		0.1	0.2	1.7	0.0		1.7	-1.7
2	2002	0.0				16.1	16.1	32.7	6.8		1.4	2.9	2.0	4.6	50.4	0.0		50.4	-34.3
3	2003	0.0				35.2	35.2	69.4	17.0			6.4	4.3	9.7	106.8	0.0		106.8	-71.6
4	2004	0.0				18.5	18.5	34.0	10.2	1.2		3.4	2.3	5.1	56.2	0.0		56.2	-37.7
5	2005	8.5	0.12	0.14	0.88	0.4	10.0								0.0	1.6		1.6	8.5
6	2006	11.5	0.12	0.15	1.18	0.4	13.3								0.0	1.6		1.6	11.8
7	2007	14.3	0.12	0.15	1.46	0.4	16.5								0.0	1.6		1.6	14.9
8	2008	14.3	0.12	0.15	1.46	0.4	16.5								0.0	1.6		1.6	14.9
9	2009	15.4	0.12	0.15	1.57	0.4	17.6								0.0	1.6		1.6	16.1
10	2010	15.6	0.12	0.15	1.58	0.4	17.8								0.0	1.6		1.6	16.3
11	2011	16.6	0.12	0.15	1.69	0.4	19.0								0.0	1.6		1.6	17.4
12	2012	17.7	0.12	0.15	1.80	0.4	20.2								0.0	1.6		1.6	18.6
13	2013	17.7	0.12	0.15	1.80	0.4	20.2								0.0	1.6		1.6	18.6
14	2014	17.7	0.12	0.15	1.80	0.4	20.2								0.0	1.6		1.6	18.6
15	2015	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
16	2016	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
17	2017	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
18	2018	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
19	2019	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
20	2020	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
21	2021	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
22	2022	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
23	2023	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
24	2024	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
25	2025	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
26	2026	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
27	2027	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
28	2028	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
29	2029	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6	12.3	13.9	6.3
30	2030	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
31	2031	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
32	2032	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
33	2033	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
34	2034	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
35	2035	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
36	2036	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
37	2037	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
38	2038	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
39	2039	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
40	2040	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
41	2041	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
42	2042	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
43	2043	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
44	2044	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
45	2045	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
46	2046	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
47	2047	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
48	2048	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
49	2049	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
50	2050	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
51	2051	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
52	2052	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
53	2053	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6
54	2054	17.7	0.12	0.16	1.80	0.4	20.2								0.0	1.6		1.6	18.6

EIRR= 10.0%

B/C = 1.17 (at discount rate: 8%)

NPV= 32.3 (at discount rate: 8%)

NPV= 87.4 (at discount rate: 6%)

NPV= -0.3 (at discount rate: 10%)

NPV= -20.4 (at discount rate: 12%)

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (3/10)

Taskourt Unit: million DH

Year in order	Year	Benefit					Cost											Net Cash Flow
							Investment								O/M	Replace-ment	Total Cost	
		Agri-culture	Flood & erosion control	water supply	Other direct benefit	Total Benefit	Dam	Irrigation	Water supply	Resettle-ment	Engr. services	Adminis-tration	Physical contingency	Sub-total				
1	2001	0.0			0.0	0.0	0.0	0.0		12.3		0.6	1.3	14.2	0.0		14.2	-14.2
2	2002	0.0			0.0	0.0	28.8	0.0		12.3	2.1	2.1	4.5	49.8	0.0		49.8	-49.8
3	2003	0.0			0.0	0.0	60.2	24.5			6.3	4.2	9.5	104.7	0.0		104.7	-104.7
4	2004	0.0			0.0	0.0	86.4	61.3			11.0	7.4	16.6	182.7	0.0		182.7	-182.7
5	2005	0.0			0.0	0.0	86.5	36.7	2.1		9.3	6.3	14.2	155.1	0.0		155.1	-155.1
6	2006	25.8	0.397	0.254	2.6	29.1								0.0	4.2		4.2	24.9
7	2007	34.6	0.397	0.256	3.5	38.8								0.0	4.2		4.2	34.6
8	2008	40.7	0.397	0.258	4.1	45.4								0.0	4.2		4.2	41.2
9	2009	45.7	0.397	0.259	4.6	51.0								0.0	4.2		4.2	46.8
10	2010	49.1	0.397	0.261	5.0	54.7								0.0	4.2		4.2	50.5
11	2011	49.1	0.397	0.263	5.0	54.7								0.0	4.2		4.2	50.5
12	2012	49.1	0.397	0.265	5.0	54.7								0.0	4.2		4.2	50.5
13	2013	49.1	0.397	0.267	5.0	54.7								0.0	4.2		4.2	50.5
14	2014	49.1	0.397	0.269	5.0	54.7								0.0	4.2		4.2	50.5
15	2015	49.1	0.397	0.270	5.0	54.7								0.0	4.2		4.2	50.5
16	2016	49.1	0.397	0.272	5.0	54.7								0.0	4.2		4.2	50.5
17	2017	49.1	0.397	0.274	5.0	54.7								0.0	4.2		4.2	50.5
18	2018	49.1	0.397	0.276	5.0	54.8								0.0	4.2		4.2	50.5
19	2019	49.1	0.397	0.278	5.0	54.8								0.0	4.2		4.2	50.5
20	2020	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
21	2021	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
22	2022	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
23	2023	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
24	2024	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
25	2025	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
26	2026	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
27	2027	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
28	2028	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
29	2029	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
30	2030	49.1	0.397	0.280	5.0	54.8								0.0	4.2	29.8	34.0	20.8
31	2031	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
32	2032	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
33	2033	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
34	2034	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
35	2035	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
36	2036	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
37	2037	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
38	2038	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
39	2039	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
40	2040	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
41	2041	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
42	2042	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
43	2043	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
44	2044	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
45	2045	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
46	2046	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
47	2047	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
48	2048	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
49	2049	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
50	2050	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
51	2051	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
52	2052	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
53	2053	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
54	2054	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5
55	2055	49.1	0.397	0.280	5.0	54.8								0.0	4.2		4.2	50.5

EIRR= 8.1%

B/C = 1.02 (at discount rate: 8%)

NPV= 6.5 (at discount rate: 8%)

NPV= 146.9 (at discount rate: 6%)

NPV= -73.1 (at discount rate: 10%)

NPV= -119.3 (at discount rate: 12%)

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (4/10)

Taskourt (including Indirect Benefit) Unit: million DH

Year in order	Year	Benefit						Cost											Net Cash Flow
								Investment								O/M	Replace-ment	Total Cost	
		Agri-culture	Flood & erosion control	water supply	Other direct benefit	Indirect Benefit	Total Benefit	Dam	Irrigation	Water supply	Resettle-ment	Engr. services	Adminis-tration	Physical contingency	Sub-total				
1	2001	0.0			0.0	0.0	0.0	0.0	0.0		12.3		0.6	1.3	14.2	0.0		14.2	-14.2
2	2002	0.0			0.0	11.7	11.7	28.8	0.0		12.3	2.1	2.1	4.5	49.8	0.0		49.8	-38.1
3	2003	0.0			0.0	34.5	34.5	60.2	24.5			6.3	4.2	9.5	104.7	0.0		104.7	-70.2
4	2004	0.0			0.0	60.1	60.1	86.4	61.3			11.0	7.4	16.6	182.7	0.0		182.7	-122.6
5	2005	0.0			0.0	51.0	51.0	86.5	36.7	2.1		9.3	6.3	14.2	155.1	0.0		155.1	-104.1
6	2006	25.8	0.397	0.254	2.6	0.9	30.0								0.0	4.2		4.2	25.8
7	2007	34.6	0.397	0.256	3.5	0.9	39.7								0.0	4.2		4.2	35.5
8	2008	40.7	0.397	0.258	4.1	0.9	46.3								0.0	4.2		4.2	42.1
9	2009	45.7	0.397	0.259	4.6	0.9	51.9								0.0	4.2		4.2	47.7
10	2010	49.1	0.397	0.261	5.0	0.9	55.6								0.0	4.2		4.2	51.4
11	2011	49.1	0.397	0.263	5.0	0.9	55.6								0.0	4.2		4.2	51.4
12	2012	49.1	0.397	0.265	5.0	0.9	55.6								0.0	4.2		4.2	51.4
13	2013	49.1	0.397	0.267	5.0	0.9	55.6								0.0	4.2		4.2	51.4
14	2014	49.1	0.397	0.269	5.0	0.9	55.6								0.0	4.2		4.2	51.4
15	2015	49.1	0.397	0.270	5.0	0.9	55.6								0.0	4.2		4.2	51.4
16	2016	49.1	0.397	0.272	5.0	0.9	55.6								0.0	4.2		4.2	51.4
17	2017	49.1	0.397	0.274	5.0	0.9	55.6								0.0	4.2		4.2	51.4
18	2018	49.1	0.397	0.276	5.0	0.9	55.7								0.0	4.2		4.2	51.4
19	2019	49.1	0.397	0.278	5.0	0.9	55.7								0.0	4.2		4.2	51.4
20	2020	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
21	2021	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
22	2022	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
23	2023	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
24	2024	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
25	2025	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
26	2026	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
27	2027	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
28	2028	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
29	2029	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
30	2030	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2	29.8	34.0	21.7
31	2031	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
32	2032	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
33	2033	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
34	2034	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
35	2035	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
36	2036	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
37	2037	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
38	2038	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
39	2039	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
40	2040	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
41	2041	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
42	2042	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
43	2043	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
44	2044	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
45	2045	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
46	2046	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
47	2047	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
48	2048	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
49	2049	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
50	2050	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
51	2051	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
52	2052	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
53	2053	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
54	2054	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4
55	2055	49.1	0.397	0.280	5.0	0.9	55.7								0.0	4.2		4.2	51.4

EIRR= 11.4%

B/C = 1.31 (at discount rate: 8%)

NPV= 130.3 (at discount rate: 8%)

NPV= 282.6 (at discount rate: 6%)

NPV= 40.8 (at discount rate: 10%)

NPV= -14.0 (at discount rate: 12%)

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (5/10)

Timkit

Unit: million DH

Year in order	Year	Benefit				Cost										Net Cash Flow
						Investment							O/M	Replace-ment	Total Cost	
		Agri-culture	Flood & erosion control	Other direct benefit	Total Benefit	Dam	Irrigation	Resettle-ment	Engr. services	Adminis-tration	Physical contingency	Sub-total				
1	2001	0.0		0.0	0.0	0.0	0.0	2.8		0.1	0.3	3.2	0.0		3.2	-3.2
2	2002	0.0		0.0	0.0	26.2	0.0	2.7	2.0	1.4	3.2	35.5	0.0		35.5	-35.5
3	2003	0.0		0.0	0.0	33.9	20.9		4.0	2.7	6.2	67.7	0.0		67.7	-67.7
4	2004	0.0		0.0	0.0	50.9	52.2		7.7	5.2	11.6	127.6	0.0		127.6	-127.6
5	2005	0.0		0.0	0.0	43.3	31.3		5.5	3.8	8.3	92.2	0.0		92.2	-92.2
6	2006	15.6	0.5	1.6	17.8							0.0	3.5		3.5	14.3
7	2007	21.7	0.5	2.2	24.4							0.0	3.5		3.5	20.9
8	2008	25.2	0.5	2.6	28.3							0.0	3.5		3.5	24.8
9	2009	27.1	0.5	2.8	30.4							0.0	3.5		3.5	26.9
10	2010	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
11	2011	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
12	2012	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
13	2013	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
14	2014	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
15	2015	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
16	2016	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
17	2017	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
18	2018	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
19	2019	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
20	2020	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
21	2021	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
22	2022	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
23	2023	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
24	2024	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
25	2025	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
26	2026	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
27	2027	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
28	2028	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
29	2029	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
30	2030	28.1	0.5	2.9	31.5							0.0	3.5	20.0	23.5	8.0
31	2031	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
32	2032	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
33	2033	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
34	2034	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
35	2035	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
36	2036	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
37	2037	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
38	2038	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
39	2039	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
40	2040	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
41	2041	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
42	2042	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
43	2043	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
44	2044	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
45	2045	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
46	2046	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
47	2047	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
48	2048	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
49	2049	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
50	2050	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
51	2051	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
52	2052	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
53	2053	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
54	2054	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0
55	2055	28.1	0.5	2.9	31.5							0.0	3.5		3.5	28.0

EIRR= 7.1%

B/C = 0.90 (at discount rate: 8%)

NPV= -27.6 (at discount rate: 8%)

NPV= 47.9 (at discount rate: 6%)

NPV= -69.6 (at discount rate: 10%)

NPV= -93.3 (at discount rate: 12%)

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (6/10)

Timkit (including Indirect Benefit)

Unit: million DH

Year in order	Year	Benefit					Cost										Net Cash Flow
							Investment							O/M	Replace-ment	Total Cost	
		Agri-culture	Flood & erosion control	Other direct benefit	Indirect Benefit	Total Benefit	Dam	Irrigation	Resettle-ment	Engr. services	Adminis-tration	Physical contingency	Sub-total				
1	2001	0.0		0.0	0.0	0.0	0.0	0.0	2.8		0.1	0.3	3.2	0.0		3.2	-3.2
2	2002	0.0		0.0	10.7	10.7	26.2	0.0	2.7	2.0	1.4	3.2	35.5	0.0		35.5	-24.8
3	2003	0.0		0.0	22.3	22.3	33.9	20.9		4.0	2.7	6.2	67.7	0.0		67.7	-45.4
4	2004	0.0		0.0	42.0	42.0	50.9	52.2		7.7	5.2	11.6	127.6	0.0		127.6	-85.6
5	2005	0.0		0.0	30.4	30.4	43.3	31.3		5.5	3.8	8.3	92.2	0.0		92.2	-61.8
6	2006	15.6	0.5	1.6	0.7	18.5							0.0	3.5		3.5	15.0
7	2007	21.7	0.5	2.2	0.7	25.1							0.0	3.5		3.5	21.6
8	2008	25.2	0.5	2.6	0.7	29.0							0.0	3.5		3.5	25.5
9	2009	27.1	0.5	2.8	0.7	31.1							0.0	3.5		3.5	27.6
10	2010	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
11	2011	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
12	2012	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
13	2013	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
14	2014	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
15	2015	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
16	2016	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
17	2017	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
18	2018	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
19	2019	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
20	2020	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
21	2021	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
22	2022	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
23	2023	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
24	2024	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
25	2025	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
26	2026	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
27	2027	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
28	2028	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
29	2029	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
30	2030	28.1	0.5	2.9	0.7	32.2							0.0	3.5	20.0	23.5	8.7
31	2031	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
32	2032	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
33	2033	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
34	2034	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
35	2035	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
36	2036	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
37	2037	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
38	2038	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
39	2039	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
40	2040	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
41	2041	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
42	2042	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
43	2043	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
44	2044	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
45	2045	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
46	2046	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
47	2047	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
48	2048	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
49	2049	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
50	2050	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
51	2051	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
52	2052	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
53	2053	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
54	2054	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7
55	2055	28.1	0.5	2.9	0.7	32.2							0.0	3.5		3.5	28.7

EIRR= 10.4%

B/C = 1.21 (at discount rate: 8%)

NPV= 56.6 (at discount rate: 8%)

NPV= 140.2 (at discount rate: 6%)

NPV= 7.8 (at discount rate: 10%)

NPV= -21.8 (at discount rate: 12%)

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (7/10)

Azghar

Unit: million DH

Year in order	Year	Benefit: Agri-culture	Flood & erosion control	Other direct benefit	Neg. benefit to downstream reservoir	Total Benefit	Cost: Investment: Dam	Irrigation	Resettle-ment	Engr. services	Adminis-tration	Physical contingency	Sub-total	O/M	Replace-ment	Total Cost	Net Cash Flow
1	2001	0.0	0.00	0.0	0.0	0.0	0.0	0.0	2.2		0.1	0.2	2.5	0.0		2.5	-2.5
2	2002	0.0	0.00	0.0	0.0	0.0	25.7	13.6	2.2	2.9	2.1	4.7	51.2	0.0		51.2	-51.2
3	2003	0.0	0.00	0.0	0.0	0.0	40.7	34.1		5.5	3.7	8.4	92.4	0.0		92.4	-92.4
4	2004	0.0	0.00	0.0	0.0	0.0	40.6	20.5		4.6	3.1	6.8	75.6	0.0		75.6	-75.6
5	2005	19.8	0.03	2.0	-22.1	-0.3							0.0	2.09		2.1	-2.4
6	2006	32.1	0.03	3.2	-22.1	13.2							0.0	2.09		2.1	11.1
7	2007	41.4	0.03	4.1	-22.1	23.5							0.0	2.09		2.1	21.4
8	2008	51.3	0.03	5.1	-22.1	34.4							0.0	2.09		2.1	32.3
9	2009	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
10	2010	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
11	2011	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
12	2012	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
13	2013	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
14	2014	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
15	2015	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
16	2016	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
17	2017	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
18	2018	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
19	2019	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
20	2020	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
21	2021	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
22	2022	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
23	2023	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
24	2024	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
25	2025	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
26	2026	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
27	2027	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
28	2028	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
29	2029	58.3	0.03	5.8	-22.1	42.1							0.0	2.09	13.4	15.5	26.6
30	2030	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
31	2031	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
32	2032	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
33	2033	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
34	2034	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
35	2035	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
36	2036	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
37	2037	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
38	2038	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
39	2039	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
40	2040	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
41	2041	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
42	2042	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
43	2043	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
44	2044	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
45	2045	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
46	2046	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
47	2047	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
48	2048	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
49	2049	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
50	2050	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
51	2051	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
52	2052	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
53	2053	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0
54	2054	58.3	0.03	5.8	-22.1	42.1							0.0	2.09		2.1	40.0

EIRR= 12.2%
B/C = 1.62 (at discount rate: 8%)
NPV= 120.9 (at discount rate: 8%)
NPV= 242.0 (at discount rate: 6%)
NPV= 48.5 (at discount rate: 10%)
NPV= 3.4 (at discount rate: 12%)

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (8/10)

Azghar (including Indirect Benefit)

Unit: million DH

Year in order	Year	Benefit: Agri-culture	Flood & erosion control	Other direct benefit	Indirect Benefit	Neg. benefit to downstream reservoir	Total Benefit	Cost: Investment: Dam	Irrigation	Resettle-ment	Engr. services	Adminis-tration	Physical contingency	Sub-total	O/M	Replace-ment	Total Cost	Net Cash Flow
1	2001	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	2.2		0.1	0.2	2.5	0.0		2.5	-2.5
2	2002	0.0	0.00	0.0	16.0	0.0	16.0	25.7	13.6	2.2	2.9	2.1	4.7	51.2	0.0		51.2	-35.2
3	2003	0.0	0.00	0.0	30.4	0.0	30.4	40.7	34.1		5.5	3.7	8.4	92.4	0.0		92.4	-62.0
4	2004	0.0	0.00	0.0	24.9	0.0	24.9	40.6	20.5		4.6	3.1	6.8	75.6	0.0		75.6	-50.7
5	2005	19.8	0.03	2.0	1.3	-22.1	1.0							0.0	2.09		2.1	-1.1
6	2006	32.1	0.03	3.2	1.3	-22.1	14.5							0.0	2.09		2.1	12.4
7	2007	41.4	0.03	4.1	1.3	-22.1	24.8							0.0	2.09		2.1	22.7
8	2008	51.3	0.03	5.1	1.3	-22.1	35.7							0.0	2.09		2.1	33.6
9	2009	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
10	2010	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
11	2011	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
12	2012	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
13	2013	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
14	2014	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
15	2015	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
16	2016	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
17	2017	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
18	2018	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
19	2019	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
20	2020	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
21	2021	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
22	2022	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
23	2023	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
24	2024	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
25	2025	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
26	2026	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
27	2027	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
28	2028	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
29	2029	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09	13.4	15.5	27.9
30	2030	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
31	2031	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
32	2032	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
33	2033	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
34	2034	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
35	2035	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
36	2036	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
37	2037	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
38	2038	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
39	2039	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
40	2040	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
41	2041	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
42	2042	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
43	2043	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
44	2044	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
45	2045	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
46	2046	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
47	2047	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
48	2048	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
49	2049	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
50	2050	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
51	2051	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
52	2052	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
53	2053	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3
54	2054	58.3	0.03	5.8	1.3	-22.1	43.4							0.0	2.09		2.1	41.3

EIRR= 16.6%
B/C = 1.97 (at discount rate: 8%)
NPV= 188.7 (at discount rate: 8%)
NPV= 317.8 (at discount rate: 6%)
NPV= 110.4 (at discount rate: 10%)
NPV= 60.5 (at discount rate: 12%)

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (9/10)

Overall Plan — Unit: million DH

Year in order	Year	Benefit					Cost							Net Cash Flow
							Investment					O/M	Replace-ment		
		N° Fifikh	Taskourt	Timkit	Azghar	Total Benefit	N° Fifikh	Taskourt	Timkit	Azghar	Sub-total			Total Cost	
1	2001					-					-			-	-
2	2002					-					-			-	-
3	2003					-		14.2			14.2			14.2	-14.2
4	2004					-	1.7	49.8	3.2	2.5	57.2			57.2	-57.2
5	2005					-	50.4	104.7	35.5	51.2	241.8			241.8	-241.8
6	2006					-	106.8	182.7	67.7	92.4	449.6			449.6	-449.6
7	2007					-	56.2	155.1	127.6	75.6	414.5			414.5	-414.5
8	2008	9.6	29.1		-0.3	38.5			92.2		92.2	7.9		100.1	-61.6
9	2009	12.9	38.8	17.8	13.2	82.8					-	11.4		11.4	71.4
10	2010	16.1	45.4	24.4	23.5	109.4					-	11.4		11.4	98.0
11	2011	16.1	51.0	28.3	34.4	129.7					-	11.4		11.4	118.3
12	2012	17.2	54.7	30.4	42.1	144.4					-	11.4		11.4	133.0
13	2013	17.4	54.7	31.5	42.1	145.7					-	11.4		11.4	134.3
14	2014	18.6	54.7	31.5	42.1	146.9					-	11.4		11.4	135.5
15	2015	19.8	54.7	31.5	42.1	148.1					-	11.4		11.4	136.7
16	2016	19.8	54.7	31.5	42.1	148.1					-	11.4		11.4	136.7
17	2017	19.8	54.7	31.5	42.1	148.1					-	11.4		11.4	136.7
18	2018	19.8	54.7	31.5	42.1	148.1					-	11.4		11.4	136.7
19	2019	19.8	54.7	31.5	42.1	148.1					-	11.4		11.4	136.7
20	2020	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
21	2021	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
22	2022	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
23	2023	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
24	2024	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
25	2025	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
26	2026	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
27	2027	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
28	2028	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
29	2029	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
30	2030	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
31	2031	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
32	2032	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
33	2033	19.8	54.8	31.5	42.1	148.1					-	11.4	55.5	66.9	81.2
34	2034	19.8	54.8	31.5	42.1	148.1					-	11.4	20.0	31.4	116.7
35	2035	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
36	2036	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
37	2037	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
38	2038	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
39	2039	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
40	2040	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
41	2041	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
42	2042	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
43	2043	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
44	2044	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
45	2045	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
46	2046	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
47	2047	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
48	2048	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
49	2049	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
50	2050	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
51	2051	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
52	2052	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
53	2053	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
54	2054	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
55	2055	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
56	2056	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
57	2055	19.8	54.8	31.5	42.1	148.1					-	11.4		11.4	136.7
58	2056	-	-	31.5	-	31.5					-	3.5		3.5	28.0

EIRR=	8.5%			
B/C =	1.07	(at discount rate:	8%)	
NPV=	58.8	(at discount rate:	8%)	
NPV=	394.6	(at discount rate:	6%)	
NPV=	-117.7	(at discount rate:	10%)	
NPV=	-210.3	(at discount rate:	12%)	

Table 10.1.6: Cost-Benefit Analysis of the Priority Projects (10/10)

Overall Plan (including Indirect Benefit) — Unit: million DH

Year in order	Year	Benefit					Cost							Net Cash Flow
							Investment					O/M	Replace-ment		
		N° Fifikh	Taskourt	Timkit	Azghar	Total Benefit	N° Fifikh	Taskourt	Timkit	Azghar	Sub-total			Total Cost	
1	2001					-					-			-	-
2	2002					-					-			-	-
3	2003					-		14.2			14.2			14.2	-14.2
4	2004		11.7			11.7	1.7	49.8	3.2	2.5	57.2			57.2	-45.5
5	2005	16.1	34.5	10.7	16.0	77.2	50.4	104.7	35.5	51.2	241.8			241.8	-164.6
6	2006	35.2	60.1	22.3	30.4	148.0	106.8	182.7	67.7	92.4	449.6			449.6	-301.6
7	2007	18.5	51.0	42.0	24.9	136.3	56.2	155.1	127.6	75.6	414.5			414.5	-278.2
8	2008	10.0	30.0	30.4	1.0	71.5			92.2		92.2	7.9		100.1	-28.6
9	2009	13.3	39.7	18.5	14.5	86.1					-	11.4		11.4	74.7
10	2010	16.5	46.3	25.1	24.8	112.7					-	11.4		11.4	101.3
11	2011	16.5	51.9	29.0	35.7	133.0					-	11.4		11.4	121.6
12	2012	17.6	55.6	31.1	43.4	147.7					-	11.4		11.4	136.3
13	2013	17.8	55.6	32.2	43.4	149.0					-	11.4		11.4	137.6
14	2014	19.0	55.6	32.2	43.4	150.2					-	11.4		11.4	138.8
15	2015	20.2	55.6	32.2	43.4	151.4					-	11.4		11.4	140.0
16	2016	20.2	55.6	32.2	43.4	151.4					-	11.4		11.4	140.0
17	2017	20.2	55.6	32.2	43.4	151.4					-	11.4		11.4	140.0
18	2018	20.2	55.6	32.2	43.4	151.4					-	11.4		11.4	140.0
19	2019	20.2	55.6	32.2	43.4	151.4					-	11.4		11.4	140.0
20	2020	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
21	2021	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
22	2022	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
23	2023	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
24	2024	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
25	2025	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
26	2026	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
27	2027	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
28	2028	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
29	2029	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
30	2030	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
31	2031	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
32	2032	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
33	2033	20.2	55.7	32.2	43.4	151.4					-	11.4	55.5	66.9	84.5
34	2034	20.2	55.7	32.2	43.4	151.4					-	11.4	20.0	31.4	120.0
35	2035	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
36	2036	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
37	2037	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
38	2038	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
39	2039	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
40	2040	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
41	2041	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
42	2042	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
43	2043	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
44	2044	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
45	2045	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
46	2046	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
47	2047	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
48	2048	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
49	2049	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
50	2050	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
51	2051	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
52	2052	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
53	2053	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
54	2054	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
55	2055	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
56	2056	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
57	2055	20.2	55.7	32.2	43.4	151.4					-	11.4		11.4	140.0
58	2056	-	-	32.2	-	32.2					-	3.5		3.5	28.7

EIRR=	12.0%			
B/C =	1.38	(at discount rate:	8%)	
NPV=	332.3	(at discount rate:	8%)	
NPV=	709.8	(at discount rate:	6%)	
NPV=	122.4	(at discount rate:	10%)	
NPV=	2.0	(at discount rate:	12%)	

Table 10.2.1: Annual Disbursement Schedule (1/3
(Financial Price, million DH

N'Fifikh

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	93.0	50.1	143.1	-	-	-	-	-	-	-	-	-	-	-	-	22.3	12.0	34.3	47.4	25.6	73.0	23.3	12.5	35.8	-	-	-
Irrigation facilities	18.3	18.2	36.5	-	-	-	-	-	-	-	-	-	-	-	-	3.7	3.6	7.3	9.2	9.1	18.3	5.4	5.5	10.9	-	-	-
Water supply facilities	-	1.4	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	1.4	-	-	-
Sub-total of 1	111.3	69.7	181.0	-	-	-	-	-	-	-	-	-	-	-	-	26.0	15.6	41.6	56.6	34.7	91.3	28.7	19.4	48.1	-	-	-
2. Resettlement cost	-	3.3	3.3	-	-	-	-	-	-	-	-	-	-	1.7	1.7	-	1.6	1.6	-	-	-	-	-	-	-	-	-
3. Engineering services cost	8.2	4.5	12.7	-	-	-	-	-	-	-	-	-	-	-	-	1.9	1.0	2.9	4.1	2.3	6.4	2.2	1.2	3.4	-	-	-
4. Administration cost	-	9.2	9.2	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	2.2	2.2	-	4.6	4.6	-	2.3	2.3	-	-	-
5. Physical contingency	12.0	8.7	20.7	-	-	-	-	-	-	-	-	-	-	0.2	0.2	2.8	2.0	4.8	6.1	4.2	10.3	3.1	2.3	5.4	-	-	-
Sub-total of (1.- 5.)	131.5	95.4	226.9	-	-	-	-	-	-	-	-	-	-	2.0	2.0	30.7	22.4	53.1	66.8	45.8	112.6	34.0	25.2	59.2	-	-	-
6. Price contingency	25.7	18.6	44.3	-	-	-	-	-	-	-	-	-	-	0.3	0.3	4.9	3.6	8.5	13.0	8.9	21.9	7.8	5.8	13.6	-	-	-
Sub-total of (1.- 6.)	157.2	114.0	271.2	-	-	-	-	-	-	-	-	-	-	2.3	2.3	35.6	26.0	61.6	79.8	54.7	134.5	41.8	31.0	72.8	-	-	-
7. Value Added Tax	-	38.9	38.9	-	-	-	-	-	-	-	-	-	-	0.3	0.3	-	8.8	8.8	-	19.3	19.3	-	10.5	10.5	-	-	-
Total of (1.- 7.)	157.2	152.9	310.1	-	-	-	-	-	-	-	-	-	-	2.6	2.6	35.6	34.8	70.4	79.8	74.0	153.8	41.8	41.5	83.3	-	-	-

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Taskour

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	179.0	96.4	275.4	-	-	-	-	-	-	-	-	-	19.7	10.6	30.3	41.2	22.2	63.4	59.1	31.8	90.9	59.0	31.8	90.8	-	-	-
Irrigation facilities	65.9	65.8	131.7	-	-	-	-	-	-	-	-	-	-	-	-	13.2	13.2	26.4	33.0	32.9	65.9	19.7	19.7	39.4	-	-	-
Water supply facilities	-	2.4	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.4	2.4	-	-	-
Sub-total of 1.2	244.9	164.6	409.5	-	-	-	-	-	-	-	-	-	19.7	10.6	30.3	54.4	35.4	89.8	92.1	64.7	156.8	78.7	53.9	132.6	-	-	-
2. Resettlement cost	-	28.5	28.5	-	-	-	-	-	-	-	14.3	14.3	-	14.2	14.2	-	-	-	-	-	-	-	-	-	-	-	-
3. Engineering services cost	18.6	10.1	28.7	-	-	-	-	-	-	-	-	-	1.4	0.7	2.1	4.1	2.2	6.3	7.1	3.9	11.0	6.0	3.3	9.3	-	-	-
4. Administration cost	-	21.9	21.9	-	-	-	-	-	-	-	0.7	0.7	-	2.2	2.2	-	4.5	4.5	-	7.8	7.8	-	6.7	6.7	-	-	-
5. Physical contingency	26.4	22.5	48.9	-	-	-	-	-	-	-	1.5	1.5	2.1	2.8	4.9	5.9	4.2	10.1	9.9	7.6	17.5	8.5	6.4	14.9	-	-	-
Sub-total of (1.- 5.)	289.9	247.6	537.5	-	-	-	-	-	-	-	16.5	16.5	23.2	30.5	53.7	64.4	46.3	110.7	109.1	84.0	193.1	93.2	70.3	163.5	-	-	-
6. Price contingency	55.8	45.2	101.0	-	-	-	-	-	-	-	1.5	1.5	2.9	3.8	6.7	10.3	7.4	17.7	21.2	16.3	37.5	21.4	16.2	37.6	-	-	-
Sub-total of (1.- 6.)	345.7	292.8	638.5	-	-	-	-	-	-	-	18.0	18.0	26.1	34.3	60.4	74.7	53.7	128.4	130.3	100.3	230.6	114.6	86.5	201.1	-	-	-
7. Value Added Tax	-	91.6	91.6	-	-	-	-	-	-	-	2.5	2.5	-	8.6	8.6	-	18.4	18.4	-	33.2	33.2	-	28.9	28.9	-	-	-
Total of (1.- 7.)	345.7	384.4	730.1	-	-	-	-	-	-	-	20.5	20.5	26.1	42.9	69.0	74.7	72.1	146.8	130.3	133.5	263.8	114.6	115.4	230.0	-	-	-

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Table 10.2.1: Annual Disbursement Schedule (2/3
(Financial Price, million DH

Timkit

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	105.5	56.8	162.3	-	-	-	-	-	-	-	-	-	-	-	-	17.9	9.7	27.6	23.2	12.5	35.7	34.8	18.7	53.5	29.6	15.9	45.5
Irrigation facilities	56.2	56.1	112.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.2	11.2	22.4	28.1	28.1	56.2	16.9	16.8	33.7
Sub-total of 1.3	161.7	112.9	274.6	-	-	-	-	-	-	-	-	-	-	-	-	17.9	9.7	27.6	34.4	23.7	58.1	62.9	46.8	109.7	46.5	32.7	79.2
2. Resettlement cost	-	6.4	6.4	-	-	-	-	-	-	-	-	-	-	3.2	3.2	-	3.2	3.2	-	-	-	-	-	-	-	-	-
3. Engineering services cost	12.5	6.7	19.2	-	-	-	-	-	-	-	-	-	-	-	-	1.3	0.7	2.0	2.6	1.4	4.0	5.0	2.7	7.7	3.6	1.9	5.5
4. Administration cost	-	14.0	14.0	-	-	-	-	-	-	-	-	-	-	0.2	0.2	-	1.5	1.5	-	2.9	2.9	-	5.5	5.5	-	3.9	3.9
5. Physical contingency	17.4	14.0	31.4	-	-	-	-	-	-	-	-	-	-	0.3	0.3	1.9	1.5	3.4	3.7	2.8	6.5	6.8	5.5	12.3	5.0	3.9	8.9
Sub-total of (1.- 5.)	191.6	154.0	345.6	-	-	-	-	-	-	-	-	-	-	3.7	3.7	21.1	16.6	37.7	40.7	30.8	71.5	74.7	60.5	135.2	55.1	42.4	97.5
6. Price contingency	43.2	34.3	77.5	-	-	-	-	-	-	-	-	-	-	0.5	0.5	3.4	2.6	6.0	7.9	6.0	13.9	17.2	13.9	31.1	14.7	11.3	26.0
Sub-total of (1.- 6.)	234.8	188.3	423.1	-	-	-	-	-	-	-	-	-	-	4.2	4.2	24.5	19.2	43.7	48.6	36.8	85.4	91.9	74.4	166.3	69.8	53.7	123.5
7. Value Added Tax	-	60.8	60.8	-	-	-	-	-	-	-	-	-	-	0.6	0.6	-	6.3	6.3	-	12.3	12.3	-	23.9	23.9	-	17.7	17.7
Total of (1.- 7.)	234.8	249.1	483.9	-	-	-	-	-	-	-	-	-	-	4.8	4.8	24.5	25.5	50.0	48.6	49.1	97.7	91.9	98.3	190.2	69.8	71.4	141.2

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Azghar

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	73.1	39.4	112.5	-	-	-	-	-	-	-	-	-	-	-	-	17.5	9.5	27.0	27.8	15.0	42.8	27.8	14.9	42.7	-	-	-
Irrigation facilities	36.7	36.6	73.3	-	-	-	-	-	-	-	-	-	-	-	-	7.3	7.3	14.6	18.4	18.3	36.7	11.0	11.0	22.0	-	-	-
Sub-total of 1.4	109.8	76.0	185.8	-	-	-	-	-	-	-	-	-	-	-	-	24.8	16.8	41.6	46.2	33.3	79.5	38.8	25.9	64.7	-	-	-
2. Resettlement cost	-	5.1	5.1	-	-	-	-	-	-	-	-	-	-	2.6	2.6	-	2.5	2.5	-	-	-	-	-	-	-	-	-
3. Engineering services cost	8.5	4.5	13.0	-	-	-	-	-	-	-	-	-	-	-	-	1.9	1.0	2.9	3.6	1.9	5.5	3.0	1.6	4.6	-	-	-
4. Administration cost	-	9.5	9.5	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	2.2	2.2	-	4.0	4.0	-	3.2	3.2	-	-	-
5. Physical contingency	11.8	9.5	21.3	-	-	-	-	-	-	-	-	-	-	0.3	0.3	2.7	2.3	5.0	5.0	3.9	8.9	4.1	3.0	7.1	-	-	-
Sub-total of (1.- 5.)	130.1	104.6	234.7	-	-	-	-	-	-	-	-	-	-	3.0	3.0	29.4	24.8	54.2	54.8	43.1	97.9	45.9	33.7	79.6	-	-	-
6. Price contingency	25.9	20.4	46.3	-	-	-	-	-	-	-	-	-	-	0.4	0.4	4.7	3.9	8.6	10.6	8.4	19.0	10.6	7.7	18.3	-	-	-
Sub-total of (1.- 6.)	156.0	125.0	281.0	-	-	-	-	-	-	-	-	-	-	3.4	3.4	34.1	28.7	62.8	65.4	51.5	116.9	56.5	41.4	97.9	-	-	-
7. Value Added Tax	-	40.4	40.4	-	-	-	-	-	-	-	-	-	-	0.5	0.5	-	9.0	9.0	-	16.8	16.8	-	14.1	14.1	-	-	-
Total of (1.- 7.)	156.0	165.4	321.4	-	-	-	-	-	-	-	-	-	-	3.9	3.9	34.1	37.7	71.8	65.4	68.3	133.7	56.5	55.5	112.0	-	-	-

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Table 10.2.1: Annual Disbursement Schedule (3/3
(Financial Price, million DH

Overall Plan

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	450.6	242.7	693.3	-	-	-	-	-	-	-	-	-	19.7	10.6	30.3	98.9	53.4	152.3	157.5	84.9	242.4	144.9	77.9	222.8	29.6	15.9	45.5
Irrigation facilities	177.1	176.7	353.8	-	-	-	-	-	-	-	-	-	-	-	-	24.2	24.1	48.3	71.8	71.5	143.3	64.2	64.3	128.5	16.9	16.8	33.7
Water supply facilities	-	3.8	3.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.8	3.8	-	-	-
Sub-total of 1	627.7	423.2	1,050.9	-	-	-	-	-	-	-	-	-	19.7	10.6	30.3	123.1	77.5	200.6	229.3	156.4	385.7	209.1	146.0	355.1	46.5	32.7	79.2
2. Resettlement cost	-	43.3	43.3	-	-	-	-	-	-	-	14.3	14.3	-	21.7	21.7	-	7.3	7.3	-	-	-	-	-	-	-	-	-
3. Engineering services cost	47.8	25.8	73.6	-	-	-	-	-	-	-	-	-	1.4	0.7	2.1	9.2	4.9	14.1	17.4	9.5	26.9	16.2	8.8	25.0	3.6	1.9	5.5
4. Administration cost	-	54.6	54.6	-	-	-	-	-	-	-	0.7	0.7	-	2.6	2.6	-	10.4	10.4	-	19.3	19.3	-	17.7	17.7	-	3.9	3.9
5. Physical contingency	67.6	54.7	122.3	-	-	-	-	-	-	-	1.5	1.5	2.1	3.6	5.7	13.3	10.0	23.3	24.7	18.5	43.2	22.5	17.2	39.7	5.0	3.9	8.9
Sub-total of (1.- 5.)	743.1	601.6	1,344.7	-	-	-	-	-	-	-	16.5	16.5	23.2	39.2	62.4	145.6	110.1	255.7	271.4	203.7	475.1	247.8	189.7	437.5	55.1	42.4	97.5
6. Price contingency	150.6	118.5	269.1	-	-	-	-	-	-	-	1.5	1.5	2.9	5.0	7.9	23.3	17.5	40.8	52.7	39.6	92.3	57.0	43.6	100.6	14.7	11.3	26.0
Sub-total of (1.- 6.)	893.7	720.1	1,613.8	-	-	-	-	-	-	-	18.0	18.0	26.1	44.2	70.3	168.9	127.6	296.5	324.1	243.3	567.4	304.8	233.3	538.1	69.8	53.7	123.5
7. Value Added Tax	-	231.7	231.7	-	-	-	-	-	-	-	2.5	2.5	-	10.0	10.0	-	42.5	42.5	-	81.6	81.6	-	77.4	77.4	-	17.7	17.7
Total of (1.- 7.)	893.7	951.8	1,845.5	-	-	-	-	-	-	-	20.5	20.5	26.1	54.2	80.3	168.9	170.1	339.0	324.1	324.9	649.0	304.8	310.7	615.5	69.8	71.4	141.2

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Table 10.2.2: Estimated Farm Income under Present Condition (Without Project) (Financial Price, DH/ha)

N'fifikh

Crops		Benefit					Expenditure		Net
		Occupancy	Yield		Unit price	Benefit	Unit cost	Net cost	Benefit
		(%)	Qty.	Unit	(DH/kg)	(DH)	(DH/ha)	(DH)	(DH)
		a	b		c	d=a* b* c	e	f=e* a	g=d-f
Cereals 1	Soft wheat	45.5	1.43	(ton/ha)	2.54	1,653	2,029	923	730
Cereals 2	Hard wheat	30.0	1.14	(ton/ha)	2.54	870	2,223	668	202
Fodder	Barley	4.6	1,297	UF	3.00	177	1,476	67	110
Legume	Broad bean	4.6	0.66	(ton/ha)	3.93	118	2,405	109	9
Vegetable	Potato	1.8	27.3	(ton/ha)	2.06	1,024	13,310	242	782
Tree Crop	Grape	4.6	0.84	(ton/ha)	2.92	112	3,060	139	-27
Fodder from cereal 1	-	45.5	725	UF	3.00	990	-	-	990
Fodder from cereal 2	-	30.0	593	UF	3.00	534	-	-	534
Fallow	-	9.0	500	UF	3.00	135	-	-	135
Total		175.5				5,613		2,148	3,465

Taskourt

Crops		Benefit					Expenditure		Net
		Occupancy	Yield		Unit price	Benefit	Unit cost	Net cost	Benefit
		(%)	Qty.	Unit	(DH/kg)	(DH)	(DH/ha)	(DH)	(DH)
		a	b		c	d=a* b* c	e	f=e* a	g=d-f
Cereals 1	Soft wheat	41	0.27	(ton/ha)	2.89	320	1,614	662	-342
Cereals 2	Barley	45	0.28	(ton/ha)	2.52	318	1,463	658	-340
Tree Crop 1	Olive	5	0.72	(ton/ha)	2.61	94	2,745	137	-43
Tree Crop 2	Almond	5	0.34	(ton/ha)	48.24	820	1,460	73	747
Fodder from cereal 1	-	41	137	UF	3.00	169	-	-	169
Fodder from cereal 2	-	45	142	UF	3.00	192	-	-	192
Fallow	-	4	500	UF	3.00	60	-	-	60
Total		186				1,973		1,530	443

Timkit

Crops		Benefit					Expenditure		Net
		Occupancy	Yield		Unit price	Benefit	Unit cost	Net cost	Benefit
		(%)	Qty.	Unit	(DH/kg)	(DH)	(DH/ha)	(DH)	(DH)
		a	b		c	d=a* b* c	e	f=e* a	g=d-f
Cereals	Hard wheat	50.4	2.8	(ton/ha)	3.33	4,699	2,588	1,304	3,395
Fodder	Alfalfa	12.6	5,846	UF	5.20	3,830	4,474	564	3,266
Vegetable	Potato	4.2	27.6	(ton/ha)	2.34	2,713	5,504	231	2,482
Tree Crop 1	Dates	15.12	1.33	(ton/ha)	8.00	1,609	2,304	348	1,261
Tree Crop 2	Olive	1.68	2.1	(ton/ha)	2.69	95	4,474	75	20
Fodder from cereal	-	50.4	1,000	UF	3.00	1,512	-	-	1,512
Total		134.4				14,458		2,522	11,936

Azghar

Crops		Benefit					Expenditure		Net
		Occupancy	Yield		Unit price	Benefit	Unit cost	Net cost	Benefit
		(%)	Qty.	Unit	(DH/kg)	(DH)	(DH/ha)	(DH)	(DH)
		a	b		c	d=a* b* c	e	f=e* a	g=d-f
Cereals 1	Hard wheat	28.7	0.47	(ton/ha)	3.23	436	2,195	630	-194
Cereals 2	Barley	32.8	0.68	(ton/ha)	2.00	446	1,963	644	-198
Fodder	Barley	4.1	473	UF	3.00	58	1,983	81	-23
Legume	Broad bean	4.1	0.21	(ton/ha)	3.73	32	2,050	84	-52
Tree Crop	Olive	12.3	0.84	(ton/ha)	3.04	314	1,605	197	117
Fodder from cereal 1	-	28.7	238	UF	3.00	205	-	-	205
Fodder from cereal 2	-	32.8	402	UF	3.00	396	-	-	396
Fallow	-	18.0	500	UF	3.00	270	-	-	270
Total		161.5				2,157		1,636	521

Table 10.2.3: Expected Farm Income with Project (Financial Price, DH/ha)

N'fifikh

Crops		Benefit						Expenditure		Net
		Occupancy	Yield		Unit price		Benefit	Unit cost	Net cost	Benefit
		(%)	Qty.	Unit	(DH)	Unit	(DH)	(DH/ha)	(DH)	(DH)
		a	b		c		d=a* b* c	e	f=e* a	g=d-f
Cerelas	Soft wheat	30	4.0	(ton/ha)	2.54	(DH/kg)	3,048	3,938	1,181	1,867
Fodder 1	Barley	12.5	2,300	UF	3.00	UF	863	3,938	492	371
Fodder 2	Alfalfa	12.5	10,500	UF	5.20	UF	6,825	7,775	972	5,853
Vegetable 1	Potato	15	31	(ton/ha)	2.06	(DH/kg)	9,579	16,994	2,549	7,030
Vegetable 2	Totato	15	50	(ton/ha)	1.44	(DH/kg)	10,800	15,201	2,280	8,520
Tree crop 1	Grape	7.5	10	(ton/ha)	2.92	(DH/kg)	2,190	4,428	332	1,858
Tree crop 2	Olive	7.5	10	(ton/ha)	2.07	(DH/kg)	1,553	4,858	364	1,189
Fodder from cereals	-	30	1,000	UF	3.00	UF	900	-	-	900
Total		130					35,758		8,170	27,588

Taskourt

Crops		Benefit						Expenditure		Net
		Occupancy	Yield		Unit price		Benefit	Unit cost	Net cost	Benefit
		(%)	Qty.	Unit	(DH)	Unit	(DH)	(DH/ha)	(DH)	(DH)
		a	b		c		d=a* b* c	e	f=e* a	g=d-f
Cerelas 1	Soft wheat	60	4.0	(ton/ha)	2.89	(DH/kg)	6,936	3,938	2,363	4,573
Cerelas 2	Barley	10	4.0	(ton/ha)	2.52	(DH/kg)	1,008	3,938	394	614
Fodder	Alfalfa	10	10,500	UF	5.20	UF	5,460	7,775	778	4,682
Vegetable 1	Watermelon	5	31	(ton/ha)	4.00	(DH/kg)	6,200	13,505	675	5,525
Vegetable 2	Tomato	5	50	(ton/ha)	2.04	(DH/kg)	5,100	15,201	760	4,340
Tree crop 1	Olive	8	10	(ton/ha)	2.61	(DH/kg)	2,088	4,858	389	1,699
Tree crop 2	Almond	2	3.5	(ton/ha)	48.24	(DH/kg)	3,377	2,285	46	3,331
Fodder from cereals 1	-	60	1,000	UF	3.00	UF	1,800	-	-	1,800
Fodder from cereals 2	-	10	1,000	UF	3.00	UF	300	-	-	300
Total		170					32,269		5,405	26,864

Timkit

Crops		Benefit						Expenditure		Net
		Occupancy	Yield		Unit price		Benefit	Unit cost	Net cost	Benefit
		(%)	Qty.	Unit	(DH)	Unit	(DH)	(DH/ha)	(DH)	(DH)
		a	b		c		d=a* b* c	e	f=e* a	g=d-f
Cerelas	Hard wheat	55	4.0	(ton/ha)	3.33	(DH/kg)	7,326	3,938	2,166	5,160
Fodder	Alfalfa	15	10,500	UF	5.20	UF	8,190	7,775	1,166	7,024
Vegetable 1	Potato	10	31	(ton/ha)	2.34	(DH/kg)	7,254	16,994	1,699	5,555
Vegetable 2	Watermelon	5	31	(ton/ha)	3.75	(DH/kg)	5,813	13,505	675	5,138
Tree crop 1	Datas	15	3.5	(ton/ha)	8.00	(DH/kg)	4,200	3,008	451	3,749
Tree crop 2	Olive	5	10	(ton/ha)	2.69	(DH/kg)	1,345	4,858	243	1,102
Fodder from cereals	-	55	1,000	UF	3.00	UF	1,650	-	-	1,650
Total		160					35,778		6,400	29,378

Azghar

Crops		Benefit						Expenditure		Net
		Occupancy	Yield		Unit price		Benefit	Unit cost	Net cost	Benefit
		(%)	Qty.	Unit	(DH)	Unit	(DH)	(DH/ha)	(DH)	(DH)
		a	b		c		d=a* b* c	e	f=e* a	g=d-f
Cerelas 1	Hard wheat	50	4.0	(ton/ha)	3.23	(DH/kg)	6,460	3,938	1,969	4,491
Cerelas 2	Barley	10	4.0	(ton/ha)	2.00	(DH/kg)	800	3,938	394	406
Fodder 1	Barley	2.5	2,300	UF	3.00	UF	173	3,938	98	75
Fodder 2	Alfalfa	7.5	10,500	UF	5.20	UF	4,095	7,775	583	3,512
Legetable	Broad bean	5	15	(ton/ha)	3.73	(DH/kg)	2,798	12,149	607	2,191
Vegetable 1	Potato	10	31	(ton/ha)	2.99	(DH/kg)	9,269	16,994	1,699	7,570
Vegetable 2	Tomato	10	50	(ton/ha)	2.07	(DH/kg)	10,350	15,201	1,520	8,830
Tree crop	Olive	15	10	(ton/ha)	3.04	(DH/kg)	4,560	4,858	729	3,831
Fodder from cereals 1	-	50	1,000	UF	3.00	UF	1,500	-	-	1,500
Fodder from cereals 2	-	10	1,000	UF	3.00	UF	300	-	-	300
Total		170					40,305		7,599	32,706

Table 10.2.4: Estimation of Capacity to Pay

Item	Unit	Scale of Farmers		
		Small 1 ha or less	Medium from 1 ha to 4 ha	Large more than 4 ha
N'Fifikh				
1) Number of sample farmers	nos	11	21	31
2) Average size of farmland	ha	0.9	2.4	14.6
3) Net income " without project"	DH	3,119	8,316	50,589
4) Expected net income " with project"	DH	24,829	66,211	402,785
5) Estimated non-agricultural expenditure	DH	7,000	7,250	8,500
6) Capacity to pay	DH	17,829	58,961	394,285
Taskourt				
1) Number of sample farmers	nos	4	27	44
2) Average size of farmland	ha	0.8	2.6	11.3
3) Net income " without project"	DH	354	1,152	5,006
4) Expected net income " with project"	DH	21,491	69,846	303,563
5) Estimated non-agricultural expenditure	DH	5,250	6,100	10,100
6) Capacity to pay	DH	16,241	63,746	293,463
Timkit				
1) Number of sample farmers	nos	43	18	16
2) Average size of farmland	ha	0.4	2.2	8.9
3) Net income " without project"	DH	4,774	26,259	106,230
4) Expected net income " with project"	DH	11,751	64,632	261,464
5) Estimated non-agricultural expenditure	DH	5,527	5,627	9,850
6) Capacity to pay	DH	6,225	59,005	251,614
Azghar				
1) Number of sample farmers	nos	3	26	15
2) Average size of farmland	ha	0.8	2.5	10
3) Net income " without project"	DH	417	1,303	5,210
4) Expected net income " with project"	DH	26,165	81,765	327,060
5) Estimated non-agricultural expenditure	DH	5,900	7,750	9,250
6) Capacity to pay	DH	20,265	74,015	317,810

Note: Non-agricultural expenditure is estimated from farms' expenditure obtained by the household interview survey on the assumption that half of the total expenditure is non-agricultural expenditure.

Table 10.2.5: Financial Cash Flow Statement for Implementation of the Projects (1/5)

N'Fifikh **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Cash Inflow Water supply	Cash Inflow Government subsidy	Cash Inflow Total (c)	Balance (c) - (b)
1	2001										-		-			-	-	-
2	2002										-		-			-	-	-
3	2003										-		-			-	-	-
4	2004		2.6	2.6	-	2.6					-		-			-	-	-
5	2005	35.6	34.8	70.4	54.7	15.7					-		-			-	-	-
6	2006	79.8	74.0	153.8	170.1	38.4					1.2		1.2			1.2	1.2	-
7	2007	41.8	41.5	83.3	232.5	20.9					3.7		3.7			3.7	3.7	-
8	2008				232.5		1.0	0.5	0.1		5.1		6.7	0.9	0.1	5.7	6.7	-
9	2009				232.5		1.0	0.7	0.1		5.1		6.9	1.3	0.1	5.5	6.9	-
10	2010				232.5		1.1	0.9	0.1		5.1		7.2	1.6	0.1	5.5	7.2	-
11	2011				232.5		1.1	0.9	0.1		5.1		7.2	1.6	0.1	5.5	7.2	-
12	2012				232.5		1.1	1.0	0.1		5.1		7.3	1.7	0.1	5.5	7.3	-
13	2013				232.5		1.2	1.0	0.1		5.1		7.4	1.7	0.2	5.6	7.4	-
14	2014				232.5		1.2	1.1	0.1		5.1		7.5	1.8	0.2	5.6	7.5	-
15	2015				220.8		1.2	1.3	0.1		5.1	11.7	19.4	2.0	0.2	17.3	19.4	-
16	2016				209.1		1.3	1.3	0.1		4.9	11.7	19.3	2.0	0.2	17.1	19.3	-
17	2017				197.4		1.3	1.3	0.1		4.6	11.7	19.0	2.0	0.2	16.8	19.0	-
18	2018				185.7		1.3	1.4	0.2		4.3	11.7	18.9	2.0	0.2	16.8	18.9	-
19	2019				174.0		1.4	1.4	0.2		4.1	11.7	18.8	2.0	0.2	16.6	18.8	-
20	2020				162.3		1.4	1.5	0.2		3.8	11.7	18.6	2.0	0.2	16.5	18.6	-
21	2021				150.6		1.5	1.5	0.2		3.6	11.7	18.5	2.0	0.2	16.3	18.5	-
22	2022				138.9		1.5	1.5	0.2		3.3	11.7	18.2	2.0	0.2	16.1	18.2	-
23	2023				127.2		1.6	1.6	0.2		3.1	11.7	18.2	2.0	0.2	16.0	18.2	-
24	2024				115.5		1.6	1.6	0.2		2.8	11.7	17.9	2.0	0.2	15.7	17.9	-
25	2025				103.8		1.6	1.7	0.2		2.5	11.7	17.7	2.0	0.2	15.6	17.7	-
26	2026				92.1		1.7	1.7	0.2		2.3	11.7	17.6	2.0	0.2	15.4	17.6	-
27	2027				80.4		1.7	1.8	0.2		2.0	11.7	17.4	2.0	0.2	15.3	17.4	-
28	2028				68.7		1.8	1.8	0.2		1.8	11.7	17.3	2.0	0.2	15.1	17.3	-
29	2029				57.0		1.9	1.9	0.2		1.5	11.7	17.2	2.0	0.2	15.1	17.2	-
30	2030				45.3		1.9	1.9	0.2		1.3	11.7	17.0	2.0	0.2	14.8	17.0	-
31	2031				33.6		2.0	2.0	0.2		1.0	11.7	16.9	2.0	0.2	14.7	16.9	-
32	2032				21.9		2.0	2.1	0.2		0.7	11.7	16.7	2.0	0.2	14.6	16.7	-
33	2033				10.2		2.1	2.1	0.2	31.5	0.5	11.7	48.1	2.0	0.2	45.9	48.1	-
34	2034				-		2.2	2.2	0.2		0.2	10.2	15.0	2.0	0.2	12.9	15.0	-
35	2035				-		2.2	2.3	0.3				4.8	2.0	0.2	2.6	4.8	-
36	2036				-		2.3	2.3	0.3				4.9	2.0	0.2	2.7	4.9	-
37	2037				-		2.4	2.4	0.3				5.1	2.0	0.2	2.9	5.1	-

Note: 1) F.C. means foreign currency components and L.C. means local currency components.
2) 75% of the capital costs are assumed to be financed by bilateral or international organization as far as the costs are not non-eligible items.
3) The non-eligible items are costs for land acquisition, house compensation, administration, and any type of taxes and duties.
4) The assumed condition of finance is with an interest rate of 2.2% per annum for repayment period of 30 years including a grace period of 10 years.
5) The price escalation of 3% per annum is assumed for the capital cost, O & M cost, and replacement cost of facilities
6) Annual irrigation water charges are set to cover O & M and replacement cost of irrigation facilities for 25 years.

Table 10.2.5: Financial Cash Flow Statement for Implementation of the Projects (2/5)

Taskourt **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Cash Inflow Water supply	Cash Inflow Government subsidy	Cash Inflow Total (c)	Balance (c) - (b)
1	2001										-		-			-	-	-
2	2002										-		-			-	-	-
3	2003		20.5	20.5	-	20.5					-		-			-	-	-
4	2004	26.1	42.9	69.0	40.1	28.9					-		-			-	-	-
5	2005	74.7	72.1	146.8	162.6	24.3					0.9		0.9			0.9	0.9	-
6	2006	130.3	133.5	263.8	375.0	51.4					3.6		3.6			3.6	3.6	-
7	2007	114.6	115.4	230.0	547.5	57.5					8.3		8.3			8.3	8.3	-
8	2008				547.5	-	1.9	1.9	0.2		12.0		16.0	3.8	0.3	12.0	16.0	-
9	2009				547.5		2.0	2.7	0.2		12.0		16.9	5.0	0.3	11.7	16.9	-
10	2010				547.5		2.0	3.2	0.2		12.0		17.4	5.9	0.3	11.3	17.4	-
11	2011				547.5		2.1	3.7	0.2		12.0		18.0	6.6	0.3	11.2	18.0	-
12	2012				547.5		2.2	4.1	0.2		12.0		18.5	7.1	0.3	11.2	18.5	-
13	2013				547.5		2.2	4.3	0.2		12.0		18.7	7.1	0.3	11.4	18.7	-
14	2014				520.1		2.3	4.4	0.2		12.0	27.4	46.3	7.1	0.3	39.0	46.3	-
15	2015				492.7		2.4	4.5	0.2		11.4	27.4	45.9	7.1	0.3	38.6	45.9	-
16	2016				465.3		2.4	4.6	0.2		10.8	27.4	45.4	7.1	0.3	38.1	45.4	-
17	2017				437.9		2.5	4.8	0.2		10.2	27.4	45.1	7.1	0.3	37.8	45.1	-
18	2018				410.5		2.6	4.9	0.3		9.6	27.4	44.8	7.1	0.3	37.5	44.8	-
19	2019				383.1		2.7	5.1	0.3		9.0	27.4	44.5	7.1	0.3	37.2	44.5	-
20	2020				355.7		2.7	5.2	0.3		8.4	27.4	44.0	7.1	0.3	36.7	44.0	-
21	2021				328.3		2.8	5.4	0.3		7.8	27.4	43.7	7.1	0.3	36.3	43.7	-
22	2022				300.9		2.9	5.6	0.3		7.2	27.4	43.4	7.1	0.3	36.0	43.4	-
23	2023				273.5		3.0	5.7	0.3		6.6	27.4	43.0	7.1	0.3	35.6	43.0	-
24	2024				246.1		3.1	5.9	0.3		6.0	27.4	42.7	7.1	0.3	35.3	42.7	-
25	2025				218.7		3.2	6.1	0.3		5.4	27.4	42.4	7.1	0.3	35.0	42.4	-
26	2026				191.3		3.3	6.2	0.3		4.8	27.4	42.0	7.1	0.3	34.6	42.0	-
27	2027				163.9		3.4	6.4	0.3		4.2	27.4	41.7	7.1	0.3	34.3	41.7	-
28	2028				136.5		3.5	6.6	0.3		3.6	27.4	41.4	7.1	0.3	34.0	41.4	-
29	2029				109.1		3.6	6.8	0.4		3.0	27.4	41.2	7.1	0.3	33.8	41.2	-
30	2030				81.7		3.7	7.0	0.4		2.4	27.4	40.9	7.1	0.3	33.5	40.9	-
31	2031				54.3		3.8	7.2	0.4		1.8	27.4	40.6	7.1	0.3	33.2	40.6	-
32	2032				26.9		3.9	7.5	0.4		1.2	27.4	40.4	7.1	0.3	33.0	40.4	-
33	2033				-		4.0	7.7	0.4	78.6	0.6	26.9	118.2	7.1	0.3	110.8	118.2	-
34	2034				-		4.1	7.9	0.4				12.4	7.1	0.3	5.0	12.4	-
35	2035				-		4.3	8.2	0.4				12.9	7.1	0.3	5.5	12.9	-
36	2036				-		4.4	8.4	0.4				13.2	7.1	0.3	5.8	13.2	-
37	2037				-		4.5	8.6	0.4				13.5	7.1	0.3	6.1	13.5	-

Note: 1) F.C. means foreign currency components and L.C. means local currency components.
2) 75% of the capital costs are assumed to be financed by bilateral or international organization as far as the costs are not non-eligible items.
3) The non-eligible items are costs for land acquisition, house compensation, administration, and any type of taxes and duties.
4) The assumed condition of finance is with an interest rate of 2.2% per annum for repayment period of 30 years including a grace period of 10 years.
5) The price escalation of 3% per annum is assumed for the capital cost, O & M cost, and replacement cost of facilities
6) Annual irrigation water charges are set to cover O & M and replacement cost of irrigation facilities for 25 years.

Table 10.2.5: Financial Cash Flow Statement for Implementation of the Projects (3/5)

Timkit **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Cash Inflow Water supply	Cash Inflow Government subsidy	Cash Inflow Total (c)	Balance (c) - (b)
1	2001										-		-			-	-	-
2	2002										-		-			-	-	-
3	2003										-		-			-	-	-
4	2004		4.8	4.8	-	4.8					-		-			-	-	-
5	2005	24.5	25.5	50.0	37.7	12.3					-		-			-	-	-
6	2006	48.6	49.1	97.7	114.3	21.1					0.8		0.8			0.8	0.8	-
7	2007	91.9	98.3	190.2	257.0	47.5					2.5		2.5			2.5	2.5	-
8	2008	69.8	71.4	141.2	362.9	35.3					5.7		5.7			5.7	5.7	-
9	2009				362.9		1.2	1.8			8.0		11.0	3.5		7.5	11.0	-
10	2010				362.9		1.2	2.6			8.0		11.8	4.8		7.0	11.8	-
11	2011				362.9		1.2	3.1			8.0		12.3	5.6		6.7	12.3	-
12	2012				362.9		1.3	3.4			8.0		12.7	6.0		6.7	12.7	-
13	2013				362.9		1.3	3.6			8.0		12.9	6.2		6.7	12.9	-
14	2014				362.9		1.4	3.7			8.0		13.1	6.2		6.9	13.1	-
15	2015				344.7		1.4	3.8			8.0	18.2	31.4	6.2		25.2	31.4	-
16	2016				326.5		1.4	4.0			7.6	18.2	31.2	6.2		25.0	31.2	-
17	2017				308.3		1.5	4.1			7.2	18.2	31.0	6.2		24.8	31.0	-
18	2018				290.1		1.5	4.2			6.8	18.2	30.7	6.2		24.5	30.7	-
19	2019				271.9		1.6	4.3			6.4	18.2	30.5	6.2		24.3	30.5	-
20	2020				253.7		1.6	4.5			6.0	18.2	30.3	6.2		24.1	30.3	-
21	2021				235.5		1.7	4.6			5.6	18.2	30.1	6.2		23.9	30.1	-
22	2022				217.3		1.7	4.7			5.2	18.2	29.8	6.2		23.6	29.8	-
23	2023				199.1		1.8	4.9			4.8	18.2	29.7	6.2		23.5	29.7	-
24	2024				180.9		1.8	5.0			4.4	18.2	29.4	6.2		23.2	29.4	-
25	2025				162.7		1.9	5.2			4.0	18.2	29.3	6.2		23.1	29.3	-
26	2026				144.5		1.9	5.3			3.6	18.2	29.0	6.2		22.8	29.0	-
27	2027				126.3		2.0	5.5			3.2	18.2	28.9	6.2		22.7	28.9	-
28	2028				108.1		2.0	5.7			2.8	18.2	28.7	6.2		22.5	28.7	-
29	2029				89.9		2.1	5.8			2.4	18.2	28.5	6.2		22.3	28.5	-
30	2030				71.7		2.2	6.0			2.0	18.2	28.4	6.2		22.2	28.4	-
31	2031				53.5		2.2	6.2			1.6	18.2	28.2	6.2		22.0	28.2	-
32	2032				35.3		2.3	6.4			1.2	18.2	28.1	6.2		21.9	28.1	-
33	2033				17.1		2.4	6.6			0.8	18.2	28.0	6.2		21.8	28.0	-
34	2034				-		2.4	6.8		58.1	0.4	17.1	84.8	6.2		78.6	84.8	-
35	2035				-		2.5	7.0					9.5	6.2		3.3	9.5	-
36	2036				-		2.6	7.2					9.8	6.2		3.6	9.8	-
37	2037				-		2.7	7.4					10.1	6.2		3.9	10.1	-

Note: 1) F.C. means foreign currency components and L.C. means local currency components.
2) 75% of the capital costs are assumed to be financed by bilateral or international organization as far as the costs are not non-eligible items.
3) The non-eligible items are costs for land acquisition, house compensation, administration, and any type of taxes and duties.
4) The assumed condition of finance is with an interest rate of 2.2% per annum for repayment period of 30 years including a grace period of 10 years.
5) The price escalation of 3% per annum is assumed for the capital cost, O & M cost, and replacement cost of facilities
6) Annual irrigation water charges are set to cover O & M and replacement cost of irrigation facilities for 25 years.

Table 10.2.5: Financial Cash Flow Statement for Implementation of the Projects (4/5)

Azghar **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Cash Inflow Water supply	Cash Inflow Government subsidy	Cash Inflow Total (c)	Balance (c) - (b)
1	2001										-		-			-	-	-
2	2002										-		-			-	-	-
3	2003										-		-			-	-	-
4	2004		3.9	3.9	-	3.9					-		-			-	-	-
5	2005	34.1	37.7	71.8	56.7	15.1					-		-			-	-	-
6	2006	65.4	68.3	133.7	157.0	33.4					1.2		1.2			1.2	1.2	-
7	2007	56.5	55.5	112.0	241.0	28.0					3.5		3.5			3.5	3.5	-
8	2008				241.0		0.8	0.7			5.3		6.8	1.4		5.4	6.8	-
9	2009				241.0		0.8	1.2			5.3		7.3	2.2		5.1	7.3	-
10	2010				241.0		0.8	1.5			5.3		7.6	2.8		4.8	7.6	-
11	2011				241.0		0.9	2.0			5.3		8.2	3.5		4.7	8.2	-
12	2012				241.0		0.9	2.3			5.3		8.5	4.0		4.5	8.5	-
13	2013				241.0		0.9	2.4			5.3		8.6	4.0		4.6	8.6	-
14	2014				241.0		0.9	2.4			5.3		8.6	4.0		4.6	8.6	-
15	2015				228.9		1.0	2.5			5.3	12.1	20.9	4.0		16.9	20.9	-
16	2016				216.8		1.0	2.6			5.0	12.1	20.7	4.0		16.7	20.7	-
17	2017				204.7		1.0	2.7			4.8	12.1	20.6	4.0		16.6	20.6	-
18	2018				192.6		1.1	2.7			4.5	12.1	20.4	4.0		16.4	20.4	-
19	2019				180.5		1.1	2.8			4.2	12.1	20.2	4.0		16.2	20.2	-
20	2020				168.4		1.1	2.9			4.0	12.1	20.1	4.0		16.1	20.1	-
21	2021				156.3		1.2	3.0			3.7	12.1	20.0	4.0		16.0	20.0	-
22	2022				144.2		1.2	3.1			3.4	12.1	19.8	4.0		15.8	19.8	-
23	2023				132.1		1.2	3.2			3.2	12.1	19.7	4.0		15.7	19.7	-
24	2024				120.0		1.3	3.3			2.9	12.1	19.6	4.0		15.6	19.6	-
25	2025				107.9		1.3	3.4			2.6	12.1	19.4	4.0		15.4	19.4	-
26	2026				95.8		1.3	3.5			2.4	12.1	19.3	4.0		15.3	19.3	-
27	2027				83.7		1.4	3.6			2.1	12.1	19.2	4.0		15.2	19.2	-
28	2028				71.6		1.4	3.7			1.8	12.1	19.0	4.0		15.0	19.0	-
29	2029				59.5		1.5	3.8			1.6	12.1	19.0	4.0		15.0	19.0	-
30	2030				47.4		1.5	3.9			1.3	12.1	18.8	4.0		14.8	18.8	-
31	2031				35.3		1.5	4.0			1.0	12.1	18.6	4.0		14.6	18.6	-
32	2032				23.2		1.6	4.2			0.8	12.1	18.7	4.0		14.7	18.7	-
33	2033				11.1		1.6	4.3		37.8	0.5	12.1	56.3	4.0		52.3	56.3	-
34	2034				-		1.7	4.4			0.2	11.1	17.4	4.0		13.4	17.4	-
35	2035				-		1.7	4.5					6.2	4.0		2.2	6.2	-
36	2036				-		1.8	4.7					6.5	4.0		2.5	6.5	-
37	2037				-		1.8	4.8					6.6	4.0		2.6	6.6	-

Note: 1) F.C. means foreign currency components and L.C. means local currency components.
2) 75% of the capital costs are assumed to be financed by bilateral or international organization as far as the costs are not non-eligible items.
3) The non-eligible items are costs for land acquisition, house compensation, administration, and any type of taxes and duties.
4) The assumed condition of finance is with an interest rate of 2.2% per annum for repayment period of 30 years including a grace period of 10 years.
5) The price escalation of 3% per annum is assumed for the capital cost, O & M cost, and replacement cost of facilities
6) Annual irrigation water charges are set to cover O & M and replacement cost of irrigation facilities for 25 years.

Table 10.2.5: Financial Cash Flow Statement for Implementation of the Projects (5/5)

Overall Plan **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Cash Inflow Water supply	Cash Inflow Government subsidy	Cash Inflow Total (c)	Balance (c) - (b)
1	2001												-				-	-
2	2002												-				-	-
3	2003	-	20.5	20.5	-	20.5							-				-	-
4	2004	26.1	54.2	80.3	40.1	40.2							-				-	-
5	2005	168.9	170.1	339.0	311.7	67.4					0.9		0.9			0.9	0.9	-
6	2006	324.1	324.9	649.0	816.4	144.3					6.9		6.9			6.9	6.9	-
7	2007	304.8	310.7	615.5	1,278.0	153.9					18.0		18.0			18.0	18.0	-
8	2008	69.8	71.4	141.2	1,383.9	35.3	3.7	3.1	0.3		28.1		35.2	6.1	0.4	28.7	35.2	-
9	2009				1,383.9		5.0	6.4	0.3		30.4		42.1	12.0	0.4	29.7	42.1	-
10	2010				1,383.9		5.1	8.2	0.3		30.4		44.0	15.1	0.4	28.5	44.0	-
11	2011				1,383.9		5.3	9.7	0.3		30.4		45.7	17.3	0.4	28.0	45.7	-
12	2012				1,383.9		5.5	10.8	0.3		30.4		47.0	18.8	0.4	27.8	47.0	-
13	2013				1,383.9		5.6	11.3	0.3		30.4		47.6	19.0	0.4	28.2	47.6	-
14	2014				1,356.5		5.8	11.6	0.3		30.4	27.4	75.5	19.1	0.4	56.0	75.5	-
15	2015				1,287.1		6.0	12.1	0.3		29.8	69.4	117.6	19.3	0.4	97.9	117.6	-
16	2016				1,217.7		6.1	12.5	0.3		28.3	69.4	116.6	19.3	0.4	96.9	116.6	-
17	2017				1,148.3		6.3	12.9	0.3		26.8	69.4	115.7	19.3	0.4	96.0	115.7	-
18	2018				1,078.9		6.5	13.2	0.5		25.3	69.4	114.9	19.3	0.4	95.1	114.9	-
19	2019				1,009.5		6.8	13.6	0.5		23.7	69.4	114.0	19.3	0.4	94.3	114.0	-
20	2020				940.1		6.8	14.1	0.5		22.2	69.4	113.0	19.3	0.4	93.3	113.0	-
21	2021				870.7		7.2	14.5	0.5		20.7	69.4	112.3	19.3	0.4	92.5	112.3	-
22	2022				801.3		7.3	14.9	0.5		19.2	69.4	111.3	19.3	0.4	91.5	111.3	-
23	2023				731.9		7.6	15.4	0.5		17.6	69.4	110.5	19.3	0.4	90.8	110.5	-
24	2024				662.5		7.8	15.8	0.5		16.1	69.4	109.6	19.3	0.4	89.9	109.6	-
25	2025				593.1		8.0	16.4	0.5		14.6	69.4	108.9	19.3	0.4	89.1	108.9	-
26	2026				523.7		8.2	16.7	0.5		13.0	69.4	107.8	19.3	0.4	88.1	107.8	-
27	2027				454.3		8.5	17.3	0.5		11.5	69.4	107.2	19.3	0.4	87.5	107.2	-
28	2028				384.9		8.7	17.8	0.5		10.0	69.4	106.4	19.3	0.4	86.7	106.4	-
29	2029				315.5		9.1	18.3	0.6		8.5	69.4	105.9	19.3	0.4	86.1	105.9	-
30	2030				246.1		9.3	18.8	0.6		6.9	69.4	105.0	19.3	0.4	85.3	105.0	-
31	2031				176.7		9.5	19.4	0.6		5.4	69.4	104.3	19.3	0.4	84.6	104.3	-
32	2032				107.3		9.8	20.2	0.6		3.9	69.4	103.9	19.3	0.4	84.1	103.9	-
33	2033				38.4		10.1	20.7	0.6	147.9	2.4	68.9	250.6	19.3	0.4	230.8	250.6	-
34	2034				-		10.4	21.3	0.6	58.1	0.8	38.4	129.6	19.3	0.4	109.9	129.6	-
35	2035				-		10.7	22.0	0.7				33.4	19.3	0.4	13.7	33.4	-
36	2036				-		11.1	22.6	0.7				34.4	19.3	0.4	14.7	34.4	-
37	2037				-		11.4	23.2	0.7				35.3	19.3	0.4	15.6	35.3	-

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