Feasibility Study on Water Resources Development in
Rural Area in
the Kingdom of Morocco
Final Report
Volume III Supporting Report (1)
Basic Study

Supporting Report VIII Projects Evaluation and Prioritization

FEASIBILITY STUDY
ON
WATER RESOURCES DEVELOPMENT
IN
RURAL AREA
IN
THE KINGDOM OF MOROCCO

FINAL REPORT

VOLUME III
SUPPORTING REPORT (1)
BASIC STUDY

SUPPORTING REPORT VIII
PROJECT EVALUATION
AND
PRIORITIZATION

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SUPPORTING REPORT VIII

PROJECT EVALUATION AND PRIORITIZATION

VIII1 Project Evaluation

Before prioritizing for the 25 dam prospective projects, evaluation of each dam project has been made on the basis of five major items consisting of social aspects, technical feasibility, natural environmental impact, social environmental impact and economic viability. In evaluating each item, scoring method is adopted. Final evaluation of the projects is comprehensively made on the basis of the scores given to each item.

VIII1.1 Social Aspects

Social aspects of the projects such as (1) project function and its conformity with basic development strategy, (2) status in the government development program, (3) urgency for project implementation, and (4) effects on stabilization of social condition, etc. are reviewed and evaluated.

VIII1.1.1 Description of Each Project

No.1 Neckor Dam

The main purpose of this dam is to reduce sediment inflow to the existing El Khattabi dam. Currently, the sedimentation of this reservoir reaches to about 30% of the total capacity. El Khattabi dam plays a vital role of this area such as for irrigation, municipal water supply, and flood control. Therefore, implementation of countermeasure is urgently necessitated. However, it is not clear whether the Neckor dam is the optimal solution or not, since alternative study on the countermeasure is not available yet. It is also noted that there exists no farmland to be irrigated between Neckor and El Khattabi dams. MOE has completed APD for this project.

No.2 Tizimellal Dam

The major function of this dam is to reduce sediment inflow to Al Wahda dam. Development need is not high as the beneficial effect is negligible. MOE has completed APD for this project.

No.3 Ait Baddou Dam

The main function of this dam is sediment control for Sidi Driss dam and Rocade canal. The Rocade canal is a key facility for the municipal and irrigation water supply in Marrakech area. Priority of the project is rather low because sediment flow of this river is not so serious. MOE is conducting pre-APD for this project.

No.4 Ain Kwachiya Dam

There are three major functions for this dam, namely, to irrigate the downstream farmlands, to protect Sidi Yahya from flood, and to control salinity in the area. Command area is favorable for irrigation farming from the topographic and soil aspects. However, since the basin is rather small, socio-economic impacts will not be so large. MOE has completed APD for this project, and MOA gives the primary priority.

No.5 N'Fifikh Dam

The downstream area of the N'Fifikh river, though it was a favorable vegetable production farmland, is now suffering from saline ground water due to geological origin. And the river water is flowing out into the sea in vain without any retention and utilization. It is proposed to create a reservoir by constructing a dam. In addition to this, it is expected that the project will favorably irrigate the downstream area that is blessed with soil and topography. In this regard, the highest priority should be given to this project. MoE has completed APD for this project, and MOA gives the primary priority. The dam project was applied for OECF loan. In order to mitigate social problem due to relocation and land acquisition, dam site is proposed to be shifted in the upper reaches, about 20 km far from the original site.

No.6 Tazarane Dam

The main functions of this dam are to reduce sediment inflow to Al Wahda dam and irrigate the downstream farmlands. Since the catchment area of the proposed dam is small, beneficial effect on sediment control is also small. MOE has completed APD for this project.

No.7 Amezmiz Dam

Feasibility study of the rehabilitation project was conducted by FAO (Food and Agriculture Organization) in 1987. The rehabilitation project was implemented with the financial assistance of IBRD (International Bank for Reconstruction and Development) based, and completed in 1995. This project was conducted without considering the dam. MOE has completed APD for this project, and MOA gives the secondary priority. Financing of OECF loan was once applied for the dam project. All of these show the fact of a notable deficiency of water in the area. However, the construction of dam upstream of the rehabilitated area should be examined carefully. Since the investment was already made without dam consideration additional work have a possibility of dual investment.

No.8 Boulaouane Dam

The main objective of this project is to irrigate the farmlands located downstream of the proposed dam site. At present, some parts of these areas are

irrigated by the traditional method. However, the existing canals are not functioning sufficiently due to large seasonal fluctuations of the river water, and accordingly the agricultural productivity is unstable. The areas to be developed are favorable in view of topography, though the soils contain gravel, which can be removed easily. Implementation of this project will attain sustainable agricultural development in this region. MOE has completed pre-APD for this project, and MOA gives the secondary priority.

No.9 Taskourt Dam

The main objective of this project is to irrigate the extensive farmlands located downstream of the proposed dam site. The general existing condition is more or less the same as the above Boulaouane site (No. 8). Implementation of this project will attain sustainable agricultural development in the region. Taskourt dam is listed in Five Year National Development Plan of the hydraulic sector. MOE is conducting pre-APD for this project and MOA gives it primary priority.

No.10 Timkit Dam

The main function of this dam is to irrigate three existing oases. The ground water table that was within 10 m from surface in 1970s has drawn down currently to more than 30 m. As a result, many of the farmers abandoned farming in these oases, since the rain is too little to practice farming in this area. To cope with this, the Regional Agency for Irrigation and Agricultural Development of the Tafilalet constructed two diversion weirs and main canals in advance. Implementation of the proposed dam is an urgent need for surface irrigation in order to restore farmlands and to establish sustainable agricultural activities. MOE has completed APD for this project and listed in the Master Plan with high priority. MOA also gives the primary priority. The dam project was applied for OECF loan.

No.11 Tadighoust Dam

The main function of this dam is to supply water to the three oases located at about 100 kilometers downstream of the proposed dam site by releasing water to the Rheris River. Since these oases are receiving surface and subsurface river water, the implementation of the dam does not seem to be an urgent need. MOE has completed pre-APD for this project and listed in the Master Plan.

A trans-basin canal is under construction near Erfoud town to transfer 50 m^3/s of water of the Rheris river to the Ziz river in order to foster the irrigation water supply in Tafilat area.

No.12 Tiouzaguine Dam

The major functions of the dam are to irrigate the oases located along the Ziz River and to supply potable water to Gourrama. As these oases are receiving

surface and subsurface river water and the town of Gourrama is provided with ground water, though the amount is not necessarily sufficient, the implementation of the dam does not seem to be an urgent need. MOE has completed pre-APD for this project.

No.13 Kheng Grou Dam

The major function of the dam is to irrigate the oases located along the Guir River. As these oases are receiving surface and subsurface river water, the implementation of the dam does not seem to be an urgent need. Currently, construction of irrigation facilities without dam is under way at the downstream. MOE has completed APD for this project.

No.14 Adarouch Dam

There are three main purposes for this dam, irrigation of the downstream areas, drinking water for livestock and stable water supply to Kansera dam for potable water supply to two towns of Kemisset and Tiflet. It should be noted that the major beneficiary is the private farm, and hence, it may contribute neither to the alleviation of poverty nor mitigation of the rural differentials. Adarouch dam is listed in Five Year National Development Plan of the hydraulic sector. MOE has completed APD for this project, and MOA gives the primary priority.

No.15 Sidi Omar Dam

The main objective of this project is irrigation. The command area is favorable for irrigation farming from the topographic and soil aspects. Since the area is more or less irrigated and the population density is not so high, implementation of the project does not seem to be so urgent. MOE is conducting pre-APD for this project, and MOA gives the secondary priority.

No.16 Tiouine Dam

The major functions of this dam are irrigation and flood control for the downstream farmlands. At present, part of these areas are irrigated by three canals rehabilitated or constructed, and the national road is often damaged due to flooding. These canals are not functioning effectively due to large seasonal fluctuations of the river water and floods.

Thus, the agricultural productivity is unstable. The areas to be developed are favorable in view of topography, though the soils contain gravel. Implementation of this project will attain sustainable agricultural development in this region. MOE has completed pre-APD for this project.

No.17 Azghar Dam

The proposed dam has function of irrigation in the downstream farmlands. The area is suffering from severe drought, as the ground water is not favorably

utilized because of poor geological formations. As the situation is as such, some farmers are about to abandon farming and some are engaged in grazing in the forests. The fact may result in population outflow and devastation of environment. It is an urgent need to implement the project for the stabilization of the social conditions. MOE has completed pre-APD for this project.

No.18 Boukarkour Dam

There are three major functions for this dam, namely, to irrigate the downstream farmlands, to supply stable water to Mellah dam and to protect flood from Mohamedia. MOE has completed APD for this project and listed in the Master Plan. The dam project was once applied for OECF loan.

No.19 Aoulai Dam

There are two major functions for this dam. One is to control sedimentation of Al Wahda dam, and the other is to irrigate the downstream farmlands. Priority of the project is rather low due to small effect on sediment control and unfavorable condition for irrigated farming. MOE has completed pre-APD for this project.

No.20 Sidi Abbou Dam

There are two major functions for this dam. One is to irrigate the downstream farmlands, and the other is to control salinity in the areas. MOE is conducting pre-APD for this project, and listed this project in the Master Plan.

No.21 Sidi El Mokhfi Dam

The main purposes of this dam are to reduce sediment inflow to Al Wahda dam and to irrigate downstream areas. As the basin is rather large, beneficial effect is also large. MOE has completed pre-APD for this project.

No.22 N'ouantz Dam

The main objectives of the N'ouantz project are to irrigate the downstream farmlands and supply water to livestock. MOA gives the primary priority.

No.23 Igui N'ouaqa Dam

The major objectives of this project are to recharge water for Souss-Massa ground water basin and to practice irrigation in the downstream areas. Since the rain is too little to practice farming, large amount of ground water was exploited in this region. Some information indicates that the annual drawn down of the ground water table was 1.6 meters per annum recently. To cope with this, recharging water is an urgent need for restoration of farmlands. However, the effect of the water recharge is unforeseen unless the ground water flow regime is grasped through further detailed hydro-geological investigation. MOE has completed APD for this project, and MOA gives the 2nd priority.

No.24 Amount Abdelmoumen Dam

The main function of this dam is to compensate storage capacity of the existing Abdelmoumen dam, as it has technical problems for water pressure. MOE is conducting pre-APD for this project.

No.25 Sidi Abdellah Dam

The major objectives of this project are to recharge water for Souss-Massa ground water basin and to practice irrigation in the downstream areas. The general situation of this area is more or less the same as that of Igui N'ouaqa (No. 23). Thus, recharging water is an urgent need for restoration of farmlands. However, the effect of the water recharge is unforeseen unless the ground water flow regime is grasped through further detailed hydro-geological investigation. MOE has completed APD for this project.

VIII1.1.2 Method of Evaluation

Level of social aspects such as:

(1) Project function and its conformity with basic development strategy,

(2) Status in the government development program,

(3) Urgency for project implementation, and

(4) Effects on stabilization of social condition

These levels are assessed for each project from A to C scales where A is considered as good, B is fair and C is poor at the current stage. The number of A, B and C are counted and simply multiplied by 2, 1 and 0 respectively. The total points are then classified into three ranks such as:

A: Social aspect is good (7 or 8 points),

B: Social aspect is fair (4,5 or 6 points),

C: Social aspect is rather poor (<4 points).

VIII1.1.3 Result of Evaluation

Level of social aspects for each project is calculated and classified into three ranks as presented in Table VIII1.1.1 The dam sites, No. 4, 5, 9, 10, 17 and 25 are classified as rank A that is considered good in social aspect, meanwhile No. 2, 3, 12 and 22 are classified as rank C that is considered rather poor.

VIII1.2 Technical Feasibility

In order to evaluate and show-up the principal technical issues of the respective projects, discussions were made based on the planning principles and design features. The major issues of each project are summarized below.

VIII1.2.1 Description of Each Project

No.1 Neckor Dam

- Alternative studies are not available on the measures to cope with the reservoir sedimentation problem of El Khattabi dam.
- Thick alluvial deposits Foundation treatment for bearing capacity and leakage water should be carefully studied, since the dam will be founded on very thick alluvial deposits.
- The dam will be of single purpose for sediment control, because no farmland to be irrigated exists. Economic viability will be low.

No.2 Tizimellal Dam

- Negligible effect to Al Wahda: One of the 15 dams proposed for sediment control of the existing Al Wahda dam. However, judging from catchment size and distance, sediment control effect to Al Wahda dam will be negligible small, though the primary function of this dam is the sediment control. In addition, existing sediment flow has been already controlled by the existing Bouhouda dam located in downstream of the proposed site.
- Material procurement: Procurement of embankment material is difficult near the site.
- Undulating topography: Command area is not favorable for irrigation because of undulating topography.
- Single purpose dam: The dam will be of single purpose of sediment control, because no appropriate land for irrigation is identified. Economic viability will be low.

No.3 Ait Baddou Dam

- Site selection: The sediment flow of the proposed site seems not so serious and sediment control effects to Side Driss dam cannot be expected. Suitable site for sediment control should be re-studied.
- Limestone: Careful investigation and treatment for leakage water are necessary, for the bedrock is formed with alternated limestone and marly limestone layers.

No.4 Ain Kwachiya Dam

- No particular technical issue

No.5 N'Fifikh Dam (Lower)

- Fault line: Careful foundation treatment may be necessary, for a fault line exists along the foot of right side bank.

No.5 N'Fifikh Dam (Upper)

- No particular technical issue

No.6 Tazarane Dam

- Negligible effect to Al Wahda: One of the 15 dams proposed for sediment control of Al Wahda dam. However, judging from catchment size and distance, the sediment control effects to Al Wahda dam will be negligible small. Bob Ouender dam is proposed in downstream of the proposed site and this dam may absorb the effects of the Tazarane dam.
- Poor soil: The proposed command area is not favorable being located along the flood plain with poor soil.
- Procurement of embankment material is difficult near the site.

No.7 Amezmiz Dam

- Hard access: Access to the dam site is long and hard. Use of riverbed during dry period should be considered for the transportation of construction equipment and materials.
- Removal of gravel is required for the farmland to be irrigated.

No.8 Boulaouane Dam

- Limestone: Careful investigation and treatment for leakage water are necessary, for the foundation will be on the limestone bar with small-scale karsts and open joints. A large volume of ground treatment may be required.
- Removal of gravel is required for the vast farmland to be irrigated.

No.9 Taskourt Dam

- Thick river deposits: Deep excavation will be necessitated to found the dam body on sound bedrock, since the site is covered with thick river deposits.
- Hard access: Access to the dam site is long and hard. Use of riverbed during dry period should be considered for the transportation of construction equipment and materials.
- Removal of gravel is required for the farmland to be irrigated.

No.10 Timkit Dam

- Limestone: Careful investigation and treatment for leakage water are necessary, since the site is located in the narrow gorge of limestone with many karsts especially along the bedding planes.

No.11 Tadighoust Dam

- Plan coordination: Coordination on water use in the downstream reaches is required in relation with trans-basin canal project near Erfoud.
- Thick river deposits: Deep excavation will be necessitated to found the dam body on sound bedrock, since the site is covered with thick river deposits.
- Limestone: Treatment by grouting may be needed for the foundation limestone that has some open joints.

No.12 Tiouzaguine Dam

- Plan coordination: Coordination on implementation priority should be first made among the proposed dams in the Guir River. According to the field information, Kaddussa dam (Large dam) should have higher priority.
- Soluble limestone: Careful investigation and treatment for leakage water are required, since some soluble limestone exist in the bedrocks composed of limestone relatively closely joined.

No.13 Kheng Grou Dam

- Implementation schedule: Present water demand downstream of this dam is not so much compared to water resources potential which can be developed by this dam. Implementation schedule might be postponed.
- Limestone: Detailed investigation is necessary, since the basement rocks made of hard limestone have some slightly open joints.

No.14 Adarouch Dam

- Plan coordination: Ouljet Soltane dam (listed in Five Year Development Plan) is proposed in downstream of the proposed site and this dam will diminish the effects of the Adarouch dam. Therefore, plan coordination may be required among the two as far as the Kansera dam is concerned.

No.15 Sidi Omar Dam

- Severely folded bedrock: Careful investigation and foundation treatment are necessary, since the bedrock on right bank is severely folded, schistose and in some places sheared.

No.16 Tiouine Dam

- Implementation schedule: Present water demand downstream of this dam is

not so much compared to water resources potential that can be developed by this dam. Implementation schedule might be postponed

- Porous bedrock in reservoir: Detailed geological investigation is necessary to confirm the existence of impervious bedrock under the reservoir area, since very porous and loose conglomerate and sandstone extend in the reservoir area mostly on the left bank.

No.17 Azghar Dam

- No particular technical issue.

No.18 Boukarkour Dam

- Pumping irrigation: Pumping irrigation is required because of topography, which require costly operation and maintenance. Study on alternative plan might be required.
- Little flood control effect to Mohamedia: This dam doesn't have direct effects on flood control for Mohamedia city and surrounding areas, because Mellah dam exists downstream and absorb the effects.

No.19 Aoulai Dam

- Severely weathered rock: Careful and costly foundation treatment to assure enough bearing capacity will be necessary, since dam foundation is mainly formed with severely weathered rock.
- Poor soil: The proposed command area is not favorable being located along the flood plain with poor soil.

No.20 Sidi Abbou Dam

- Limestone: Careful investigation and treatment for leakage water are necessary, because of limestone foundation with karsts. Alternative dam axis including dam type is necessary to be studied.
- Sloped topography: The command area is located on rather steep sloped topography.

No.21 Sidi El Mokhfi Dam

- Loose foundation: Sufficient foundation treatment will be required, for the foundation is loosened, and bedding and joint planes are opened.
- Unstable reservoir slope: Some studies are necessary on the stability of reservoir slope, for it looks somewhat unstable.
- Undulating topography: The command area is partly unfavorable for irrigation due to undulating topography.

No.22 N'ouantz Dam

- Small storage volume: Storage volume of the dam is very small even compared with the sediment inflow. The reservoir will be full of sediment within less than 40 years.
- Low bearing capacity: Bearing capacity should be studied carefully, for the dam foundation will be on the alternated sandstone and mudstone layers.
- Pumping irrigation: Pumping irrigation is required for both irrigation and livestock water supply, which requires costly operation and maintenance.

No.23 Igui N'ouaqa Dam

- Effect of groundwater recharge: Relationship between groundwater recharge and effect to water use in the lower basin is not clear in quantitative manner, which make the project evaluation difficult.
- Severely karstified limestone: Careful investigation and treatment for leakage water are required, for the dam foundation will be on severely karstified limestone strata.

No.24 Amount Abdelmoumen Dam

- Alternative studies: Alternative studies are not available on the measures to compensate functions of the existing Abdelmoumen dam that has technical problems. Since pre-APD is still ongoing, project features are not yet fixed.
- Open conglomerate layers: Careful investigation and treatment for leakage water will be necessary, since joints in the conglomerate layers are commonly open.

No.25 Sidi Abdellah Dam

- Effect of groundwater recharge: Relationship between groundwater recharge and effect to water use in the lower basin is not clear in quantitative manner, which make the project evaluation difficult.
- Limestone: Careful investigation and treatment for leakage water are required for the dam foundation that will be on karstified limestone strata.

VIII1.2.2 Method of Evaluation

Identification of serious problems in respect of technical matters such as (1) extremely unfavorable geological conditions, (2) large sedimentation compared to reservoir volume, (3) not properly functioning in primary function of the project is carried out at first.

Excepting the identified projects above, level of technical feasibility is assessed from A to C scales on each technical item tabulated on Table VIII1.2.1 where A

is considered as good, B is fair and C is poor. The number of A, B and C in (I) dam, (II) irrigation, (III) water supply, (IV) groundwater restoration and (V) flood and sediment control are separately counted and multiplied by 2,1 and 0 respectively.

The summed up points for the above (I) to (V) are converted with weighed points by conversion rate shown on Table VIII1.2.3. The total points are then classified into three ranks such as

A Technical feasibility is good (>60 points),

B Technical feasibility is fair (40-60 points),

C Technical feasibility is poor (<40 points).

Separately from evaluation in technical feasibility by ranking above, the maturity in the existing planning and/or study with respect to (1) sufficiency and certainty of technical information, and (2) check of alternative development plans, are also assessed for each project.

VIII1.2.3 Result of Evaluation

Serious problems in technical issues are identified in the dam sites No.2 Tizimellal (for negligible benefit in primary function) and No.22 N'ouantz (for filling-up of reservoir by sedimentation within 40 years).

Meanwhile, insufficient maturity in the existing planning and/or study are identified in the dam sites No.11 Tadighoust (plan coordination with trans-basin canal project near Erfoud), 12 Tiouzaguine (plan coordination with Kaddussa dam), 13 Kheng Grou (postpone of implementation schedule), 14 Adarouch (plan coordination with Ouljet Soltane dam), 16 Tiouine (postpone of implementation schedule), 18 Bourkarkour (alternative plan for pump-up irrigation), 20 Sidi Abbou (alternative plan for dam axis), 23 Iguin'Quaqa (effect of groundwater restoration), 24 Amont Abdelmoumen (alternative plan for compensating Abdelmoumen dam), 25 Sidi Abdellah (effect of groundwater restoration).

Level of technical feasibility for each project, except No.2 and 22, are calculated and classified into three ranks as presented in Tables VIII1.2.2 and VIII1.2.4.

As a result, the dam sites, No. 5, 7, 8, 9, 10, 15 and 17 are classified as rank A that is considered good in technical feasibility, with judgment that there is no problem in maturity in their existing plans and/or studies.

VIII1.3 Natural Environment

VIII.3.1 Ecological Description of Each Project

The Government of Morocco has a management network system for the areas that are biologically and ecologically representative in Morocco. The primary objective of this system, Sites of Biological and Ecological Interests (SIBE), is to form a conservation network to ensure protection and sustainability of the significant ecosystems. SIBE was established in 1995 covering 22 biological zones with 160 sites with three categories (Priority 1: 48 sites, Priority 2: 50 sites, Priority 3: 62 sites). Sites classified as Priority 1 includes original and most representative ecosystems and the richest in terms of biological diversity. Therefore, those sites must be fully protected. Sites categorized as Priority 2 and Priority 3 are also protected, and activities such as hunting and fishing are restricted within these areas.

Negative environmental impact in relation to the activities of dam construction is only temporal, but impact due to the operation of a dam is rather permanent in the areas both upstream and downstream of a dam site. Terrestrial ecosystems located upstream of dam sites will be permanently lost once those areas are submerged in a dam reservoir. Similarly, aquatic ecosystems downstream of the sites may be seriously affected in according to the control of water discharge. Therefore, ecological site description of the environmentally protected areas (i.e. sensitive ecosystems) that seem to be affected with the proposed dams are identified and described in this section. Then, negative impacts on those ecosystems are to be examined and the validity of the locations of the dams is to be assessed from ecological point of view.

No. 1 Neckor Dam

There is Al Hoceima National Park at the shoreline. This park includes inland and shoreline areas and is considered as one of the best preserved coastal sites of Moroccan Mediterranean Sea. This is also a popular tourist destination particularly for divers.

No. 2 Tizimellal Dam

There is no national parks or protected areas around this dam site.

No. 3 Ait Baddou Dam

Imi N’ifri protected area (Priority 3) is located downstream of this dam site. This area consists mainly of limestone, and it is recognized that it constitutes unique geomorphologic features in Morocco. This area is also considered as an important habitat especially for wild birds.

No. 4 Ain Kwachiya Dam

Ilot de Skhirat protected area (Priority 2) is located at the coast. It is about 10 km downstream of this dam site, and the estuary of Khellata river is at eastern end of the protected area. There is no further information or description available for the area at present time.

No. 5 N'Fifikh Dam

This dam site is also close to Ilot de Skhirat protected area (Priority 2). The estuary of N'fifikh River is at western end of the protected area.

No. 6 Tazarane Dam

Protected areas, Souk El Had (Priority 3) and Jbel Amergou (Priority 3), are located downstream of this proposed dam site. Size of the surface area of the reservoir is estimated at about 51 ha with a water storage capacity of 9.2 million m^3 so that submerging area is relatively small. However, Souk El Had contains 343 ha of oak (*Quercus coccifera*) forest where a wide variety of wildlife have been recorded and that hunting is prohibited. Furthermore, Jbel Amergou contains some endangered reptiles so that any negative impacts to these ecosystems should be minimized. This dam should also be evaluated with a status of dams such as No. 2, 19 and 21 to assess overall impacts on Tafrannt Wargha Reservoir which is located downstream of the three dam sites.

No. 7 Amezmiz Dam

There is no national parks or protected areas downstream or upstream of this dam site. There is an existing dam downstream of this site. Impacts with this dam should be evaluated together with No. 8 and 9 because these sites are in the tributaries of Rensift River.

No. 8 Boulaouane Dam

No national parks or protected areas exist downstream or upstream of this site.

No. 9 Taskourt Dam

No national parks or protected areas exist downstream or upstream of this site.

No. 10 Timkit Dam

No national parks or protected areas exist downstream or upstream of this site. Grotte d'akhyam protected area (Priority 3) is located upstream of this site, but a detailed description of the area is not available.

No. 11 Tadighoust Dam

No national parks or protected areas exist downstream or upstream of this site. Haut Atlas Oriental National Park is located upstream of the site, but a detailed description of the park is not available.

No. 12 Tiouzaguine Dam

Protected area, Jbel Toghioult (Priority 2), is located upstream of this dam site. Since this area (10,000 ha) contains old growth of oak forests, this habitat holds a variety of wildlife species (18 mammal species, 44 avian species and 18 reptiles). Introduction of wildlife management and reinforcement of current regulations seems to be an imminent requirement for this area. The following list of 15 avian endemic species has been recorded, and those species can be used as indicators of the conditions of the ecosystem.

Hieraaetus fasciatus	*Eremophila alpestris atlas*
Aquila chrysaetos	*Sylvia deserticola*
Neophron percnopterus	*Monticola solitarius*
Falco peregrinus	*Oenanthe lugens*
Pterocles orientalis	*Phoenicurus moussieri*
Bubo ascalaphus	*Turdus merula nauritanicus*
Picus vaillantii	*Turdus viscivorus deichleri*
	Parus ater atlas

Rare endemic mammal species found in this protected area are listed as follows

Atlantoxerus getulus	*Gazella cuvieri*
Ctenodactylus gundi	*Ammotragus lervia*
Genetta genetta	

No. 13 Kheng Grou Dam

No national parks or protected areas exist downstream or upstream of this site.

No. 14 Adarouch Dam

Kharrouba protected site (Priority 1) is located downstream of this dam site. It is considered as one of the most beautiful areas in the central plateau of Morocco. Wildlife species are abundant in this area, but some mammal species have become extinct (i.e. wild fowl, hyena, panther and deer) so far. Some wildlife species such as porcupine (*Hystrix cristata*) and lynx (*Felis caracal algira*) are strictly protected, and hunting is also prohibited in this area.

No. 15 Sidi Omar Dam

El Harcha protected area (Priority 1) is located downstream of this dam site. This area includes 3,700 ha of natural forest that is recognized as a significant ecosystem in Morocco. Several rare and endangered wildlife species can be found in this area. It has been recorded that 25 species of mammal, 82 species of bird (20 species are rare or endangered) and 25 species of reptile exist in the area. Important mammalian species include hyena (*Hyaena hyaena barbara*), caracal lynx (*Felis caracal algira*), panther (*Panthera pardus panthera*) and cuvieri deer (*Bazella cuvieri*).

No. 16 Tiwine Dam

Al Monsour Dam protected area (Priority 2) is located downstream of this dam site, but a detailed description of the area is not available.

No. 17 Azghar Dam

Tazekka National Park established in 1950, is situated upstream of the dam site. This area includes more than 680 ha of cedar forest, and snow in the alpine areas provides rather stable water supply for downstream.

No. 18 Boukarkour Dam

No national parks or protected areas exist downstream or upstream of this site.

No. 19 Aoulai Dam

A strictly protected area, Lalla Outka (Priority 1), is located downstream of this dam site. However, a detailed description of this area is not available and that impacts to the area should carefully be considered. Jbel Tizirane (Priority 2) is located upstream of the dam site. This area includes 1,100 ha of cedar forest. Annual rainfall of this area is 2,000 mm, which forms sufficient vegetative cover for many wildlife species. Several endangered wildlife species have been recorded in this area, and 8 species of mammalian species are listed below. Other endangered species include 23 species of bird and 11 species of reptile.

Scrocidura russula yebalensis	*Myotis emarginatus*
Barbastella barbastellus	*Macaca sylvanus*
Hystrix cristata	*Genetta genetta*
Herpestes ichneumon	*Felis libyca*

No. 20 Sidi Abbou Dam

Idriss Dam protected area of 3,000 – 4,000 ha (Priority 1) is located downstream of this dam site. This site holds a variety of bird species, but a detailed description of the area is not available.

No. 21 Sidi El Mokhfi Dam

Koudiat Tidighine protected area (Priority 2) is located upstream of this dam site. This area is 4,000 ha of cedar and oak mixed forest and includes one of the most significant cedar forests of Morocco. There are 7 rare or endangered species of mammal, 22 endangered bird species and 11 rare species of reptile in this area. There is Ain Bou Adel protected area (Priority 2) downstream of the dam site, but a detailed description of the area is not available.

No. 22 Nouantz Dam

Bou Tferda protected area (Priority 3) is located downstream of this dam site. It has been identified that this area is a viable territory for reintroduction of the panther. There is no further information available on the area.

No. 23 Iguin' Ouaqa Dam

Aghbar protected area of 6,500 ha (Priority 1) is located upstream of the dam site. Cypress is a dominant species of this forest, and livestock (e.g. sheep and goats) damage to the forest is becoming a serious problem in this area. There are 8 rare or endangered species of mammal, 24 endangered bird species and 19 rare species of reptile in this protected area.

No. 24 Amount Abdelmoumen Dam

Ain Asmama protected area of 22,000 ha (Priority 1) is located upstream of this dam site. This area is considered as one of the most important protected areas in Morocco, which contains a wide variety of endemic fauna and flora. It has been discussed that this area should be upgraded to a national park. There have been 25 species of mammal recorded, and of which the following 11 species are rare:

Atlantoxerus getulus	*Hyaena hyaena barbara*
Mastomys erythroleucus	*Felis libyca*
Hystric cristata	*Felis caracal algira*
Lutra lutra angustifrons	*Gazella cuvieri*
Genetta genetta	*Ammotragus lervia*
Herpestes ichneumon	

A total of 84 species of bird and 28 species of reptile have also been recorded. Also, it is known that many rare and endangered plant species grow there.

No. 25 Sidi Abdellah Dam

Tichka protected area (Priority 3) is located around the summits of high Atlas (3,400 m) upstream of this dam site. This alpine ecosystem requires additional protection from free grazing by livestock. There are also Ademine protected area (Priority 1) and Souss-Massa National Park downstream of the dam site. Souss-Massa National Park holds 34,000 ha of area extending 65 km to the north to the south of the shoreline. Some rare animal species including oryx, addax and ostrich inhabit in this area. Massa river is classified as a biological reserve and is recognized as a nesting ground for more than 275 species of bird.

VIII1.3.2 Method of Evaluation

JICA's guidelines suggest that using a check-list for the process of screening and scoping be appropriate and efficient. This method is extensively used and generally accepted as a useful method[1]. Environmental items for the assessment of negative impacts on natural environment in this study are, therefore, selected in reference to JICA's guidelines.

[1] Canter, W. C. (1996) Environmental Impact Assessment, McGraw-Hill, Inc.

Level of environmental impact was assessed referring to the principal features of the proposed dams (see Table VIII1.3.1) and conditions of natural environment around the sites. For a dam project, the location of a dam is critical at the level of screening, and JICA's guidelines focus on the assessment if there is any overlap between the dam site with impoundment and environmentally protected areas (i.e. national parks and other environmental reserves). Therefore, the locations of currently proposed 25 dam sites with submerging areas are carefully assessed with the locations of environmentally protected areas around the sites.

Furthermore, a distance between the dam sites and protected areas particularly downstream reaches are also examined critically, because those areas may be affected with changes in water regime controlled by the dams. This aspect is also assessed using a check-list.

Environmental impacts at each site were scored from "A" to "D" scales on each environmental item in a check-list where "A" is considered as imposing only minor impact, "B" is moderate impact, "C" is significant impact, and "D" is unknown at the current stage of the project. The number of "A," "B," "C" and "D" are counted in each check-list and simply multiplied by 2, 3, 4 and 1 respectively. The total points are then classified into three ranks such as:

- A: Impact is minor (< 55 points),
- B: Impact is moderate (56 – 60 points),
- C: Impact is significant (> 61 points).

It is, therefore, recommended that project sites be chosen from the group of Rank A. The group of Rank B is likely to cause moderate environmental impacts so that appropriate environmental management plan should, therefore, be formulated within the framework of the projects. It is predicted that significant environmental impact is likely to occur with the sites grouped in Rank C. Selection of any sites from this category should be avoided, but if a dam site were chosen from this group, a full-scale EIA with a comprehensive environmental management and monitoring program should be developed.

VIII1.3.3 Result of Evaluation

The level of negative impacts on natural environment for each proposed dam site is calculated and classified into three ranks as presented in the TableVIII1.3.2. Level of impact for each environmental element was assessed and presented in a check-list for each dam site (Data Book). One of the main aspects of this screening was to check if there is any overlaps between project command areas and environmentally protected areas, or if there is a protected area in a close proximity to the dam sites. There was no overlap was found in this screening.

Environmental impacts on the sensitive ecosystems (i.e. SIBE sites) around the dam sites were also assessed and presented in the check-lists, and the locality of the dam sites was evaluated. The dam sites, No. 19 and 21 are classified as category "C" with significant impacts. There are some protected areas around No. 19 and 21 sites where water discharge is higher than any other proposed dam sites. Therefore, negative impact on the ecosystems around those sites seems to be higher than that of other sites in this study.

No. 1 Neckor Dam

This site is located relatively close to Mediterranean Sea (10 km). The estuary of Neckor river is adjacent to Al Hoceima National Park. It has been estimated that average annual sediment of Nockor river is 3.8 million m^3/yr, and the main objective of this dam is to control landslide. Therefore, if flow of the sediment by the river is reduced by this proposed dam, erosion at the shoreline will likely to occur. However, a large dam, Mohamed B. A. El Khatitabi Dam, that is located downstream of this proposed site is already controlling the sediment flow so that this proposed dam does not seem to affect shoreline configuration of the National Park significantly.

No. 2 Tizimellal Dam

The objectives of this dam are the protection of landslide and water supply for irrigation. There is no protected area upstream or downstream of the proposed dam site so that it is predicted that possible environmental impacts will be minimal. However, the river where this dam is proposed is one of the rivers that flows into Tafrannt Wargha Reservoir, and construction of a dam in other waterways has also been proposed (No. 6, 19 and 21). Therefore, it is important that potential impact be evaluated within the context of the overall river basin.

No. 3 Ait Baddou Dam

Current annual inflow of the water is relatively high at this dam site, which has been estimated at 27.9 million m^3, but there is another dam downstream of this site. Therefore, negative impact on the downstream ecosystem is likely to be reduced. There is also a protected area, Oued Lakhdar, upstream of the dam site, but it is predicted that possible impact on the area be moderate.

No. 4 Ain Kwachiya Dam

Average annual sediment volume of Khellata river has been estimated at 0.02 million m^3/yr with the annual water inflow of 6.6 million m^3. Impacts on the shoreline configuration should, therefore, be predicted as moderate due to the control of this sediment and water inflow. However, quantitative evaluation is not available at this stage of the project. Furthermore, there is a protected site, Ilot de Sknirat, at the coast so that ecosystem impacts should be considered.

No. 5 N'Fifikh Dam

General propensity of this dam site is similar to that of No. 4 Ain Kwachiya. Estimated sediment volume of this site is 0.03 million m^3/yr with the annual inflow of water is 8.8 million m^3. Proposed area of irrigation is 800 ha so that water contamination and soil erosion should be limited. Size of submerging area with this dam is large (680 ha) so that its ecological status should be examined around this site. This site is also close to Ilot de Skinirat, located at coastal line.

No. 6 Tazarane Dam

There are protected areas downstream of the dam site, but the size of irrigation area and submerging area with the proposed dam is relatively small. Therefore, it is predicted that negative impacts to the natural environment at this site are predicted as moderate.

No. 7 Amezmiz Dam

Dam sites, No. 7, 8 and 9, belong to Tensift River Basin so that an assessment of impacts with these dams should be evaluated within a context of overall impacts to the river basin. Dam reservoir area created by this dam will be about 55.2 ha with a water storage capacity of 11 million m^3 so that submerging area is relatively small. Annual average water inflow is 15.5 million m^3, which is the minimum water flow among the proposed dam sites within the basin. Annual sediment volume has been estimated at 0.03 million m^3/yr.

No. 8 Boulaouane Dam

Dam reservoir surface area is small, and the proposed irrigation size is 900 ha. Annual average water inflow is 46.77 million m^3, which is the highest flow among the proposed dam sites within the basin.

No. 9 Taskourt Dam

Proposed size of irrigation area is quite large (6,900 ha) and a considerable amount of sediment flow was observed in the field. Therefore, a moderate impact is predicted although no protected area exists upstream or downstream.

No. 10 Timkit Dam

Annual average water inflow of this dam site is 11.71 million m^3. The aim of this dam is to store water for irrigation, which is discharged by occasional floods. It is possible that flood supplies water for downstream ecosystems, but environmentally protected areas as sensitive ecosystems have not been identified within 100 km downstream of the dam site. Therefore, the impact with this proposed dam is predicted as minor.

No. 11 Tadighoust Dam

Haut Atlas Oriental National Park is situated upstream of this dam site, but the proposed dam does not seem to affect the park. Dam volume of this site is large (593,800 m^3), but the impact during the construction stage is temporal. Size of irrigation area is medium, and submerging surface area is small. Therefore, the impact of this dam is predicted to be minor.

No. 12 Tiouzaguine Dam

There is Jbel Toghioult protected area upstream of the proposed dam site, but this dam does not seem to affect the area seriously. Average annual water inflow is only 4.1 million m^3, and that the impact on aquatic ecosystems should also be minimal. Ecological status of fauna and flora on the submerging area is not clearly known at this stage.

No. 13 Kheng Grou Dam

No sensitive ecosystem has been identified around the dam site. Proposed size of the irrigation area is small, but the surface area of the dam reservoir is 840 ha. Negative environmental impact with this proposed dam is predicted as minor, but ecological condition of the submerging area still needs to be studied.

No. 14 Adarouch Dam

Kharrouba protected area is located downstream of the dam site, and it is considered as a significant ecosystem in Morocco. Size of the surface area of the dam reservoir has been estimated at 328 ha, and the current average water inflow is 64.4 million m^3 so that negative impacts on upstream and downstream environments are evaluated as relatively high.

No. 15 Sidi Omar Dam

Protected area, El Harcha, downstream of the dam site is considered as one of the most important ecosystems in Morocco. Although current average water inflow is 27.8 million m^3 in this area, it is predicted that negative impact to the downstream ecosystem be significant.

No. 16 Tiwine Dam

Although detailed description of the downstream ecosystem is not available, it is known that the annual average water inflow of this site is relatively high (96.8 million m^3). Therefore, controlling the flow of the water can cause significant impacts. Surface area of the dam reservoir is also large (705 ha) so that negative impacts on a variety of native fauna and flora are also likely to occur.

No. 17 Azghar Dam Site

There is a national park upstream of the dam site, but it is unlikely that dam construction is to cause significant negative impacts to the park. Volume of

sediment flow or size of submerging area is not large so that the impact with this dam is predicted to be minor.

No. 18 Boukarkour Dam

Scale of the dam or submerging area is not large. It is relatively close to the shoreline (30 km), but sediment volume in the river is limited, and there is an existing dam downstream of the site. Therefore, the impact with this proposed dam is predicted to be minor.

No. 19 Aoulai Dam

Annual average water inflow in this site is 177.7 million m^3 so that controlling this water flow has a high possibility of causing significant impacts to the ecosystem downstream of the site (Lalla Outka protected area). Since the size of reservoir (surface area of 710 ha) and irrigation area (5,000 ha) is also large so that salinity and erosion problems may also be significant.

No. 20 Sidi Abbou Dam

Proposed size of irrigation area is 2,000 ha, and submerging area is relatively large (432 ha). Although detailed description of the protected area, Barr. Idriss, is not available, potential impacts with this proposed dam are predicted to be moderate.

No. 21 Sidi El Mokhfi Dam

Annual average water inflow of this site is 181.4 million m^3 so that controlling this water flow may cause serious impacts particularly to sensitive ecosystems downstream of the site. Although detailed description of Ain Bou Adel protected area downstream of the site is not available, impacts to this ecosystem with the proposed dam is predicted as significant.

No. 22 Nouantz Dam

One of the purposes of this dam is irrigation, but the size of irrigation area is not clearly defined yet. Therefore, negative impacts with this dam are not properly evaluated at this stage and that the level of impact may change in a later stage of the project.

No. 23 Iguin' Ouaqa Dam

There is a protected area upstream of the dam site, but it is unlikely that significant negative impacts will be imposed to the area. This dam can affect Soss river basin together with No. 24 and No. 25 dams so that these dams should not be evaluated independently or separately. Impacts on Admine protected area as well as Soss-Massa National Park on the coast can be serious depending on the future status of all the dams in the basin.

No. 24 Amount Abdelmoumen Dam

Although Ain Asmama is a fully protected area, it will not be affected seriously by the dam reservoir. Since the protected area is located upstream of the site, negative impact to the ecosystem is predicted to be minimal.

No. 25 Sidi Abdellah Dam

Alpine ecosystem, Tichka protected area, will not be affected seriously with this proposed dam. The level of current grazing pressure on the vegetative cover should be controlled because the dam reservoir may supply water to the animals and that may increase the population size. Ademine protected area and Souss-Massa National Park are located downstream of this dam site. Detailed description of these areas is not available, but those are environmentally important and fully protected. As presented previously, negative impacts on those ecosystems should be considered in the context of the development in this watershed as a whole, because the status of No. 23 and 24 also affect the level of impact with this proposed dam.

VIII1.3.4 Summary of IEE

Summary of the IEE on natural environment is presented in the following Table. From environmental point of view, dam sites listed in "A" and "B" are recommended for a further study (F/S) in the second phase to examine a feasibility of construction. The two sites listed in "C" are likely to cause more serious negative impacts particularly on natural ecosystems downstream of the sites in comparison with the level of impacts predicted with the rest of the proposed sites.

The result of this IEE is based on the existing information so that more thorough assessment (EIA) of environmental impacts using primary data needs to be conducted in the second phase of the study. Terms of reference (TOR) for investigations on a contract basis, collecting primary data, as part of the EIA are presented in the Phase 2.

Summary of the IEE on Natural Environment

Level of Impacts	Dam Sites
A (Minor)	Neckor (No.1), Tizimellal (No. 2), Ait Baddou (No. 3), Ain Kwachiya (No. 4), N'fifikh (No. 5), Tazarane (No. 6), Amezmiz, (No. 7), Boulaouane (No. 8), Timkit (No. 10), Tadighoust (No. 11), Tiouzaguine (No. 12), Kheng Grou (No. 13), Azghar (No. 17), Boukarkour (No. 18), N'ouantz (No. 22), Iguin' Ouaqa (No. 23), Amount Abdelmoumen (No. 24)
B (Moderate)	Taskourt (No. 9), Adarough (No. 14), Sidi Omar (No. 15), Tiwine (No. 16), Sidi Abbou (No. 20), Sidi Abdellah (No. 25)
C (Significant)	Aoulai (No. 19), Sidi El Mokhfi (No. 21)

VIII1.4 Social Environmental Impact

VIII1.4.1 Method of Evaluation

Social environmental investigation was conducted out by field survey for all the 25 dam sites. Information was collected with meetings using a guideline and filling up the checklist prepared beforehand. The checklist consists of matrix, intervention elements in the row and social elements in the column as follows:

(1) Intervention elements (project activities):

- Construction phase: 5 items
- Operation phase: 4 items

(2) Social elements:

- Socio-demography: 6 items
- Gender and development: 4 items
- Basic infrastructures: 6 items
- Facilities: 3 items
- Agricultural resources: 3 items
- Patrimony, tourism and culture: 4 items
- Income: 5 items

The matrix checklist was filled up with negative impact levels A through D:

- Level-A: Significant negative impact with point 4
- Level-B: Moderate negative impact with point 3
- Level-C: Minor negative impact with point 2
- Level-D: Impact is unknown with point 1

The negative social impact is evaluated with points for each dam site, and finally classified into following ranks:

- Rank-A: Site having minor negative impact (<40 points)
- Rank-B: Site having moderate negative impact (40-60 points)
- Rank-C: Site having significant negative impact (>60 points)

The site with points more than 100 is regarded to have critical negative social impacts beyond the ranking. This investigation, however, remains on the initial examination level due to the time allowed for the study, but will meet the need at this stage.

VIII1.4.2 Evaluated Ranking

The results of ranking evaluated by the negative social impacts are shown in the Table VIII1.4.1. This ranking is rather relative because different parameters receive the same weight no matter how their qualitative social values are different. But the impact on Gender end Generation is considered in all the sites. The sites No.1, 3 and 5, rated H, are not ranked, because their points exceed a limit of the worst, Rank-C. From the social viewpoint, these sites must seek for other development programs.

VIII1.4.3 Social Analysis of Each Site

Summary of each site conditions and comments for the ranking are as below:

No. 1 Neckor Dam

This site is densely populated and is located in a zone listed in the development plan of rural communities. There are 50 houses (height standing building) holding 350 inhabitants. In principle, people have a building permit. Some families have already been displaced during the construction of Mohammed Ben Abdelkrim El Khattabi Dam. They were quite dissatisfied with the idea of new location. The same feeling is shared with those who have decided to live in this zone (Immigrants in Europe). These people do not understand why they had been given a building permit in the same zone of the dam construction. So the people are strongly opposed to the dam construction. The price of compensation may, therefore, be very high because of the cost of land and the type of buildings. At a social level, the benefit of farmers downstream is insignificant, given the small area to be irrigated and the size of population concerned.

No. 2 Tizimellal Dam

The site is sparsely populated. Only 8 families with 60 inhabitations are living in the submerging area. Negative social impact is relatively important when impacts on gender is considered (68 points) regardless of the population size. Downstream, the area to be irrigated is limited because of the harsh relief. Furthermore, in the absence of a conventional crop with the farmers downstream in order to limit the cultivating of cannabis, irrigation may increase the production of the cultivation. The forest in this area will likely be cleared for the purpose of the cultivation of cannabis, which accelerates erosion. Considerable number of the local people living in this area is benefited from the cannabis. Resettlement of the people to similar environment is the only satisfy strategy.

No. 3 Ait Baddou Dam

The site is relatively populated. There are 37 families that constitutes 380 inhabitations. The analysis of the social impact has shown that the impact is excessively negative (103 points). The land, being on a fertile valley, is economically quite valuable due to the cultivation of apples. The social ties between local people as a community makes their resettlement very difficult. No reimbursement can compensate their stability, history and organization. The population, males and females, is strongly opposed to this dam project. There will be a possibility to move the people to a site for resettlement upstream.

No.4 Ain Kwachiya Dam

The site is sparsely populated. There are 9 families consisting of 50 inhabitants. The negative social impact is insignificant. The dam is classified as Rank-A. Poverty level of the population, the lack of infrastructure, the absence of organization and the proximity of large cities make the population, men and women, in favor of the dam construction. The submerged area will affect a small population and a majority of the resettling people has lands that will be irrigated from the dam reservoir. The dam can be used for water supply to Rabat, Casablanca and other adjacent cities in the future.

No. 5 N'Fifikh Dam (Downstream)

The site is in a valley of a fertile area, which attracts many urban investors. They make an investment in livestock and agriculture. Grapes have been introduced recently. Its situation nearby the road network also attracts the inhabitants living in landlocked country towards Douar Beni Karzaz (submerged area). Actually, the population is about 124 families consisting of 624 inhabitations. The dam is for the purpose of irrigation for the plateau's agricultural lands by pumping, at the expense of already profitable lands. Moreover, similar to the site No1, compensation will be very high and out of reach: price of the land and construction make it very high. The result of the social screening exceeded the ranking system with the high points in total. Executives and technicians who participated in the visit suggested that people living in this area be resettled 20 Km upstream: The new site will be beneficial for the whole N'fifikh valley.

No. 5 N'Fifikh Dam (Upstream): Ain Ksoub

This site is relatively populated. There are 89 families with 381 persons. Its people in the proposed reservoir area live on an irrigated farming land and a profitable livestock breeding receiving benefit from the adjacent forestry. But the

yield production is not enough and some males look for jobs in surrounding areas Cities such as Casablanca and Rabat. A few of the population have not accepted this dam project. This opinion is probably influenced by local people living in N'Fifikh area (first site). They think it will be beneficial to move the dam site for about 3 to 4 Km upstream towards Sidi Ahmed El Marzouk. Other people have accepted the dam construction. Nevertheless, difficult negotiations should be necessary in phase II.

No. 6 Tazarane Dam

Sparsely populated (13 families and 130 inhabitants) and poor in terms of social infrastructure, the dam construction might contribute to the development of the cannabis cultivation if no negotiations with the farmers downstream are undertaken before the construction. The development of the cannabis downstream will increase the level of erosion. This dam proposal seems to cause some negative social impacts on the population and environment. In fact, the villagers, male and female, oppose to the project. Despite the conflicts, these people show solidarity when necessary. To this effect, reconstruction of roads by the people proves how much they attach to their land.

No. 7 Amezmiz Dam

The site is densely populated. It's about 190 families that consist of 1,200 inhabitants. The douar (small village) has a long history of common life in the area. The population had lived there for a long time in harmony with their environment until the 1970s. Degradation of the environment, demographic growth and the breaking up of parcels has transformed their agriculture into a subsistence farming. Potatoes and some tree-dwelling products are the main crops for market. People's perception is different. Especially old men think that no compensation can replace their harmony and solidarity. In case it is necessary to construct the dam, people wish to be relocated to the domain lands. This relocation must guarantee the respect of their lifestyle, social harmony and their job as farmers. While women (excluding older generations) hope to move to a place that can allow them to satisfy their needs and grant them some profits. The negative social impact is very important, and the site is classified as Rank C.

No. 8 Boulaoune Dam

The number of families is 127 holding 750 inhabitants. This site is evaluated as Rank B, because the negative social impact was found to be moderate in the submerged area even though it is relatively populated. In fact, those douars are used for housing. Except for livestock, all revenues come from outside. The people do not oppose to the construction of the dam, especially women.

Besides the objectives that are set downstream for irrigation, the dam will solve the frequent flood and will supply water. Currently, families use the "Matfias," they buy tanks and fill them up for 300 DH/4M^3. At the provincial level, Chichaouan is listed by the PNUD as one of the poorest provinces. Job creation in the irrigated area along with the improvement of agricultural production in the province will help reduce the level of poverty.

No. 9 Taskourt Dam

The number of families and population size are important. There are 600 families, approximately 3,600 inhabitants live in this area. The predicted social impact is moderate when the population's socio-economic situation and their perceptions are considered. This site has calculated to be 58 points. Also, the population is emotionally prepared for the project because they have heard about it for more than 30 years. Their activities and local investment is very limited, and the site is very isolated, which encourages younger generations and women to make some changes. Women, on the other sites, cannot express themselves in the presence of men. Irrigation will be profitable to the small and mid scale farmers and will create jobs in one of the poorest areas in Morocco.

No. 10 Timkit Dam

Sparsely populated with 30 families being consisted of 250 inhabitants. This site is evaluated as Rank A. The negative social impact is insignificant. It is worth mentioning that Timkit, similar to Boulaouane and Igui N'ouaqa, is used for housing purposes. Most of the income of the villagers come from outside. Local natural potential for development is low. Its contribution downstream is considerable. Moreover, the irrigation of 2,900 ha will have important economic impacts. The site is located upstream of numerous oasis that are considered as a historical and cultural patrimony of Morocco with a function of "khattara" (old system for collecting and conserved underground water for irrigation).

No.11 Tadighoust Dam

Not populated, this site is evaluated as Rank A. The negative social impact is insignificant. The contribution of the dam varies from irrigation (4,000 ha) of oasis to underground water supply. It will also protect the oasis downstream of the dam site from the frequent floods.

No. 12 Tiouzaguine Dam

Not populated, the negative social impact is insignificant. The site is evaluated as Rank A. The population around the submerged area is of the origin of

nomad. Income is generated from outside and to a lesser extent from raising cattle. In relation to the dam construction, only lands will be compensated.

No. 13 Kheng Grou Dam

There is a relatively populated village with 49 families holding 234 persons. This site is classified in Rank B with a moderate negative social impact. If the intention of the people in the submerging area is considered, the dam proposal for this site is feasible. Considerable size of the lands in this area are often washed away in the flood. Also, the yield of crops is low, and income of households depends largely on the men working outside. Many of the villagers living in this area are willing to be resettled to a site downstream between Moghl and Taguitount on the domain public lands or properly be compensated.

No. 14 Adarouch Dam

This site concerned 15 families holding 75 inhabitants. The result of social screening for the site is 36 points, which ranked in a group with insignificant negative social impact. The people living on the site have already been expropriated in the past. Now the villagers are necessary to be relocated from an area with grazing pressure since they are livestock breeders. Downstream, this dam is meant primarily for a supply of potable water to Khemisset and Tiflet. As far as irrigation is concerned, the dam will irrigate about 1,500 ha, but will be profitable mainly to a private company of red meat production. Nonetheless, considering the economic condition in this area, the company can help create jobs. We should also mention that approximately half of the submerging area belongs to the company. Therefore, its participation can reduce the cost of compensation. Also the resettlement of the families could be negotiated with this company to seek for a possibility to provide them some lands downstream.

No. 15 Sidi Omar Dam

This site is evaluated as Rank A that has insignificant negative social impacts. There are only 3 secondary houses for 12 persons in the submerged area. Those 3 families are favor of the project but on the condition that they get appropriate compensation or be relocated downstream. The downstream of the irrigated area will benefit small and medium scale farmers. The problems of potable water supply and water for livestock will be reduced.

No. 16 Tiouine Dam

The site is considered to have insignificant negative social impacts although the population size is large. It is about approximately 60 families with 450 people.

In fact the site is used for housing purposes, because 2/3 of the males work outside. Reduction of the land size due to floods and poor productivity has made agriculture just subsistence farming. The villagers live mainly on women's handcrafts and exodus. Their detachment from agriculture has let the people accept the dam proposal. Women hope that the project would allow them to develop their skills and find a more profitable site to market their products.

No. 17 Azghar Dam

The population size in this site is very small. It is only 7 families staying part of the year. All of them have other houses in urban center, Ribat ane Alkhair. The study shows that the dam construction will have an insignificant negative social impact. The accumulated points are less than 40 points. Its impact downstream will be positively important for the area or even the province. Jobs will be created and the exodus will be reduced. The negative impact on the women will be less than the other sites because of their current strength in the dimension at both family and community levels.

No. 18 Boukarkour Dam

Similar to Azghar, the dam construction will have insignificant impacts on the people (16 families for 106 persons) who live on the income that is generated essentially by the men working outside. The women hope that the dam be constructed in order to escape the present harsh conditions. Actually, because of the small size of their douar, the women know in advance that they will not have access to electricity, health care and school.

No. 19 Aoulai Dam

There are 13 families and 104 persons living in the submerging area. However, the analysis of the study ranked this site in the group having important social impacts. In fact, the irrigation development downstream may lead to the cannabis progress, which cultivation has been introduced to the area. Negative social impact would be more significant on women and children (increase of deterioration of strategic dimension of women) than others.

No. 20 Sidi Abbou Dam

There is approximately the same population than that of Aoulai (16 families and 96 persons). However, the Study grouped this site in Rank B with a moderate negative social impact (42 points). It is important to note that the dam site is strategic. It is located in a larger periphery of the cannabis cultivation. The realization of the dam site combined with the transfer of the appropriate

technology and a close observation of the farmers to increase their income might create a model pilot site for the cannabis zones. Challenge would be to find competitive alternatives to this cultivation. Still, a consensus must be achieved with the beneficiaries before the construction of this site.

No. 21 Sidi El Mokhfi Dam

Twenty persons live in the submerging area. The situation in this site is similar to that of Sidi Abou's situation. The cannabis has just introduced into the area. However, a strategy to stop the newly introduced cannabis must be developed in the downstream area. The impact on the woman would be the same as for site No19. Depending on the points given to this dam, it is considered as having a moderate negative social impact

No. 22 N'ouantz Dam

This site is relatively populated. There are 50 families with 425 persons. The study brought about an important negative social impact (75 points). The pressure on the forest in this area is important. However, the life of the villagers is comfortable because their history is rich and culture provides them a harmonious and cohesive lifestyle. Raising livestock on the forest gives them relative income. Irrigation will be profitable for large-scaled tree-growing farms recently introduced by urban people into the region. This situation pushes them to be opposed to the implementation of the dam.

No. 23 Igui N'ouaqa Dam

There are 285 families with approximately 1,500 inhabitants in the submerging area. However, the majority of people (men and women) depend on the money sent by their immigrant relatives. The idea to leave the area, especially the youngsters, has already matured in their minds. This means that compensation for the dam construction is feasible. The negative social impact is moderate (47 points). Downstream, the dam will serve for irrigation and flood control. However, without adequate measures, the irrigation development can become a threat to the Argane tree forest that is already aggravated downstream.

No. 24 Amont Abdelmoumen Dam

The population lives in the submerging area is around 247 families with 1,488 inhabitants. The analysis of the socio-economic data in the area of Amont Abdelmoumen shows an important negative social impact (54 points). Moreover, an expropriation of a large, stable and organized population, will have a considerable negative impact for the next generations. It is a favorite

retirement place for ex-immigrants. Even if men are opposed to the dam construction, women and youngsters are in favor of the project in order to escape the harsh conditions. We can add that the number of the divorced women and spinsters is increasing now because of migration. The woman is concerned about changing their current lifestyle.

No. 25 Sidi Abdellah Dam

The site is not populated without much infrastructure. The study shows that the negative social impact is insignificant (30 points). But the Argane tree forest is very dense in the submerging area and less dense in the areas downstream of the dam site. The only person who lives on the site is in favor of getting benefit from the dam project. The dam will serve different purposes: the protection of the Douars located downstream, the protection of the city of Taroudant from frequent floods and the irrigation of an important area.

VIII1.4.4 Conclusion and Recommendations

The study of negative social impact has led to classify dams in 3 ranks:

- Rank-A: Eleven (11) dams (No.4, 5 (upper), 10, 11, 12, 14, 15, 16, 17, 18 and 25)
- Rank-B: Seven (7) dams (No.8, 13, 19, 20, 21, 23 and 24)
- Rank-C: Five (5) dams (No.2, 6, 7, 9 and 22)

Dam sites No.1, 3 and 5 (lower) were excluded from ranking since the points marked were extreme high (worse) being more than 100 points.

Dams for the 2nd phase Feasibility Study can be chosen from Ranks A and B, considering the evaluation results from other aspects as well. As far as Rank C is concerned, further intensive study is needed in order to mitigate negative impacts.

The ranking is based on the checklist with established elements and items. If we add to this result the perception of the population, the ranking can be slightly different. We have also noticed that, in various sites, the population was in favor of the project, although the negative impact was significant. This attitude can be explained by the lack of infrastructure, isolation, scattered habitations, small size douars, and income they can generate if they migrate.

The opportunity to move to other clement and better-equipped areas is seen by the population as the chance of a lifetime to improve their conditions. This

finding is very clear especially for the women who live in sites where life conditions are very harsh. In case dams are not built on these sites, we think that social of infrastructure and equipment programs will become a priority.

The economic development of the area and the improvement of the people's lifestyle in the proposed project sites will not be necessarily beneficial to the woman. In fact, although the development of agricultural activities through irrigation will bring some profit to the woman, it might not be beneficial for them if there are no accompanying measures that are set on time. This is due to:

- The woman see other tasks added to their activities, which will increase their daily working hours, though they are busy already
- Despite the improvement of lifestyle, the unfavourable practical conditions persist and have repercussions on the level of schooling and illiteracy; and
- Since the decision-making is in general the responsibility of men along with the family budget, the strategic dimension of the woman deteriorates further.

Accompanying measures in favor of women must be set up at the beginning of the project in order to avoid the mistakes that have been made previously in the irrigated areas.

VIII1.5 Economic Viability

VIII1.5.1 Methodology

The economic analyses of the Projects have been conducted with the methodology as discussed below

(1) Price Level

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) Benefits of the Project

Benefits of the Projects are estimated depending on their purposes. The following benefits are envisaged after implementation of the Projects.

(a) Agricultural Benefit

Irrigation will be extended by the implementation of the Projects. There will be improvements in crop yields or switching to higher yielding or higher value crops. Changes in agricultural net income between with and without project are estimated as the benefit of the Projects.

Production increase of livestock is also expected by availableness of water for animals and production increase of fodder after implementation of the Projects. Such a benefit will be estimated from benefits of production increase of fodder for the sake of convenience.

(b) Domestic Water Supply Benefit

Simple domestic water supply facilities will be installed annex to the irrigation facilities. The facilities may contribute to improvement of public health and quality-of-life by supplying better quality water and easiness of water carrying work which has been done by women and children.

(c) Flood and Erosion Control Benefits

The flood inundations and riverbank erosion will be mitigated after construction of the dams. Such benefits are estimated from difference of flood and erosion damage between those with and without project. In addition to these, the lifetime of the existing reservoir located downstream of a proposed dam will be prolonged by the sediment alleviation effect. Such benefits of the sediment alleviation are also taken into account.

(d) Other Benefits

Other than benefits discussed above, other direct and indirect benefit are expected by the implementation of the Projects.

(3) Economic Cost and Benefit

Economic costs and benefits are used for the economic analyses of the Projects. Conversion factors are applied for calculation of the economic costs and benefits. To use conversion factor is a short cut method of converting the actual money prices of goods or services into their economic prices. Conversion factors are the ratios of the economic prices of a good or group of goods to their domestic market prices (less indirect tax).

(4) Economic Evaluation

The economic viability of the Projects is examined by cost-benefit analysis. The analysis is conducted by a cash flow using economic prices discussed above. The projects are evaluated from the economical viewpoints using three types of indicators, i.e. economic internal rate of return (EIRR), benefit cost ratio (B/C), and net present value (NPV). By using a discounting procedure, benefits and costs of the Projects arise at different points in time can be compared in terms of present values.

EIRR is the rate that meets the totals of the benefits and costs come out from a project during its project life. B/C is the ratio of the totals of the benefits and costs during the project life. NPV is the difference between the present worth of the benefit stream less the present worth of the cost stream. All these indicators are commonly used for economic analyses of development projects.

The discount rate to be applied for calculation of B/C and NPV is normally "opportunity cost of capital" and it is assumed to be from eight to ten percent in the case of Morocco. However, the proposed projects mainly aim to increase and/or stabilize agricultural production, domestic water supply, and flood and erosion control by storing and/or regulating scarce water resources by dams. As a matter of course, the benefits of the Projects are not very large though all of their functions are very important for rural farmers. Therefore, in this study, the discount rate of five percent has been applied for calculation of B/C and NPV. The discount rates of six, eight, and ten percent are also tested for calculation of NPV for reference.

The project life of 40 years after construction of dams is assumed for the evaluation. The procedures for the economic analyses are shown by a flow chart in Figure VIII1.5.1.

VIII1.5.2 The Projects Subject to Economic Analysis

Before conducting the economic analysis, the Projects has been screened from the following view points as discussed in Chapter 6 of Main Report

- Social aspect,
- Technical feasibility,
- Natural environmental aspect,
- Social environmental aspect, and
- Maturity in planning and/or study

Only the Projects that satisfy all these aspects without serious defect are subject to economic analysis. The following projects passed the screenings and are subject to economic analysis.

Major Functions of Projects Subject to Economic Analysis

Zone	No.	Name of Project	Functions			
			A	W	F	O
I	6	Tazarane	x	x		x
	19	Aoulai	x	x		x
	21	Sidi el Mokhfi	x	x	x	x
	17	Azghar	x	x	x	x
II	4	Ain Kwachiya	x	x	x	x
	5	Upper N'fifikh	x	x	x	x
	15	Sidi Omar	x	x	x	x
III	7	Amezmiz	x	x	x	x
	8	Boulaouane	x	x	x	x
	9	Tascourt	x	x	x	x
V	10	Timkit	x	x	x	x

Note
A Agriculture including irrigation and live stock
W Small scale domestic water supply annex to irrigation facilities
F Flood and erosion control including sediment alleviation for downstream reservoir
O Other benefit

VIII1.5.3 Benefit of the Projects

(1) Agricultural Benefit

(a) Economic Prices of Crops and Production Costs

Present farm gate prices of crops were surveyed by the study team. The prices of the crops and their production costs have been converted into economic value using the conversion factors as shown below. The applied conversion factors are the same as that had been elaborated by the Ministry of Public Works for the economic analysis of the same kind of project, "Acturalisation del L'Etude de la Rentabilite Economique du Complexe Dchar El Oued - Ait Messaoud, 1994".

Economic Prices of Crops

Crops	Unit	Farm-gate price	Conv. factor	Economic price
Wheat	DH/kg	2.67	0.82	2.19
Straw	DH/UF	3.00	0.75	2.25
Tomato	DH/kg	1.60	1	1.60
Potato	DH/kg	2.07	1	2.07
Olive	DH/kg	2.71	1.13	3.06
Almond	DH/kg	7.00	1	7.00
Grapes	DH/kg	3.04	1	3.04
Dates	DH/kg	10.00	1	10.00
Alfalfa	DH/UF	5.00	0.75	3.75

Production costs of the crops have been estimated based on the latest price and standard volume of inputs. The production cost have also been converted into the economic value with the same manner as those of crops. The economic prices of the inputs are as shown below

Economic Production Cost

Input	Unit	Financial price	Conv. factor	Economic price	Input	Unit	Financial price	Conv. factor	Economic price
Seed					Fertilizer				
Wheat	DH/kg	3	1	3	Urea	DH/kg	1.26	1.51	1.90
Tomato	DH/kg	820	1	820	TSP	DH/kg	1.84	1.32	2.43
Potato	DH/kg	3.5	1	3.5	K2SO4	DH/kg	2.46	1	2.46
Olive *1	DH/ha	140	1	140	Agricultural Chemicals	DH/ha	50	0.7	35
Almond *2	DH/kg	0	1	0	Mechanization				
Grapes *3	DH/kg	0	1	0	Tractor	DH/day	157	0.7	110
Dates *4	DH/ha	465	1	465	Animal traction	DH/day	41	0.7	29
Alfalfa	DH/kg	360	1	360	Baler	DH/day	157	0.7	110
Manure	DH/ton	150	1	150	Labor Force	DH/day	41	0.59	24.2
					Other		0.1		0.1

Note *1 30 years of life time is assumed. Replacement cost only.

*2 Existing trees only. No new planting considered.

*3 Existing trees only. No new planting considered.

*4 50 years of life time is assumed. Replacement cost only.

(b) Increase of Net Income

Based on the economic prices discussed above, the net income of each crop per hectare has been estimated as shown in Table VIII1.5.1. According to the agronomic study using model crops and cropping patterns based on the characteristcs of each zone, the following net income is expected after implementation of the Projects.

Expected Net Income per Hectare after Implementation of the Projects

	Zone I		Zone II		Zone III		Zone IV		Zone V	
	(ha)	(DH)	(ha)	(DH)	(ha)	(DH)	(ha)	(DH)	(ha)	(DH)
Net Income										
Wheat (including strow)	0.65	4,611	0.75	5,321	0.75	5,321	0.65	4,611	0.65	4,611
Summer vegetable (tomato)	0.05	2,079	0.1	4,158	0.025	1,040	0.1	4,158	0.05	2,079
Winter vegetable (potato)	0.05	1,979	0.1	3,957	0.025	989	0.1	3,957	0.05	1,979
Furits (olive)	0.1	2,741	0.05	1,370	0.1	2,741	0.1	2,741	0.1	2,741
2nd fruits (almond)	0.1	1,198			0.1	1,198	0.1	1,198		
2nd fruits (grapes)			0.05	1,201						
2nd fruits (dates)									0.1	2,768
Fodder (alfalfa)	0.1	2,629	0.05	1,314	0.025	657	0.05	1,314	0.1	2,629
Total of Net Income		15,236		17,322		11,945		17,980		16,806

The farm income under the present condition has been estimated by the study team. The farm income has been converted into economic prices by applying the same conversion factors as shown in Table VIII1.5.2 and the average income by zone has been summarized below.

Farm Income under Present Situation (DH/ha)

	Zone I	Zone II	Zone III	Zone IV	Zone V
Gross Income	3,540	6,647	3,568	6,633	8,133
Expenditure	1,329	1,329	1,329	1,329	1,329
Net Income	2,211	5,318	2,239	5,304	6,804

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 zone is shown below.

Incremental Net Income by Zone (DH/ha)

	Zone I	Zone II	Zone III	Zone IV	Zone V
Net Income with Project	15,236	17,322	11,945	17,980	16,806
Net Income without Project	2,211	5,318	2,239	5,304	6,804
Increase of Net Income	13,025	12,004	9,706	12,676	10,002

Based on the above incremental net income per hectar, the agricultural benefits of the project have been estimated by multiplying command area to be developed. The results of estimation is presented in the table below:

Estimation of Agricultural Benefit of the Projects

ZONE I No. Project	Increase of Net Income (@13,025/ha)		**ZONE III** No. Project	Increase of Net Income (@9,706/ha)	
	Q'ty (ha)	Amount (million DH)		Q'ty (ha)	Amount (million DH)
6 Tazarane	900	11.7	7 Amezmiz	1,500	14.6
19 Aoulai	5,000	65.1	8 Boulaouane	2,000	19.4
21 Sidi El Mokhfi	3,600	46.9	9 Taskourt	5,200	50.5
17 Azghar	1,600	20.8			
ZONE II No. Project	Increase of Net Income (@12,004/ha)		**ZONE V** No. Project	Increase of Net Income (@10,002/ha)	
	Q'ty (ha)	Amount (million DH)		Q'ty (ha)	Amount (million DH)
4 Ain Kwachiya	500	6.0	10 Timkit	2,900	29.0
5 N'fifikh (upper)	800	9.6			
15 Sidi Omar	1,500	18.0			

(2) Benefit of Domestic Water Supply

Simple domestic water supply facilities will be installed annex to the irrigation facilities. Quantitative benefits of the facility are not very large but qualitative benefits are quite large. The facilities may contribute to improvement of public health and quality-of-life by supplying better quality water, and easiness of water

carrying work which has been done by women and children. The benefit of the domestic water supply will be considered together with the other benefits discussed later on.

(3) Flood and Erosion Control Benefit

In the study area, flood inundation and riverbank erosion occur quite frequently during rainy seasons. Agricultural crops, livestock, houses, and infrastructure such as irrigation facilities suffer from flood and erosion damages. After construction of the dams, flood discharge may be regulated and the damages can be mitigated. The following benefits are expected

(a) Reduction in flood damage

- Riverine crops
- Land crops
- Livestock
- Houses
- Infrastructure (irrigation facilities)

(b) Reduction in erosion damage

- Land crops
- Houses

Frequency of floods is estimated based on the daily discharge data at each site.

Since river survey results were not available, areas of flooding and riverbank erosion were estimated considering the river stretches influenced by dams and topographic conditions based on the maps of scale 1/50,000 and 1/100,000.

In addition to the benefits mentioned above, if a new dam is constructed at appropriate distance upstream of an existing reservoir, sediment alleviation effect on the existing reservoir is expected. The existing reservoir may regulate the water effectively for a longer period. Such benefits of sediment alleviation for downstream reservoir has been measured from value of water, because sediment alleviation means increase of effective water. As discussed in the section of agricultural benefit, when the water is used for irrigation purposes, it can generate a net income of approximately 10,000 DH/ha. For the purposes, approximately 7,000 m^3 of water is needed. Thus, the unit value of water is estimated to be 1.43 DH/m^3. Therefore, the sediment alleviation benefits are obtained by multiplying the unit value of water and the sediment alleviation volume. The benefit accumulates year by year. However, the effect of the

sediment alleviation can be considered only when sedimentation of the downstream reservoir will have exceeded the design sedimentation volume under without project condition.

The flood and erosion control benefits including sediment alleviation effects have been estimated as shown in Table VIII1.5.3 and summarized as follow.

Annual Flood and Erosion Control Benefit (DH/year)

Name of Project	Flood & Erosion Control Benefit	Name of Project	Flood & Erosion Control Benefit
ZONE I		**ZONE III**	
6 Tazarane	0	7 Amezmiz	918,800
19 Aoulai	0	8 Boulaouane	3,462,538
21 Sidi El Mokhfi	920,108	9 Taskourt	4,715,580
17 Azghar	1,130,358		
ZONE II		**ZONE V**	
4 Ain Kwachiya	135,597	10 Timkit	800,953
5 N'fifikh (Upper)	1,646,400		
15 Sidi Omar	923,375		

(4) Other Benefit

Other than benefits discussed above, various benefits are expected from the Projects as listed below.

- Contribution to national food security,
- Reduction of food import and saving foreign exchange holdings,
- Creation of new job opportunity,
- 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 farms to consumers,
- 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 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.
- Indirect benefit that may give ripple effect to the economy outside the Project.

Such benefits are assumed 10 percent of the direct benefit. As for the projects in Zone II, other than the benefits discussed above, they are expected to mitigate the influence of salinity of geological origine on agricultural activities. Such benefits including the various benefits listed above are assumed 20 percent of the direct benefits.

VIII1.5.4 Economic Project Cost

(1) Review of Cost Estimate

The project costs have been reviewed based on the following conditions

(a) The project cost has been estimated at the price level of April 2000.

(b) The applied foreign exchange rate is one U.S. dollar equivalent to 10.68 Dirhams and 100 Japanese Yen equivalent to 9.90 Dirhams.

(c) International competitive bidding (ICB) is assumed for the construction of dams and local competitive bidding (LCB) is assumed for the construction of such facilities as irrigation and domestic water supply.

(d) The detailed design of the project is carried out by engineering consultants in a technical assistance scheme in close cooperation with the Ministry of Equipment. The cost of the detailed design is not included in the estimation. The supervision of construction works is carried out with an assistance of engineering consultants hired by the Ministry.

(e) The project costs consist of the following cost items

- Construction cost (direct construction cost + 20% overhead)
- Engineering service cost (10 % of the construction cost)
- Contingency (10% of the total of a) + b))

(f) Land acquisition and resettlement cost, administration cost, price contingency, and interest during construction are not included.

The project costs have been estimated by the study team based on the cost estimated by the Ministry with the following manners

i- Dams

The review was done based on the cost estimated by the Ministry. The dam construction costs have been reviewed based on the following conditions

- Since the costs are expressed at the price level of the year 1992 - 1999, they have been adjusted at the price level of April 2000 with an increase of 2.7% (average annual escalation rate, period approx. 4 years).
- Since the Ministry's cost estimate is based on a direct construction procedure, 20 % of contractors' overhead has been estimated.
- In case volumes of some dams were revised according to the river discharges and irrigation service area, the direct construction cost has been estimated by the standard unit costs.
- Based on the geological data and field survey observation, the costs for grouting and the unit costs of dams were revised in some cases.

ii- Irrigation Facilities

The irrigation facility cost estimated by the Ministry of Agriculture, Rural Development, and Maritime Fishery is basically applied. The study team considered that the cost estimate already includes the physical contingency of 10 %, contractors' profits and miscellaneous costs of 20%, and engineering service cost of 10 %.

iii- Water Supply Facilities

For potable water supply facilities, unit costs by ONEP are referred. Meanwhile for domestic water supply, such cost is regarded to be included in the irrigation facility cost.

(2) Economic Project Cost

Economic price is used for the economic evaluation of the project. The economic price is estimated based on the following assumptions

- Project cost includes Value Added Tax of 20 %
- Construction cost consists of traded goods of 65 % and non-traded goods of 35 %. The cost of non-traded goods is converted into the economic price by applying Standard Convertion Factor (SCF). SCF is calculated by comparing the world price and the domestic price of a representative selection of commodities and it has been obtained by the process shown below.

Calculation of Standard Conversion Factor

Year	Total Import Value (c.i.f.) (Million Dh)	Total Import Taxes - Total Export Subsidy (Million Dh)	Total Export Value (f.o.b.) (Million Dh)
1994	76,059	23,106	50,965
(1998 price)	86,305	26,219	57,831
1995	85,493	23,400	58,672
(1998 price)	91,395	25,015	62,723
1996	84,612	24,589	60,013
(1998 price)	87,820	25,522	62,288
1997	90,712	25,402	67,057
(1998 price)	93,205	26,100	68,900
1998	98,676	26,792	68,608
Average of 5 years (1998 price)	91,480	25,930	64,070

$$SCF = \frac{91{,}480 + 64{,}070}{91{,}480 + 25{,}930 + 64{,}070} = 0.86$$

Data source Annuaire Statistique du Maroc 1999

As a result of calculation, the SCF of 0.86 has been obtained.

- Engineering service cost will not be ajusted since it is considered as the professional labor.

The financial and economic project costs are shown in Table VIII1.5.4 and the annual economic costs are shown in Table VIII1.5.5.

(3) Annual Operation and Maintenance Cost

The annual operation and maintenance costs for dams and irrigation facilities are estimated as shown below

- Dam 0.5 % of the direct construction cost of the dam
- Irrigation facilities 0.5 % of the irrigation facility cost

(4) Replacement Cost

Average lifetime of the metal and mechanical works related to the project is assumed to be 20 years after installation. The replacement cost covers cost for replacement of such metal and mechanical facilities after the lifetime during project life.

VIII1.5.5 Economic Evaluation

As discussed in Subsection VIII5.1, economic analyses of the proposed projects have been conducted by cost-benefit analysis using three types of indicators, i.e. EIRR, B/C, and NPV. Cash flow of the Projects are presented in Table VIII1.5.6 and the results of the economic analyses are summarized below

Results of Economic Analysis

No.	Project	EIRR (%)	B/C DR=5%	NPV (Unit million DH) DR=5%	DR=6%	DR=8%	DR=10%
	ZONE I						
6	Tazarane	4.2%	0.89	-24.1	-47.9	-82.3	-105.2
19	Aoulai	9.3%	1.64	441.8	300.5	94.7	-43.8
21	Sidi El Mokhfi	9.1%	1.61	316.2	212.5	61.4	-40.2
17	Azghar	8.1%	1.45	118.8	71.6	3.0	-43.0
	ZONE II						
4	Ain Kwachiya	6.1%	1.14	14.7	0.7	-19.6	-33.2
5	N'fifikh (Upper)	7.8%	1.39	60.4	34.2	-3.9	-29.5
15	Sidi Omar	7.2%	1.31	84.4	40.5	-23.4	-66.3
	ZONE III						
7	Amezmiz	7.4%	1.35	72.5	37.6	-13.0	-46.7
8	Boulaouane	6.5%	1.21	36.6	10.8	-26.6	-51.6
9	Taskourt	7.6%	1.37	234.7	129.1	-24.3	-127.3
	ZONE V						
10	Timkit	5.7%	1.09	19.6	-9.3	-51.1	-79.1

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

As a result of the economic analyses, almost all the Projects exceeded EIRR of five percent except No.6 Tazarane. Especially No.19 Aoulai, No.21 Sidi El Mokhfi, and No.17 Azghar have higher economic efficiency with EIRR of more than eight percent. No.19 Aoulai, No.21 Sidi El Mokhfi, and No.9 Taskourt marked large NPV of more than 200 million DH when the discount rate is five percent.

It should be noted that this economic analysis has been conducted for comparative purposes with unified conditions as one of the tools to select the priority projects. Optimization of the facilities has not been made yet.