JAPAN INTERNATIONAL COOPERATION AGENCY
THE GOVERNMENT OF THE KINGDOM OF MOROCCO

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

FINAL REPORT

VOLUME I

EXECUTIVE SUMMARY

AUGUST, 2001

JOINT VENTURE OF
NIPPON KOEI CO., LTD. AND
NIPPON GIKEN INC.

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Data Book NE:	***Natural Environment***
Data Book SE:	***Social Environment***
Data Book EA:	***Economic Analysis***

The cost estimate is based on the price level and exchange rate of April 2000. The exchange rate is:
US$ 1.0 = Moroccan Dirham (DH) 10.68 and
Japanese Yen 100.0 = Moroccan Dirham (DH) 9.90

PREFACE

In response to a request from the Government of the Kingdom of Morocco, the Government of Japan decided to conduct the Feasibility Study on Water Resources Development in Rural Area in the Kingdom of Morocco and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. M. Kawashima of NIPPON KOEI Co., LTD (and consists of NIPPON KOEI Co., LTD. and NIPPON GIKEN INC.) to the Kingdom of Morocco, three times between December 1999 and August 2001. In addition, JICA set up an advisory committee headed by Mr. Hayao Adachi, Senior Advisor of JICA between December 1999 and August 2001 (and by Dr. Akira Niwa, Senior Advisor of JICA between April 2001.and July 2001), which examined the study from specialist and technical points of view.

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

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

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Morocco for their close cooperation extended to the Study.

August 2001

Kunihiko Saito
President
Japan International Cooperation Agency

Mr. Kunihiko Saito
President, Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

It is with great pleasure that we submit to you the Final Report of the "Feasibility Study on Water Resources Development in Rural Area in the Kingdom of Morocco".

The Study has been made to formulate the water resources development plans for the 25 medium-scale dam projects proposed by the Ministry of Equipment (MOE) and select the 4 priority projects (Phase I Basic Study), and to conduct a feasibility study of the 4 priority projects based on the water resources development plans (Phase II Feasibility Study).

The Report consists of Part I and Part II. Part I presents the results of the Basic Study and Part II incorporates the results of the Feasibility Study.

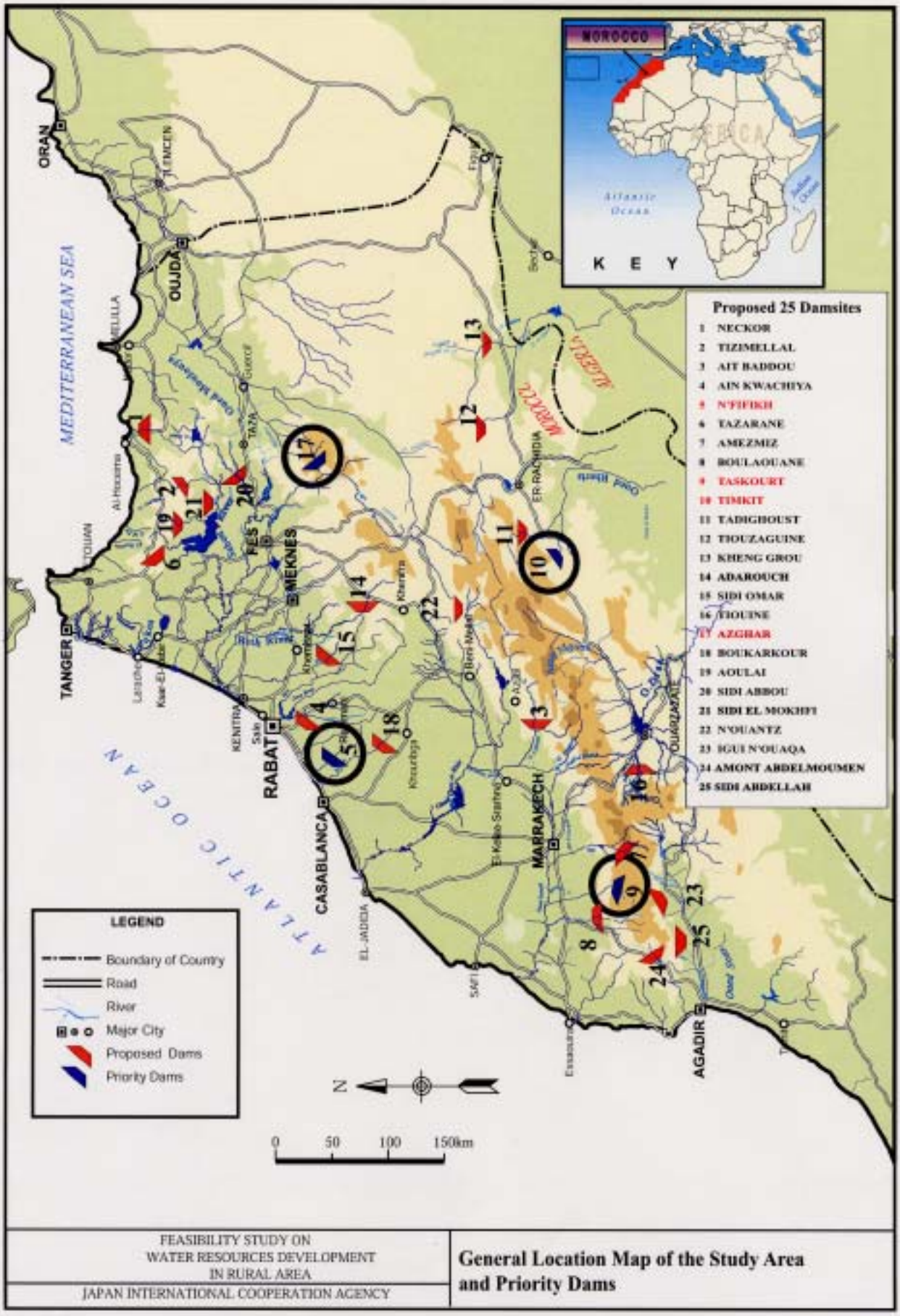
We hope that this report will be helpful for water resources development in rural areas in the Kingdom of Morocco.

We wish to express our deep appreciation and gratitude to the personnel concerned of your Agency, JICA Morocco Office, the Embassy of Japan in Morocco, MOE and the other authorities concerned of the Government of the Kingdom of Morocco for the courtesies and cooperation extended to us during our Study.

Very truly yours,

August 2001

Motoyoshi Kawashima
Team Leader for the Feasibility Study
on Water Resources Development in Rural Area
in the Kingdom of Morocco



FEASIBILITY STUDY ON
WATER RESOURCES DEVELOPMENT
IN RURAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

General Location Map of the Study Area and Priority Dams

Dam Axis of N’Fifikh Site

Irrigation Command Area of N’Fifikh Dam Site

Dam Axis of Taskourt Site

Irrigation Command Area

Dam Axis of Timkit Site

Ifegh Irrigation Command Area

Dam Axis of Azghar Site

Irrigation Command Area

Feasibility Study on Water Resources Development in the Rural Area in the Kingdom of Morocco

Final Report

Volume I Executive Summary

Outlines

OUTLINES OF THE STUDY

PART I BASIC STUDY

I.1 Objectives of the Study

I.1.1 Background of the Study

Water resources in Morocco have been developed by means of dam/reservoir projects and the total storage capacity has reached above 14 billion m^3. In fact, these projects could have achieved a certain success in such areas where implementation has been completed. However, the rural areas have experience water shortages from time to time even in the rainy season due to severe droughts.

In order to improve the rural household economy and to establish sustainable water sources and stable irrigated farming, the Government has concentrated on identifying the dam sites, doing the hydro-geological investigations and doing the design for the dam development projects since the 1980's. However, the following issues have not been investigated or studied yet:

(1) Comprehensive water resources development plan such as irrigation and domestic water development plans in the downstream areas of the proposed dam sites;
(2) Natural and social environmental assessment study; and
(3) Project evaluation in technical, financial and social-environmental aspects.

I.1.2 Scope of Work

To cope with the above, the objectives of the Study, which consists of two phases, Phase I and Phase II, are:

(1) To formulate the water resources development plans for the medium-scale dam projects (as to the definition, refer to clause 5.2 of Main Report of this Study) proposed by the Ministry of Equipment (MOE) and select the priority projects by the end of July 2000 (Phase I, Basic Study);
(2) To conduct a feasibility study of the priority projects which are identified and agreed upon by the two sides of MOE and JICA Study Team based on the water resources development plans by the middle of July 2001 (Phase II, Feasibility Study); and
(3) To transfer technology to the counterpart personnel in the course of the Study.

I.2 Basic Development Strategy

The national development plan for medium-scale dam development was established in 1994 by MOE under the program for small-scale dam development.

Directorate General of Hydraulics (DGH) nominated 53 sites for dam development, which shares approximately 15% of the incremental water demand up to 2020 as the basic policy of the Government. Out of these, 25high priority sites were short listed for the Study under the JICA technical assistance in accordance with the Scope of Work agreed upon between JICA and MOE.

Implementation of the proposed 25 medium-scale dams plays an important role in the development of domestic water, agriculture, control of flood and sedimentation, and recharging of ground water in the rural areas. Taking irrigation lands alone for instance, implementation of these dams will create approximately 34,000 ha, which share 19% of the potential small and medium-scale (PMH) and 29% of the Five Year PMH development plan (2000-2004).

I.3 Basic Study on the Medium-Scale Dam Development

I.3.1 Evaluation of the Projects

The 25 dam projects were appraised on the basis of evaluation factors consisting of: (1) social aspects, (2) technical feasibility, (3) natural environmental impact, (4) social environmental impact and (5) economic viability.

The social aspects of the project were evaluated in view of (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.

The techinical feasibility of the type and height of dams proposed by DGH were examined considering, the topographic and geological conditions of the dam sites, and materials available in the surrounding areas, as well as the geological conditions of the reservoir, magnitude of floods and type of spillway.

Likewise, technical feasibility is evaluated for irrigation development plans in view of the location of the beneficiary area, water distribution method, topography and soil conditions etc.

Natural environmental impact was evaluated on the basis of the JICA guidelines. The level of negative impacts on natural environment for each proposed dam site was classified into ranks. From a natural environmental point of view, no dam sites could be found that would immediately need to have implementation postponed.

Likewise, social environmental impact was evaluated on the basis of the guidelines. The level of negative impacts on natural environment for each proposed dam site was classified into ranks. Three dam sites were found to have critical negative social impact and accordingly must seek for other development programs must be sought for those areas.

1.3.2 Selection of the Projects

As a result of the comprehensive evaluation of the respective factors, the four projects of: 1) No.5 N'Fifikh (up-stream dam site), 2) No.9 Taskourt, 3) No.10 Timkit, and 4) No.17 Azghar were selected for the feasibility study that will be carried out in Phase II of this Study. These four projects are the most promising projects among the proposed 25 projects as they are attractive socially, technically and economically, without significant negative impact on natural and social environment.

PART II FEASIBILITY STUDY

II.1 Development Plans

II.1.1 Alternative Studies for Irrigation Scheme of Each Project

In order to examine the irrigation extent and economic feasibility of the respective projects, alternative studies were conducted for the following cases.

No.5 N'Fifikh Upstream

Four cases of the alternative study were carried out in the area. They consist of 1) gravity irrigation for the cropping pattern proposed by the JICA Study Team (NU1), 2) gravity irrigation for the existing cropping pattern (NU2), 3) gravity irrigation for the cropping pattern proposed by the DPA Ben Slimane (NU3), 4) mechanical irrigation for the cropping pattern proposed 1) above (NU4), and 5) gravity irrigation for the cropping pattern of 1) at the highland areas located in the left bank of the N'Fifikh river (about 100m high) (NU5).

No. 9 Taskourt

Two alternative studies were conducted in the area. They consist of 1) gravity irrigation for the cropping pattern proposed by the JICA Study Team through the dam with a capacity of 34 Mm^3 (TA1), and 2) mechanical irrigation for the cropping pattern and through the same dam capacity proposed 1) above (TA2). In addition, two cases with a dam capacity of 24 Mm^3, consisting of 3) gravity irrigation for the cropping pattern proposed 1) above (TA3), and 4) mechanical irrigation for the cropping pattern proposed 1) above (TA4).

No.10 Timkit

Two alternative studies were conducted in the area. They consist of 1) gravity irrigation by means of surface water from the Timkit dam and subsurface water recharged with floods through pump wells except the Ifegh area which is irrigated by surface water (TI1), and 2) gravity irrigation by means of subsurface water recharged with floods through pump wells except the Ifegh area which is irrigated by surface water (TI2). In case of both alternatives, cropping patterns were proposed by the JICA Study Team.

No.17 Azghar

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

II.1.2 Agricultural Water Users' Association (AUEA)

The government authorities are proceeding to the development of fully modernized equipment facilities including dam/reservoir for the utilization of agricultural water. In this regard, it is necessary to re-organize the existing AUEA for the projects of No.9 Taskourt and No.10 Timkit and to newly establish AUEA for the projects of No.5 N'fifikh and No.17 Azghar in accordance with Law n^{o} 02-84.

II.1.3 Determination of the Project Scale

No. 5 N'Fifikh

According to economic evaluation, Alternative NU3 brings the highest economic internal rate of return, accordingly it is suggested as the definitive plan. With cropping pattern that enhances vegetable cultivation, net irrigation area is calculated at 590 ha, and annual average irrigable area is 645 ha. Development scale of the irrigation facilities is set as the same as the Alternative NU1 of 1,000 ha.

No.9 Taskourt

According to economic evaluation, Alternative TA1 and TA3 bring the highest economic internal rate of return. Considering the DGH's policy to implement the Taskourt dam as a medium-scale dam, and vantage to mitigate negative effect due to inundation, Alternative TA3 is suggested as the definitive plan. The net irrigation area is calculated at 2,500 ha, and the annual average irrigable area is 2,713 ha. Development scale of the irrigation facilities is set the same as the Alternative TA1 of 4,500 ha.

No.10 Timkit

According to economic evaluation, Alternative TI1 brings higher economic internal rate of return, therefore it is suggested as the definitive plan. The net irrigation area is calculated at 1,350 ha, and the annual average irrigable area is 1,690 ha. Development scale of the irrigation facilities is set as the same as the Alternative TI1 of 3,060 ha.

No.17 Azghar

Development scale of the irrigation facility area is determined as 2,000 ha. According to economic evaluation, this project scale brings high economic viability even if the negative impact on the existing Idriss 1er dam in downstream is also considered. Therefore, this scale is suggested as the definitive plan.

II.1.4 Social Environment and Resettlement Plans

In all the proposed projects, social incomes are very limited by the existing agricultural and breeding activities. These incomes are not viable enough for the local people in the sites under the existing natural and social conditions.

According to the hearing survey, if proper compensation would be made, people in the submerged areas would cooperate with recommended settlement plans.

II.2 Preliminary Design

No. 5 N'Fifikh

The dam site is located in the hilly area, 25 km southwest from Ben Slimene. The site was selected at just the upstream side of the narrow valley on the Daliya River where both abutments become closer. Many out-crops of quartzite, which is hard rocks are observed at both abutments and they run across the site with narrow width. Principal features of the proposed dam are as follows:

Type of dam;	Center-cored rock fill
Elevation of dam crest;	EL 251.50 m
Elevation of dam foundation;	EL 204.00 m
Dam height;	47.50 m
Length of dam crest;	325.00 m

Irrigation facilities area (up-stream) is 1,000 ha (net).

No. 9 Taskourt

The dam site is located on the valley of the skirt of the High Atlas Mountains, about 70 km southwest from Marrakech. The site is selected on the Asif el Mehl River at just downstream of the Taskourt village, where an efficient reservoir can be planned. Principal features of the proposed dam are as follows:

Type of dam;	Concrete gravity by RCC
Elevation of dam crest;	EL 1,000.50 m
Elevation of dam foundation;	EL 927.00 m
Dam height;	73.50 m
Length of dam crest;	225.00 m

Irrigation facilities area is 4,500 ha (net).

No. 10 Timkit

The dam site is located on the Ifegh river in the mountain range 25 km northwest from Tinejdad. The dam site is selected in the downstream end of the series of gorge with very steep slope in the left abutment and moderately steep slope in the right abutment. Principal features of the proposed dam are as follows:

Type of dam;	Concrete gravity by RCC
Elevation of dam crest;	EL 1,259.50 m
Elevation of dam foundation;	EL 1,195.00 m
Dam height;	64.50 m
Length of dam crest;	210.00 m

Irrigation facilities area is 3,060 ha (net).

No. 17 Azghar

The dam site is located on the Zloul river in the hilly area, 7 km east from Ribat Al Khayre that is around 50 km eastward from Sefrou. A mountain range closes to the upstream end of the irrigation service area. The valley in the mountain range caved by the Zloul River is the dam site. Principal features of the proposed dam are as follows:

Type of dam;	Center-cored rock fill
Elevation of dam crest;	EL 859.50 m
Elevation of dam foundation;	EL 817.00 m
Dam height;	42.50 m
Length of dam crest;	325.00 m

Irrigation facilities area is 2,000 ha (net).

II.3 Project Cost

Project costs were estimated, including construction cost, resettlement cost, engineering service cost, administration cost, physical contingency, price contingency, and value added tax (April 2000 price level).

Project Cost Unit: Million DH

Cost Item	N'Fifikh	Taskourt	Timkit	Azghar	Total
1. Construction cost	181.0	409.5	274.6	185.8	1,050.9
1.1 Dam and appurtenant facilities	143.1	275.4	162.3	112.5	693.3
1.2 Irrigation facilities	36.5	131.7	112.3	73.3	353.8
1.3 Water supply system	1.4	2.4	-	-	3.8
2. Resettlement cost	3.3	28.5	6.4	5.1	43.3
3. Engineering service cost	12.7	28.7	19.2	13.0	73.6
4. Administration cost	9.2	21.9	14.0	9.5	54.6
5. Physical contingency	20.7	48.9	31.4	21.3	122.3
Sub-total (1.- 5.)	226.9	537.5	345.6	234.7	1,344.7
6. Price contingency	44.3	101.0	77.5	46.3	269.1
Sub-total (1.- 6.)	271.2	638.5	423.1	281.0	1,613.8
7. Value added tax	38.9	91.6	60.8	40.4	231.7
Total (1.- 7.)	310.1	730.1	483.9	321.4	1,845.5

II.4 Economic Evaluation

The economic analyses of the projects have been conducted for both the cases of with and without the indirect benefit (economically induced benefit). The results are summarized below (it should be noted that DGH studied the economic analysis for the large-scale dams for both the cases of with and without the indirect benefit, and the JICA Study followed the analysis procedures):

Results of Economic Analysis

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

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

As a result of the economic analyses with the indirect benefit, all the projects show favarable economic efficiency with EIRR of more then 10%. The overall plan also has a favorable result with EIRR of 12% and NPV of 332 million DH. The result show that all the priority projects are economically feasible.

II.5 Financial Analysis

For evaluation of the project feasibility from the financial aspect of farmers, typical farm budget analyses are made classifying the farmers into three groups by size of farming. The results are summarized below:

Capacity to Pay

Project	Item	Scale of farming		
		Small	Medium	Large
N'Fifikh	1) Average size of farmland (ha)	0.9	2.4	14.6
	2) Capacity to pay (DH)	17,829	58,961	394,285
	3) Average annual water charge (DH/household)	2,791	7,442	45,271
	4) Ratio to the average capacity to pay	16%	13%	11%
Taskourt	1) Average size of farmland (ha)	0.8	2.6	11.3
	2) Capacity to pay (DH)	16,241	63,746	293,463
	3) Average annual water charge (DH/household)	2,094	6,804	29,572
	4) Ratio to the average capacity to pay	13%	11%	10%
Timkit	1) Average size of farmland (ha)	0.4	2.2	8.9
	2) Capacity to pay (DH)	6,225	59,005	251,614
	3) Average annual water charge (DH/household)	1,467	8,071	32,651
	4) Ratio to the average capacity to pay	24%	14%	13%
Azghar	1) Average size of farmland (ha)	0.8	2.5	10
	2) Capacity to pay (DH)	20,265	74,015	317,810
	3) Average annual water charge (DH/household)	1,600	5,000	20,000
	4) Ratio to the average capacity to pay	8%	7%	6%

The water charge, which covers the O&M and replacement costs of the irrigation facilities, will not place a heavy economic burden on the rural farmers in the project sites.

On the other hand, the annual funds required for implementation of the projects and repayment of loan is moderate and if a soft loan is available, it will not be a heavy burden on the Government.

II.6 Conclusions and Recommendations

II.6.1 Conclusions

(1) As explained in Section I.3.2 of this Outline of the Study, the four projects, No.5 N'Fifikh (up-stream dam site), No.9 Taskourt, No.10 Timkit, and No.17 Azghar, have been selected as the priority projects.

(2) The feasibility study of the projects has been conducted. The projects are justified from the technical, social, environmental, economic and the financial viewpoints as well as O/M aspect as described in Part II Feasibility Study of this Executive Summary.

The rural areas where these projects are located only have annual mean rainfall ranging from 190 to 450 mm, which is extremely few and are devastated mountainous ones.

Further, discharge in the rivers is not usually available for people to maintain their living in the area, so water resources developments by medium-scale dam construction to regulate and use floods that occur a few times annually are very necessary. Also, as underground water resources are scarce or almost exhausted in the rural areas and water transfers from other basins are not realistic, ensuring water resources by medium-scale dam construction is very important. In this regard, the JICA Study Team proposed to formulate these four projects in the Group A projects as follows:

- No.5 N'Fifikh

This project should be implemented mainly so cultivation can resume of the devastated vegetable fields located at the suburbs of big cities such as Casablanca and Rabat. The main components to be constructed are dam facilities, irrigation facilities, and domestic water supply systems, as shown in Tables S1, S2, and Figure S6.

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

- No.9 Taskourt

The main purpose of this project is to develop large-scale irrigation to the existing farmlands located at about 30km downstream the proposed dam considering possibility of the improvement of the social environment for about 1,000 inhabitants living in the proposed reservoir area by providing settlement into a new living area. The main components to be constructed are a dam, rehabilitation of existing irrigation facilities, domestic water supply systems, and social infrastructures in new settlement areas for the inhabitants in the reservoir, as shown in Tables S1, S3, and Figure S7.

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

- No.10 Timkit

The main purpose of this dam is to provide irrigation to the three existing oases. The beneficiary areas of this project are the area immediately downstream, and areas about 30km and 40km downstream of the proposed dams, which will help stop the Sahara desert expand to the north. The main components to be constructed are dam facilities, and rehabilitation of existing irrigation facilities, as shown in Table S4, and Figure S8.

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

- No.17 Azghar

This project should be implemented mainly to develop medium-scale irrigation to the existing farmland, just downstream the proposed dam. The main components to be constructed are dam facilities and irrigation facilities as shown in Table S5, and Figure S9.

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

II.6.2 Recommendations

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

Overall Implementation schedule of the priority projects and other medium-scale dam projects to be newly identified by Moroccan Government under the long term water resources development plan until the target year 2020 is proposed as shown in Figure S10 of the Executive Summary.

(2) Project cost for the four priority projects and the annual disbursement schedules are shown in Tables S6 and S7.

As described in clauses II.4 and II.5 of this Outline of the Study, economic viability by the direct benefit for the medium-scale dam projects are generally not so high, so the financial plan for each project is rather difficult to establish. It is however possible to justify the projects even in such case considering the indirect benefit such as economically inducing benefit or in view of the social aspects, which are above all the most serious matters in Morocco. Accordingly, soft loan with low interest and long repayment period from international financing agencies such as JBIC is very necessary.

(3) For the smooth promotion and implementation of the medium-scale dam projects, a permanent and unified implementation committee comprised of the government staff dispatched from the related ministries and agencies, which should be chaired by DGH, should be established in the central government.

In addition, for the smooth implementation of the Projects, the Government should establish a Project Implementation Office (PIO) under the administration agency to each hydraulic region to be established by the central Government consisting of the Government Agencies concerned. General Directorate of Hydraulics, Ministry of Equipment would be the secretary of PIO and take overall responsibility for the implementation of the Projects.

(4) Establishment of Environmental Management Plan (EMP) is the most important practice as a long-term mitigation of the environmental impacts. Establishment of Environmental Management Unit (EMU), development of tree planting program as a counter measure for erosion problem, and involvement of the Ministry of Forestry into such tree planting program should be also forwarded.

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

(5) Terms of references for the detailed design of the 4 priority projects which should be conducted after this study are described in clause 11.2 of Volume II Main Report. In particular, prior to commencement of the detailed design for the irrigation facilities of these projects, water management study should be made considering existing water right, existing water distribution system and land consolidation to be made in future.

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ABBREVIATIONS

Abbreviations	ENGLISH	FRENCH
AEP	Potable Water Supply	**A**pprovisionnement en **E**au **P**otable
APD	Detailed Study	**A**vant **P**rojet **D**étaillé
AUEA	Association of Agricultural Water Users	**A**ssociation des **U**sagers de l'**E**au **A**gricole
BAD	African Bank for Development	**B**anque **A**fricaine de **D**éveloppement
BM	World Bank	**B**anque **M**ondiale
CAM	Agricultural Cooperative of Morocco	**C**oopérative **A**gricole du **M**aroc
CDA	Agricultural Development Center	**C**entres de **D**éveloppment **A**gricole
CERED	Center for demographic Research and Studies	**C**entre des études et de **R**echerche **D**émographiques
CLCA	Local Fund for Agricultural Credit	**C**aisse **L**ocale de **C**rédit **A**gricole
CMV	Development Center	**C**entre de **M**ise en **V**aleur
CNCA	National Fund for Agricultural Credit	**C**aisse **N**ationale de **C**rédit **A**gricole
CNE	National Council of Environment	Le **C**onseil **N**ational de l'**E**nvironnement
CSEC	Superior Council for Water and Climate	**C**onseil **S**upérieur de l'**E**au et du **C**limat
DAR	Directorate of Rural Affairs	**D**irection des **A**ffaires **R**urales
DCL	Directorate of Local Collectivities	**D**irection des **C**ollectivités **L**ocales
DCRF	Directorate of Forest Resources Conservation	**D**irection de la **C**onservation des **R**essources **F**orestières
DDF	Directorate of Forest Development	**D**irection de **D**éveloppement **F**orestière
DE	Directorate of Operation	**D**irection des **E**conomiques
DELM	Directorate of Epidemology and Abatement of Disease	**D**irection d'**E**pidemologie et de **L**utte Contre les **M**aladies
DEP	Directorate of Design and Planning	Direction de Planification et des Plans
DEPR	Division of Potable Rural Water Supply	**D**ivision d'Alimentation en **E**au Potable en Milieu **R**ural
DERD	Decentralized Regional Directorate	**D**irection de l'**E**nseignement, de la Recherche et de Développement Rural
DF	Directorate of Finance	Direction des Finances
DGCL	General Directorate of Local Communities	**D**irection **G**énérale des **C**ollectivités **L**ocales
DGH	Directorate General of Hydraulics	**D**irection **G**énérale de l'**H**ydraulique
DH	**D**irham	**D**irham
DIEC	**D**ivision of **I**nformation, **E**ducation and **C**ommunication	**D**ivision d'**I**nformation, **E**ducation et **C**ommunication
DP	Provincial Directorate	**D**irection **P**rovinciale

Abbreviations	ENGLISH	FRENCH
DPA	Provincial Directorate of Agriculture	**D**irection **P**rovinciale d' **A**griculture
DPA	Provincial Directorate of Animal	**D**irection **P**rovinicials de l' **A**nimale
DPTP	Provincial Directorate of Public Works	**D**irection **P**rovinciale des **T**ravaux Publiques
DPV	Directorate of Vegetable Production	**D**irection de la **P**roduction **V**égétale
DRD	**D**ecentralized **R**egional **D**irectorate	**D**irection **R**égionale **D**écentralisée
DT	Division of Works	**D**ivision du **T**ravail
EIRR	**E**conomic **I**nternal **R**ate of **R**eturn	
EMP	**E**nvironmental Management **P**lan	Plan de Gestion Environnementale
FERTIMA	Moroccan Company of Fertilizers	**S**ociété **M**arocaine de **F**ertilisation
FV	Training Visit	**F**ormation **V**isite
GH	Large Hydraulic	**G**rande **H**ydraulique
GPD	**G**ross **D**omestic **P**roduct	Produit National Brut
HCWC	**H**igh **C**ouncil of Water and **C**limate	Conseil Superieur de l'eau et du Climat
IBRD	**I**nternational **B**ank for **R**econstruction and **D**evelopment	Banque Internationale pour la Reconstruction et le Développement
INH	National Institute of Hygiene	**I**nstitut **N**ationale de l'**H**ygiène
JBIC	**J**apan **B**ank for **I**nternational **C**ooperation	Banque Japon de Coopération Internationale
JICA	**J**apan **I**nternational **C**ooperation **A**gency	Agence Japonaise pour la Coopération Internationale
MADRPM	Ministry of Agriculture, Rural Development and Maritime Fishing	**M**inistère de l'**A**griculture du **D**éveloppement **R**ural et des **P**êches **M**aritimes
MCEF	Ministry In Charge of Water and Forests	**M**inistère **C**hargé des **E**aux et **F**orêts
MI	**M**inistry of **I**nterior	**M**inistère de l'**I**ntérieur
MOA	**M**inistry of **A**griculture, Rural Development and Fishery	Ministère de l'Agriculture du développement Rural et des Pêches maritimes
MOE	**M**inistry of **E**quipment	Ministère de l'Equipement
MOI	**M**inistry of **I**nterior	Ministère de l'Intérieur
MPW	**M**inistry of **P**ublic **W**orks	Ministère des travaux Publics
MSL	**M**ean **S**ea **L**evel	Niveau Moyen de La mer
MSP	Ministry of Public Health	**M**inistère de la **S**anté **P**ublique
NG	**N**atural **G**round	Sol Naturel
NPV	**N**et **P**resent **V**alue	Valeur Nette Actuelle
OECF	**O**verseas **E**conomic **C**ooperation **F**und (now JBIC)	Fond de Coopération Economique Etrangère
OMM	**O**peration, **M**aintenance and **M**anagement	Opérations de gestion et de maintenance
ONE	National Office of Electricity	**O**ffice **N**ational de l'**E**lectricité
ONEP	National Office of Potable Water	**O**ffice **N**ational de l'**E**au **P**otable

Abbreviations	ENGLISH	FRENCH
ONICL	Inter professional National Office of Cereals and Leguminous	**O**ffice **N**ational Inter professionnel des **C**éréales et **L**égumineuses
ORMVA	Regional Office for Agricultural Development	**O**ffice **R**égional de la **M**ise en **V**aleur **A**gricole
PAGER	Program of Grouped Supply of Rural Water	**P**rogramme d'**A**pprovisionnement **G**roupé des **E**aux **R**urales
PAGI	Program of Large Irrigation Improvement	**P**rogramme d'**A**mélioration de la **G**rande **I**rrigation
PMH	Small and Medium-ScaleHydraulic	**P**etit et **M**oyenne **H**yraulique
PNI	National Program of Irrigation	**P**rogramme **N**ational de l'**I**rrigation
PRV	Extension and Research Project	**P**rojet de **R**echerche et de **V**ulgarisation
PSDA	Agricultural Development and Support Project	**P**rojet de **S**upport et de **D**éveloppement **A**gricole
SE	Water Service at the Provincial Directorate of Public Works	**S**ervice **E**au à la Direction provinciale de l'Equipement
SH	Section of Hydology	**S**ervice d'**H**ydraulogie
SIBE	Site of Biological and Ecological Interest	**S**ite d'**I**ntérêt **B**iologique et **E**cologique
SMN	Service of National Meteorology	**S**ervice de la **M**étéorologie **N**ationale
SONACOS	National Company of Seed Trade	**S**ociété **N**ationale de **C**ommercialisation de **S**emences
UNCAM	National Union of Cooperatives of Morocco	**U**nion **N**ationale de **C**oopératives du **M**aroc
UNDP	**U**nited **N**ations **D**evelopment **P**rogram	Programme des Nations Unies pour le Développement (PNUD)

Conversion Factors

	Metric to Imperial			Imperial to Metric		
Length	1 cm	=	0.394 inch	1 inch	=	2.54 cm
	1 m	=	3.28 feet	1 feet	=	30.48 cm
	1 km	=	0.621 mile	1 mile	=	1.609 km
Area	1 m^2	=	10.76 sq.ft	1 sq.ft	=	0.0929 m^2
	1 ha	=	2.471 acre	1 acre	=	0.4047 ha
	1 km^2	=	0.386 sq.mile	1 sq.mile	=	2.59km^2
Volume	1 lit	=	0.22 gal (imp)	1 gal(imp)	=	4.55 lit
	1 m^3	=	35.3 cu.ft	1 cu.ft	=	28.33 lit
	1 MCM	=	811 acre-ft	1 acre-ft	=	1,233.5 m^3
Weight	1 kg	=	2.20 lb	1 lb	=	0.4536 kg
	1 ton	=	0.984 long ton	1 long ton	=	1.016 ton
Derived	1 m^3/s	=	35.3 cusec	1 cusec	=	0.0283 m^3/s
Measures	1 ton/ha	=	891 lb/acre	1 lb/acre	=	1.12 kg/ha
	1 m^3/s	=	19.0 mgd	1 mgd	=	0.0529 m^3/s
Temperature	°C	=	(^{o}F-32)x5/9	^{o}F	=	1.8x°C+32
Local	1 lit	=	0.22 gantang	1 gantang	=	4.55 lit
Measures	1 kg	=	1.65 kati	1 kati	=	0.606 kg
	1 ton	=	16.5 pikul	1 pikul	=	60.6 kg

EXECUTIVE SUMMARY

I. Background of the Project

I.1 Introduction

1. The objectives of the Study, which consists of two phases, Phase I and Phase II, are:

   (1) To formulate the water resources development plans for the medium-scale dam projects (as to the definition, refer to clause 5.2 of Main Report of this Study) proposed by the Ministry of Equipment (MOE) and select the priority projects by the end of July 2000 (Phase I, Basic Study);

   (2) To conduct a feasibility study of the priority projects which are identified in Phase I and agreed upon by the two sides by the middle of July 2001 (Phase II, Feasibility Study); and

   (3) To transfer technology to the counterpart personnel in the course of the Study.

2. Part I of this Final Report deals with the results of the basic plan study on the 25 dam projects carried out in the Phase I work. It presents the basic development strategy with respect to zoning of the Study area, development of dams, domestic water and agriculture, control of flood and sedimentation, and recharging of groundwater. It also presents the criteria for selecting the priority projects out of the 25 dam projects to do study on in the Phase II work.

3. Part II of this report incorporates the results of the feasibility study for the four priority projects of N'Fifikh (No. 5), Taskourt (No. 9), Timkit (No. 10) and Azghar (No. 17). It presents the natural and socio-economic conditions, examining water resources, development plan of dams, domestic water supply, agriculture and mini-hydro power, and control of flood and sedimentation, recharging of groundwater. It also presents the preliminary design, cost estimates, economic evaluation, as well as natural and social environmental assessments.

4. Further, in the Part II of this Study, conclusions and recommendations are presented in which the implementation program is described, which has short and long term programs, and consists of implementation projects, implementation schedule, organization of project implementation, financing of project costs, construction supervision, as well as operation and maintenance.

PART I BASIC STUDY

I.2 Background of the Study

5. Water resources in Morocco have been developed by dam/reservoir projects at 94 locations as of 1997 and the total storage capacity in Morocco has reached above 14 billion m^3. These projects could have achieved a certain level of success in such areas where implementation has been completed;. however, water shortage in the rural areas happened from time to time even in the rainy season due to severe drought conditions. In addition, the rural residents living along the rivers have experienced damage to their houses and cultivated lands due to exceptional floods.

6. In order to improve the rural household economy and to establish sustainable water sources and stable irrigated farming, the Government has been concentrating on identifying dam sites, and carrying out hydrological and the geological investigations and the design for the dam development projects since the 1980s. However, the following items have not been investigated or studied yet:

   (1) Comprehensive water resources development plan such as irrigation and domestic water development plans in the downstream areas of the proposed dam sites;
   (2) Natural and social environmental assessment; and
   (3) Overall project evaluation in technical, financial and social-environmental aspects.

II The Study Area

II.1 Natural Conditions

7. Morocco is located at the northwestern end of the African Continent. The land of Morocco, which occupies an area of 710,850 km^2, stretches between longitudes 1 ° 00' and 17 ° 00' west and between latitudes 21 ° 30' and 35 ° 05' north.

II.2 Social and Economic Conditions

8. The total population of Morocco was 26,073,717,with an urban population of 13,407,835 and rural population of 12,665,882 according to the latest population census in 1994. Between 1982 and 1994, urban population grew at annual mean rate of 3.6 %,rural at 0.7 % and the total population at 2.1 %. Gross Domestic Product (GDP) of Morocco in 1998 was estimated at 341,385 million DH (approximately US$ 33 billion) and GDP per capita in the same year, at 12,291 DH (approximately US$ 1,170). Average annual growth rate of GDP during four years from 1988 to 1998 was 2.7 % on at capita was only 0.9 % on the same basis. Thus economic growth has not been able to keep up with the rapid growth in population. While the secondary and tertiary industries had been stable and growing favorably, primary industries including agricultural sector had fluctuated much according to the weather conditions GDP also had fluctuated according to the performance of the agricultural sector.

Nonetheless, agriculture is very important for Morocco since it provides a source of living for approximately 40 % of the labor force.

II.3 Water Resources Potential and Development Condition

9. Full-scale development of water resources began in the 1980s in Morocco. Water resources potential is roughly estimated at 21.0 billion m^3, consisting of 16.0 billion m^3 of surface water and 5.0 billion m^3 of groundwater. Out of 16.0 billion m^3 of surface water, 8.0 billion m^3 have been developed: 7.0 billion m^3 for irrigation and for 1.0 billion m domestic and industrial water ^{3}. Out of 5.0 billion m^3 of groundwater, approximately 3.8 billion m^3 have been mobilized: 3.2 billion m^3 for irrigation and 0.6 billion m^3 for domestic and industrial water. That leaves an estimated 9.2 billion m^3 to be possibly developed in the future.

II.4 Status of Dam Development

10. The total storage capacity of the existing large dams including medium-scale dams amounts to 14.2 billion m^3. According to the available data for the existing dams, annual regulated volume is on average about 53% of the storage capacity. Assuming that this ratio is applicable, the total regulated volume of the existing dams amounts to about 8.0 billion m^3 per year. Furthermore, 107 large dams with a total capacity of 15.0 billion m^3 are proposed for future water resources development.

II.5 Rural Water Supply

11. Total production of potable water in urban area was 780 million m^3 per year for 13.7 million inhabitants in 1997. This production volume was secured by the National Office of Potable Water (ONEP, 80% in share), state owed companies (12%), a private sector corporation (Elyo, 5%), and urban communes (3%). The rate of urban population whose home was connected to a potable water network was 83% in 1997, and it is targeted to increase to 96% by 2010. In rural areas, however, development of adequate potable water supply had been rather frustrated due to its characteristics such as that the area being isolated and having small population,.. etc. It is reported that only 38% of rural population is at present satisfactorily provided with public water supply facilities. The remaining rural population is inadequately supplied, having to rely on extraction from private wells, springs, stocked rain, river water, or transportation from other areas beyond the administrative boundaries of the area they live in.

II.6 Land Use

12. The total area of farmland in Morocco is approximately 8.70 million ha and the forest area including natural and afforestated area is approximately 5.34 million ha. In the five years, the total area of farmland has not changed, though the cropped area has changed year by year depending on agro-climatic conditions. According to the agricultural survey carried out in 1997/98, the cultivated area of cereal crops occupied 67% of the total farmland.

II.7 Irrigation

13. Irrigation area has increased to approximately 1.0 million ha as of 1999. In Morocco, irrigation area is classified into three categories in terms of irrigated conditions: 1) perennial irrigation with an equipped area of approximately 670,000 ha of GH and 330,000 ha of PMH; 2) seasonal irrigation; and 3) flooding irrigation with a total area of 300,000 ha. Potentially, 1,360,000 ha of perennial irrigation is possible: 850,000 ha of GH and 510,000 ha of PMH. In addition, there may be about 300,000 ha of lands irrigated seasonally and spreading flood.

II.8 Agricultural Production

14. Cereals are the major production crops in Morocco, which has been largely affected by weather conditions. The production of cereals in the 11 years fluctuated from 1,749,000 tons (1994/95) to 9,982,000 tons (1995/96) and the yield of cereals also fluctuated from 0.4 ton/ha to 1.6 tons/ha. Total production of cereals was 5,092,000 tons in 1998/99. Out of this production, hard wheat, soft wheat, barley and maize occupied 21%, 32%, 40%, and 7%, respectively.

II.9 Land Holding and Tenure

15. Average size of land holding per farmer is 5.8 ha in Morocco. Small farmers with less than 3 ha, consist of 58% of total farmers, but occupy only 12% of the total farmland. While, the large scale land hold farmers who have more than 20 ha occupy 32% of total farmland against 4% of total number of farmers. Tenant farmers also exist and their number is estimated at 64,400.

II.10 Extension Services

16. At the circle or commune level there are work centres and sub-centres staffed by technicians, who provide all agricultural and livestock extension services. A director heads each work centre and there is a multidisciplinary team to carry out the extension services. According to the local needs, several approaches are used for extension purposes i.e., close contact extension program, large scale and mass extension program, mobile team extension program, individual extension program for specialized farmers, observation tours, agricultural education to the young people and students, etc. Education of farmers aims mainly at utilization of inputs and machinery, loans, irrigation, cooperatives/farmers' associations, women's education.

II.11 Agricultural Credit

17. Effective rural credit mechanism is a major incentive to farmers who need help. In Morocco, the National Agricultural Bank (La Caisse Nationale de Credit Agricole : CNCA) established in 1961, provides credit to the farmers as well as agricultural industries through its regional branches (CRCA:Caisse Regionale de Credit Agricole) and local branches (CLCA: Caisse Locale de Credit Agricole). CNCA is represented in other parts of the country by nine DRDs (DRD: Decentralized Regional Directorate), 81 CRCAs and 285 CLCAs of which 132 are permanently established and 153 are temporarily established.

II.12 Marketing System

18. The marketing system of all agricultural commodities has been fully liberalized; however, there exists some control over soft quality wheat, which is the staple in Morocco. The government has a policy to keep 10,000 tons of soft quality wheat for low income families. ONICL (L'Office Nationale Interprofessionele des Cereals et des Legumineuses) under the supervision of Ministry of Agriculture, Rural Development and Fisheries gives order to CAM/UNCAM for distribution, collection, imports and exports and it pays for transportation and storage charges. Loans to purchase cereals are available from CNCA or other commercial banks.

II.13 Farmers' Organization

19. At the local level, work centres, which are the grass level extension centres under the Ministry of Agriculture, Rural Development and Fisheries as described before and Regional Office for Agricultural Development (ORMVA) initiate, assist, and help farmers to organize, form cooperatives or associations. According to the documents, the "Development Agricole et Rural" December 1998, presently there are 4,288 professional organizations distributed into 2,828 autonomous cooperatives, 713 agrarian reform cooperatives, 180 producers and 540 water users' associations.

II.14 Natural Environment

20. The Government 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 in Morocco. 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 into Priority 1 include original and most representative ecosystems and the richest in terms of biological diversity. Therefore, those sites must be fully protected. Sites categorised as Priority 2 and Priority 3 are also protected, and activities such as hunting and fishing are restricted within the area.

II.15 Social Environment

21. The recent studies of the BM, BAD and FAO (Report BM, n° 11947-MOR, May 1994; FAO/PSDA/UTF/MOR, 014) specify difficulties in the irrigated zones: lack of infrastructure and economic basis, illiteracy, lack of organization and information, indebtedness problems, etc. The policies in the irrigation are apt to concentrate on the decision of technical problems. This situation does not permit for the irrigation to play its full role. The development studies also remain insufficient without adaptation of the people's organization to realize the needs of farmers. The same study makes come out again the agricultural people and professional organizations in the ORMVA zones, knowing a considerable deficiency of the information and advice. Three main problems exist at the origin of this situation: the supply of popularization, the demand of popularization and the imbalance between the two.

22. Concerning the supply, it is noted that a large parsimony between the means allocated and absence of strategy and appropriate approach. Concerning the demand, farmers have been accustomed, since 1960 to popularization of service allowance (plowing operation) or free supply (fertilize operation). Since this date, change in the relations between frame structure and farmer have not been clarified. Farmers do not know what is expected of the public service of popularization.

23. Concerning the gender in development, essential role of the farming women has shown many things for the family plan, economic and social culture. Yet their contribution is invisible and under-estimated. In spite of these women's contribution, they have benefit from these resources. In addition, the introduction of innovations and changes in production system of animal and/or crops may bring negative impact on women and their environment (FAO, PSDA/UTF/MOR/014).

III Development Needs and Basic Development Strategy

III.1 Dam Development in the Five Year Plan

24. Major programs of the hydraulic sector are listed in the Five Year National Development Plan. Programs for surface water resources development deal with the implementation of nine large-scale water resources development projects, five medium-scale dams, and eight small-scale dams. There is also an optional program of implementation of seven large-scale dams, six medium-scale dams and 14 small-scale dams.

III.2 Water Supply Development in the Five Year Plan

25. ONEP strategy for potable water supply in the coming five years is as follows:

- Satisfy potable water demand in urban or rural centers that ONEP currently intervenes, with minimal cost as practicable as possible;
- Improvement ment of accessibility to potable water for low-income population, with provision of networks and stand pipes that have character of welfare work;
- Properly maintain facilities for production and distribution of potable water, so that efficiency of ONEP's activity might be improved;
- Maintain quality level of produced water and service for consumers;
- Participate in the Program of Grouped Supply of Rural Water (PAGER) by providing ramified pipe networks on the main ONEP water conveyances from which water would be distributed to the surrounding villages through a number of stand pipes; and
- Improve quality of polluted water, in close cooperation with local government.

III.3 Irrigation Development in the Five Year Plan

26. The action plan concerning the rural development and irrigation in Five Year National Development Plan consists of two major components of (1) adjustment of the irrigation potential (new development) and (2) improvement of the performance of irrigation sector (rehabilitation and modernization).

(1) Projects related to adjustments of the irrigation potential:

- Completion of the first phase of PNI which deals with 35,800 ha;
- Achievement of the second phase of PNI through the extension of irrigation to an area of 113,530 ha under the GH projects; and
- Another irrigation extension program of 36,230 ha, including 8,800 ha dominated by the GH projects and 27,430 ha of the PMH projects other than the framework of PNI.

(2) Projects related to the improvement of the performance of the irrigation sector:

- Completion of the on-going rehabilitation projects pertaining to the PNI first phase involving 38,950 ha of the GH projects and 29,000 ha of PMH projects;
- Achievement of a new rehabilitation program under PNI dealing with an area of 102,800 ha including 24,000 ha of GH projects and 84,200 ha of the PMH projects scattered all over the national territory; and
- Implementation of an integrated rehabilitation program involving an area of 20,810 ha of the PMH projects other than the framework of PNI.

III.4 Water Law (95 –10)

27. Water Law (95-10), which was approved by the Government in September 1995, constitutes a legal basis for policy making with regard to water resources development in Morocco in the future. In this law, the Superior Council for Water and Climate (CSEC) is assigned to formulate general guidelines for the national policy on water and climate. CSEC examines and formulates its opinion on:

- National strategy for enhancement of knowledge on climate and harnessing its impact on water resources development;
- National water plan; and
- Integrated plan for water resources development in river basins, especially distribution of water among various demand sectors and regions, as well as arrangement for development, protection and conservation of water resources.

III.5 Twenty Five (25) Dams Selected for the Study

28. The national plan for medium-scale dam development was established in 1994 by MOE under the program for small-scale dam development. General Directorate of Hydraulics (DGH) nominated 53 sites for dam development as the basic policy of the Government. Based on the annual budgetary allocation, DGH aggressively conducted a geological investigation and studies on the dams commencing from the promising sites.

It completed such investigation and studies for more than 50% of the 53 locations at the level just before detailed design (APD). Out of the projects that APD has more or less been completed for, 25 high priority sites were short listed for the Study under the JICA technical assistance in accordance with the Scope of Work agreed upon between JICA and MOE.

III.6 Significance of the Projects in the National Development Plan

29. Water resources that are to be developed through implementation of the nominated 53 dam projects are roughly estimated at 1,000 million m3 per year. Annual water demand in Morocco from 1990 up to 2020 is estimated to increase by some 6,700 million m^3. Therefore, the nominated 53 dam projects share 15% of the incremental water demand in future.

30. There are large-scale (GH) and small and medium-scale (PMH) irrigation systems. The latter projects range from a few to several thousand hectares. They represent a potential of 510,000 ha of perennial irrigation and 300,000 ha of seasonal irrigation.

Increasing attention has been given since the mid-1980s to improving PMH through rehabilitation and betterment, some 330,000 ha have been developed, and hence some 180,000 ha are to be developed.

31. According to the action plan concerning the rural development and irrigation in the Five Year National Development Plan, new irrigation development of 33,850 ha are proposed to be conducted under PMH, and an integrated rehabilitation program involving an area of 84,200 ha of PMH is scheduled to be implemented. Thus, the area to be developed under PMH projects is 118,050 ha in total.

32. Implementation of the proposed 25 medium-scale dams plays an important role in the development of rural water and agriculture, control of flood and sedimentation, and restoration of groundwater in the rural areas.

Taking irrigable lands alone for instance, implementation of these dams will newly create approximately 34,000 ha, which share 19% of the potential PMH and 29% of the Five Year PMH development plan (2000-2004).

IV Basic Concept for Development Plan

IV.1 Zoning of the Study Area

33. Water Law (95-10) of Morocco clearly states the need for management of water resources in the frame of river basins, because the river basins constitute natural geographic units that are best adapted to understand and solve problems in water resources management. In order to attain such object and reinforce existing institutional frames, basin agencies, which have financial autonomy, are to be established to evaluate, plan and manage water resources at level of the river basins.

Also the policies of the Ministry of Agriculture, Rural Development and Fishery (MOA) drafted within the framework of "the 2020 Strategy for the Rural Development" propose to establish similar zone-wise development plan in the near future based on the strategic background, which is commonly predominant in each zone. Based on the above considerations, the Study area divided into five zones for the convenience of the Study (Phase I), as the demarcation of zones made by MOE and that made by MOA is consistent each other.

IV.2 Significance of Dam Construction

34. The Government of Morocco has exploited water resources by developing mainly large-scale dams for the improvement of the rate of self-sufficiency and of the standard of living. However, large parts of the rural areas have remained without improvement in water supply condition, which has resulted in inequity between the areas developed and undeveloped.

Development of medium-size dams is proposed in the latter areas where there are still potentials of water resources. It is commonly understood that there are potentials for large-scale dams in the middle or lower streams of large rivers, whereas potentials for middle-scale dams exists at:

- the upper stream or tributaries of large rivers

- the middle to lower stream of main rivers where large-scale dams cannot be constructed
- the lower stream of medium-size rivers

Considering the above and development concept of each zone described in IV.3.34 of this Executive Summary, medium-scale dam construction by five each zone is proposed as stated below.

IV.3 Development Concept for Each Zone

35. (1) Zone I

Sedimentation that enters into the Al Wahda dam from the Rif Mountains will be reduced so that the downstream granary area that obtains irrigation water supply from this dam may be protected.

There exist many small farmlands along the steep tributaries upstream of the Al Wahda dam in the Rif Mountains. These farmlands will be protected from flood damages, and supplied with stable agricultural water. Furthermore, potable water for inhabitants in the Rif Mountains will be secured, as the groundwater in this area is scarce.

In upstream area of the Sebou and Ouergha Rivers, there exist areas that do not have benefit from the existing large dams downstream. In those areas farmers who gave up farming are increasing due to long lasted drought, with such farmers migrating into Fes or other cities, bringing social problems. A stable supply of agricultural water is needed for areas of water shortage so as to prevent such problems.

(2) Zone II

This zone in general does not have enough groundwater resources due to its geological character. Salt damage is due to excess exploitation of groundwater near the Atlantic Ocean. Due to long lasted drought, farmers who gave up farming are migrating to around Rabat and Casablanca. Therefore, surface water needs to be mobilized for stable supply of agricultural water.

(3) Zone III

Conservation of watershed will be done for the existing Sidi Driss dam so that water supply for agricultural water to its downstream farmland as well as potable water to Marrakech in the Tensift river basin might be secured.

Due to excess exploitation, the groundwater level in this area is substantially dropping and this makes supplying agricultural water more difficult. This causes farmers who gave up farming to migrate into Marrakech and other areas, causing social problems. Therefore, a stable supply of agricultural water to farmland in the Tensift River Basin is required.

There sometimes occur damages due to flood in the downstream reaches in the N'Fis, Rerhaya and Issil rivers that are located upstream of the Tensift river. Flood damages in farmland around Marrakech need to be mitigated.

(4) Zone IV

In this zone, due to long lasted shortage of water and the excess exploitation of the groundwater for sprinkler farming of fruit plantation, there has been a severe drop in the groundwater level (1.6 m per annum) at the vast farmland along the Sous river, especially near Taroudant. Conservation of groundwater needs to be secured in this area.

Damages to small farmlands in the Sous river basin due to floods that originate from the Atlas Mountain will be mitigated.

Agricultural water for small farmland at the Sous and Draa river basin will be secured and a stable supply obtained.

(5) Zone V

Due to long lasted water shortage, desertification has progressed in this zone. Securing potable water is becoming difficult and depopulation is progressed there. Most migrant workers to Rabat and Casablanca, and European countries are supposed to come from this area. Potable and agricultural water is required be secured so as to prevent depopulation due to lack of water resources.

V Development of the Projects

V.1 Development Concept

36. Based on the natural and socio-economic conditions and the Government policies related to water resources development, the basic development concept for the Study (Phase I) proposed by the Study Team is discussed hereinafter with respect to the plans for dam development, rural water supply development, agricultural development, flood and sediment control and recharging of groundwater.

V.2 Dam Development Plan

37. In order to formulate development plans such as potable water and irrigation, hydrological potential for water resources was studied by analyzing discharge records at respective gauging stations for the last 10 to 20 years. A guarantee level of 90% (1/10) is applied if a potable water supply scheme is related, and a frequency of 80% (1/5) is applied to irrigation water supply scheme.

38. Type and height of the dams proposed by DGH were examined from the viewpoint of the objectives of the dams, the topographic and geological conditions of the dam sites, and materials available in the surrounding areas, as well as the geological conditions of the reservoir, magnitude of floods and type of spillways.

Such information necessary for the determination of the features of the dams, and comments and suggestions to be considered for the modification are described in the tables attached in Supporting Report VII. However, it should be noted that alterations of the original plans identified and formulated by DGH are minimized.

V.3 Rural Water Supply Development Plan

39. Of the 25 proposed dams, only two dams, Tiouzaguine Dam (No. 12) and Adarouch Dam (No. 14) are nominated for the purpose of supplying potable water to urban and/or regional centers, whereas another 18 dams are planned to be utilized with a provision of domestic water supply facilities with simple filtering equipment for water purification in the project's irrigation or surrounding reservoir areas. Demand of such domestic water supply in the target year of 2020 is obtained by multiplying unit water demand of 20 liters/man/day with projected population with assumption of annual increase rate of 0.7%. No domestic water supply is planned for the remaining five dam project's areas where there are very few inhabitants.

V.4 Agricultural Development Plan

40. In the process of selection of crops and formulation of cropping patterns for each zone, the physical conditions, the general crop selection criteria and the current policies of the respective zones were carefully considered under the following concepts and conditions:

- Adaptability of the crops to soil and agro-climatic conditions of the area and its ability to perform optimally under irrigation;
- Expected level of technology and the experience of the farmers;
- Practically in term of the available labor force;
- Market potential and price prospect for the agricultural products;
- Optimization of the use of the supplied water resources; and
- Generation of the maximum benefits to the farmers, to the region and country.

Based on these considerations, recommended cropping patterns for the respective zone were conveniently simplified and formulated for the estimate of water demands and inputs required for and outputs derived from irrigated farming.

V.5 Irrigation and Water Demands

41. Estimate of the water demands for irrigation development was based on the meteorological information of the four representative stations of Fes (for Zone I), Sidi Jaber (for Zone II), Marrakech (for Zone III), Ouarzazate (for Zone IV) and Errachidia (for Zone V). Potential evapotranspiration was worked out by the modified Penman method. The effect of the crop characteristics on crop water requirement is given by the crop co-efficient which represents the relationship between potential and crop evapotranspiration. Effective rainfall for the respective project areas was calculated on a monthly basis.

It was assumed that the overall irrigation efficiency is 52% (conveyance efficiency: 80%, distribution and application efficiency: 65%), and that the cropping pattern proposed for each zone is applied. The water demands for the respective projects were estimated to be: 1) 745 mm/year for Zone I; 2) 825 mm/year for Zone II; 3) 946 mm/year for Zone III; 4) 1,064 mm/year for Zone IV; and 5) 1,041 mm/year for Zone V, respectively.

V.6 Flood and Sediment Control

42. The flood and sediment control study was made in line with the following:

(1) Flood mitigation function was incorporated in planning dams as much as possible, to make the project multipurpose and economical. Since the flood does not occur so often in the Study area, facilities exclusive for flood mitigation would not be economically viable in general.

(2) In order to accomplish the flood mitigation, measures other than dam should be discussed. These measures may include bank protection works and flood plain management.

(3) For reduction of the reservoir sedimentation, possible measures other than dam should be first discussed. In case a dam is proposed exclusively for sediment control purpose, the effects should be examined carefully taking into account the river system, distance form the object to be protected, etc.

V.7 Recharging of Groundwater

43. One of the most effective counter measures for the restoration of groundwater is recharging water by storing it with dams, which collect surface water in the rainy season and occasional floods. In the dry season, the stored water is released to the river so that penetrates into the underground through the pervious alluvial deposit. Such system is planned to be applied to the proposed dams located in the dry regions, such as, Igui N'ouaqa (No. 23) and Sidi Abdellah (No.25) in Taroudant, and Timkit (No. 10), Tadighoust (No. 11), Tiouzaguine (No.12) and Kheng Grou (No. 13) in Tafilalet, where very high evaporation is anticipated.

V.8 Water Balance Study

44. Based on the estimated water demand for irrigation as well as water supply, it was examined whether the extended irrigable area and the projected population to be served with the potable water exceed the capacity of respective dam storage or not. 50-year sedimentation is taken into account for estimating net reservoir capacity in this study. No maintenance flow was assumed to discharge into the downstream reach.

45. In case that frequency to match water demand in full extent was found not to satisfy the required guarantee level, irrigation area was decreased.

If such frequency was found to be high enough above the required guarantee level, irrigable area was expanded considering the restrictive conditions at each site. Scale of the respective dam was basically fixed as proposed by MOE and therefore optimization of the dam scale and the extent of beneficiaries were not made in Phase I stage study.

Dam scale, irrigation area and water supply plan reviewed by the Study are shown in tables attached in Supporting Report VII.

VI Evaluation of the Projects

VI.1 Social Aspects

46. The social aspects of the project were evaluated in view of (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. An appraisal of each project was made in view of social aspects and classified into three ranks. The dam site Nos. 4, 5, 9, 10, 17 and 25 were classified as rank A that is considered good in social aspect.

VI.2 Technical Feasibility

47. Type and height of dams proposed by DGH were examined in view of technical feasibility, especially, the topographic and geological conditions of the dam sites, and materials available in the surrounding areas, as well as the geological conditions of the reservoir, magnitude of floods and type of spillway. Likewise, technical feasibility was evaluated for irrigation development plans in view of the location of the beneficiary area, water supply method, topography and soil conditions etc. An appraisal of each project was made in view of technical feasibility and classified into three ranks. Dam site Nos. 5, 7, 8, 9, 10, 15 and 17 were classified as rank A which means the technical feasibility of the project is good with no problems in maturity in their existing plans and/or studies.

VI.3 Natural Environmental Impact

48. The level of negative impacts on natural environment for each proposed dam site was calculated and classified into three ranks. From the natural environmental point of view, dam sites listed A and B were recommended for a further study to examine feasibility of construction. The two dam site Nos. 19 and 21 listed in C are likely to cause more serious impact than the impact level predicted with the other sites. No dam sites could be found that need to have their implementation postponed.

VI.4 Social Environmental Impact

49. The dam site Nos.1, 3, and 5 (down-stream dam) rated H. These projects have a critical negative social impact and accordingly other development programs must be sought for those areas.

VI.5 Economic Viability

50. Before conducting the economic analysis, the projects were screened from the viewpoints of: 1) social aspects, 2) technical feasibility, 3) natural environmental aspect, 4) social environmental aspect, and 5) maturity in planning and/or study. Only the projects that satisfy all these aspects were subjected to economic analysis.

51. Economic analyses of the proposed projects have been conducted by cost-benefit analysis using three types of indicators, i.e. economic internal rate of return (EIRR), benefit cost ratio (B/C), and net present value (NPV).

VII Prioritization of the Projects

VII.1 Evaluation Factors

52. Dam projects that have serious problems in respect to the necessity of the dam, technical matters such as dam foundation, or natural or social environmental aspects were classified as Group D and then discarded from further classification.

53. Dam projects that fail to attain required economic viability; that is, 5% of economic internal rate of return (EIRR) were classified as Group C, then discarded from further classification. Opportunity cost in Morocco is between 8 to 10 %, however, as the economic viability of medium-scale dams are not so high, 5 % of EIRR were adopted as the minimum allowable EIRR in the Basic Study.

54. Projects that have insufficient maturity in the existing planning and/or study such as: 1) lack of information to evaluate benefit of the project, 2) necessity of further study on alternative development plan, were also classified as Group C.

55. To identify the four (4) highest priority dam projects, the projects were evaluated from 1) social aspects, 2) technical feasibility, 3) natural environmental impact, 4) social environmental impact and 5) economic viability. In order to synthesize such plural factors, a scoring system was introduced considering the character of each zone. The four (4) projects that obtain the highest total scores are classified as Group A. The others are classified as Group B.

VII.2 Results of Prioritization

56. The four projects of: 1) No.5 N'Fifikh (up-stream dam), 2) No.9 Taskourt, 3) No.10 Timkit, and 4) No.17 Azghar are categorized for Group A and are highly recommended to be realized after their feasibility is confirmed in the Feasibility Study that will be carried out in Phase II of this Study.

These four projects are considered as the most promising projects among the proposed 25 projects as they are attractive socially, technically and economically, without negative impact on natural and social environment.

57. The six projects of: 1) No.4 Ain Kwachiya, 2) No.7 Amezmiz, 3) No.8 Boulaouane, 4) No.15 Sidi Omar, 5) No.19 Aoulai, 6) No.21 Sidi El Mokhfi are categorized for Group B. These projects are recommended to be implemented next to the construction of Group A projects as they are also attractive projects without social, technical, economical and natural/social environmental problems.

58. The Study Team classified the ten projects: 1) No.11 Tadighoust, 2) No.12 Tiouzaguine, 3) No.13 Kheng Grou, 4) No.14 Adarouch, 5) No.16 Tiouine, 6) No.18 Bourkarkour, 7) No.20 Sidi Abbou, 8) No.23 Igui N'ouaqa, 9) No.24 Amont Abdelmoumen and 10) No.25 Sidi Abdellah into Group C based on the information obtained from the Phase I study. Therefore, planning of these 10 projects of Group C should be reviewed in detail. However, there is still a high possibility for these projects to be attractive projects like those of Groups A and B subject based on review results.

59. The one project of 1) No.6 Tazarane is also categorized in Group C with low economic viability. Therefore, the Study Team judges that it will be rather difficult to implement it by soft loan from a foreign country.

60. The five projects of 1) No.1 Neckor, 2) No.2 Tizimellal, 3) No.3 Ait Baddou, 4) No.5 Lower N'Fifikh and 5) No.22 N'ouantz are categorized as Group D. The Study Team cannot accept these projects in view of the project necessity, technical aspects or social environmental aspects.

PARTII FEASIBILITY STUDY

VIII Natural Conditions

VIII.1 Physiography and Geological Conditions

61. No. 5 N'Fifikh

Dam site is located almost at the border between tablelands in the Atlantic Ocean side and mountainous land. Altitude of the riverbed at the dam site is 212m, and the highest peak of river basin is a little higher than 800 m. Topographically, the catchment area is characterized by a lot of dense gullies and stream course having round hill peaks of 500 to 700 m in elevation due to erosion of old rocks over a long period of time.

Unconsolidated deposits distributing in the area are Alluvial deposits, Colluvial deposits, and Terrace deposits. Alluvial deposits consist of River deposits, Alluvial Cone deposits, and Alluvial Terrace deposits. Their composition is mainly gravel and silts. Colluvial deposits consist of the mixture of fine soil and angular rock fragments, while Terrace deposits are of mainly silty to clayey layers with some rounded gravelly layers.

No.9 Taskourt

Dam site is located on the northern slope of Haute Atlas Occidental. Altitude of the riverbed at the dam site is 943 m, and the river basin has peaks ranging over 3000 m The highest one is Jbel Igdet (3615 m).

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

No.10 Timkit

Dam site is located on the southern border of Haute Atlas Central, limited by the cliff formed by so called South Atlasic Faults. Altitude of the riverbed at the dam site is 1211 m, and the highest peak of the river basin is 2921m of Ylalla Rejdet situated notheast of the dam site.

Unconsolidated deposits in the area are Alluvial deposits, Flood deposits, Talus deposits, and Travertine. Alluvial and Flood deposits are mainly composed of sands and gravel. Bedrock around reservoir area consists of Limestone, Dolomite, and Marl of Jurassic and Cretaceous. Foundation at dam site consists of the same rocks as the above. All are Liassic formations.

No.17 Azghar

Dam site is located on the western side of Moyen Atlas whose peak altitude is more than 3000 m. Altitude of the riverbed at the dam site is 821m, and the highest peak of river basin is around 2100 m.

Unconsolidated deposits in the area are Colluvial deposits, Alluvial deposits, Terrace deposits, Travertine, and Residual soils with some wind transported soil and sheet erosion deposits.

VIII.2 Climate and Hydrology

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

General Climatic Features

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

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

63. Monthly inflows to the proposed dams were estimated based on flow records at reference stations. The average annual inflows are as shown below.

Inflow to Dam

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

(Note) *: Annual inflow including subsurface flow.

VIII.3 Soils

64. No.5 N'Fifikh

The soils of this area develop on the low and middle terraces in the large valley of the N'Fifikh River. Three types of soils lie on the area: 1) Soils developing from alluvial deposits; 2) Soils affecting isohumic condition; and 3) Soils from Vertisols.

No.9 Taskourt

There are three types of soils, consisting of: 1) Alluvial soils situated on the low terraces of the Asif El Mal river; 2) Brown calcareous soils extending in strand on the left bank of the river; and 3) Fersialitic soils occupying large surface on the left bank of the river.

No.10 Timkit

The soils of the Ifegh area are characterized by the stony and shallow soil. The Tinejdad area occupies a low alluvial terrace of the Todrha River. Soils in the Chitam area are relatively sandy. Part of the area is difficult for irrigation.

No.17 Azghar

This area is occupied by a large terrace of the Zloul River shaped in the tender schistose marls of the Jurrassique in the north edges of the Middle Atlas. Dominant soils are: 1) Isohumic red soils occupying terraces where the slope ranges between 2% and 4%; and 2) Soils facing erosion situate with relatively steep slope of 4 - 8%.

VIII.4 Natural Environment

65. Two endangered mammal species, *Felis caracal* at No.5 N'Fifikh and No.17 Azghar, and *Ammotragus levia* at No.9 Taskourt, No.10 Timkit and No.17 Azghar are distributed around the dam sites. However, mobility of those species (cat and ungulate) is quite high so that the population size is unlikely to be seriously reduced unless there is a significant loss of their habitats. Also, critical habitats of those species in the four areas have not been identified and the impact is unlikely to be significant. Similar to the status of the fauna, no endangered or rare species of plant species have been found in the areas.

IX Social Conditions

IX.1 Socioeconomic Survey

66. The Study Team conducted a socioeconomic survey in order to grasp the present condition of the people's livelihood in the beneficial areas. The survey was carried out in two ways, a group survey and a household interview survey. The group surveys were made for groups of people to be benefited by the Project for each project site. The household interview surveys were conducted using a representative sampling of villages per commune and the number of families per village.

IX.2 Population

67. Population, number of families and households in the beneficial areas of each Project sites are estimated as shown below (as of the year 2000):

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

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

IX.3 Major Economic Activities

68. Almost all the households are engaged in agriculture but many of them are also involved in other businesses as seen in the following table:

Major Economic Activities

	N'Fifikh		Taskourt		Timkit		Azghar		Total	
Major Field	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Agriculture only	33	52	28	37	15	19	19	43	95	37
Agriculture + Others	30	48	47	63	59	77	25	57	161	62
Non agricultural work	0	0	0	0	3	4	0	0	3	1

IX.4 Annual Family Income and Expenditure

69. Family budget of the households in each area largely depend on remittance from migrant workers. Approximately 40% of the family income are covered by remittance from migrant workers on average as seen in the following table.

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

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

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

IX.5 Agricultural Conditions

70. No. 5 N'Fifikh

The area is typically single cultivated area of cereals under rain-fed condition. Main cereals are soft wheat and hard wheat. Vegetables are cultivated in the irrigated areas situated near the N'Fifikh River for self-consumption and cash income. Present land occupancy of crops in the area is as follows (fallow or open Land = 9% and irrigated ratio = 3%):

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

No. 9 Taskourt

The area is located at the typical agricultural zone in the southeast Moroccan climate, which is relatively warm and low in precipitation. Main cereals consist of barley and soft wheat. Fodder cultivation (alfalfa) is practiced along the Assif El Mar River. Fruits including olive and almond are commonly cultivated. Present land occupancy of crops in this area is as follows (fallow or open land = 4% and irrigated ratio = 32% with permanent, seasonal and flood irrigation):

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

No. 10 Timkit

In this area, typical oasis agriculture (high temperature and no precipitation) is practiced by small landholders. Main crops are cereals (hard wheat), fodder (alfalfa) and fruits (dates and olive). Vegetable cultivation is also commonly practiced. Main vegetables are melons, tomatoes and potatoes. Present land occupancy of crops in this area is as follows (fallow or open land = 4% and irrigated ratio = 95%):

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

No. 17 Azghar

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

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

IX.6 Irrigation and Water Rights

71. No. 5 N'Fifikh

The diversion structures and channels are severely deteriorated and damaged, and none of them are functioning at present. Along the Daliya River, irrigation is practiced for only twenty to thirty hectares by pumping up river water and groundwater. Regarding the water right, several persons have applied for it in the past, nonetheless most of them were rejected due to insufficient qualification.

No. 9 Taskourt

In the area, the network of irrigation channels originating from the Assif El Mar consists of 18 principal irrigation channels of traditional type. Surface irrigation is predominant such as furrow, border and basin irrigation. When the river water is scarce, the enjoyment of the water rights is generally made according to the priority of the upstream on the downstream.

Distribution of water from the river to the channels, and from the channels to the villages is made based on the water rights. Irrigation water is managed by the agricultural water users' association (AUEA).

No. 10 Timkit

In the area, floods from the Tanguerfa and the Todrha rivers are conveyed to the field. Volume of floods to be conveyed to these areas is more or less proportional to acreage. Irrigation in this area is practiced by means of border method using surface and groundwater. Irrigation water is in this area is managed by AUEA.

It should be noted that the prefectural commission in charge of water right authorization (groundwater) suspended any requests in this zone until existing situation is improved.

No. 17 Azghar

In the area, no irrigation channel diverted from the Wad Zloul. However, pump-up irrigation is practiced at seven locations. Drip irrigation for tree crops is predominant in this area. Water right to use river water to irrigate these areas is authorized. There is no AUEA in this area, therefore river and well water is managed on an individual basis.

IX.7 Agricultural Extension and Supporting Services

72. Extension System

The grass-level agricultural and livestock extension services are rendered by the Work Centers (CTs) and CMVs for the four areas. In N'fifikh, Taskourt, and Azghar, CTs under DPAs are responsible and in Timkit CMVs under ORMVA are responsible for the grass level extension activities. Subcenters staffed by technicians provide extension services. According to the local needs, several approaches are used for extension purposes i.e., close contact extension program, mobile team extension program, individual extension program for specialized farmers, large scale and mass extension program, observation program etc. Farm households per extension worker vary between 400 and 2100 households.

73. Agricultural Marketing

(1) Marketing of Agricultural Products

The major destination of the agricultural products in the four areas is local weekly markets called Souks. The Souks are retail markets. The area of the Souks varies between 2 ha and 8 ha . Either farmers themselves bring the commodities to the market and sell it to the retailers or retailers/jobbers go to the farmers or big markets in town to procure and sell it in retail. Every retailers i.e. traders pay taxes to the local government, occupy the space and sell the commodities.

(2) Marketing of Agricultural Inputs

Farmers of the four areas procure agricultural inputs from the sales points of CT or CMV. Chemical fertilizers and traditional seeds are also available in weekly markets (Souks) or private shops, but certified seeds are only available in the sales points of CT, CMV or SONACOS. About 95% of the farmers of N'Fifikh buy agricultural inputs from private traders rather than from the sales points of CT.

74. Agricultural Credit

The main sources of agricultural credit in the four areas are CLCA and CRCA. Farmers must own land to be eligible for a loan. The amount of loan is determined according to the value of land.

75. Cooperatives and Farmers' Organizations

At present there are several cooperatives and farmers' associations, however those cooperatives or associations include only a small number of farmers, and their activities are confined to only a few activities such as water use, milk collection and marketing and sheep breeding etc.

IX.8 Rural Water Supply

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

N'Fifikh (No. 5)

The local population in and around the irrigation area depends on wells or springs for drinking water supply. In some locations, there exist problems of salinity or scarcity of water quantity.

Taskourt (No. 9)

The local population depends on wells, springs or "Mattfias" (storage tank) for drinking water. As a rule, "Mattfias" is used to store surface water in the river taken through "Seguia" (canal). Quality of water taken from springs or wells are comparatively better, but water from "Mattfias" is regarded as one of the causes for water-borne disease occurrence.

Timkit (No. 10)

Immediately downstream of the dam (Ifegh village), there is a water supply system that is managed by a villager's association, provided with a distribution tank, pipes and house connection facilities.

Tinejdad, the municipality that is located downstream of the dam, is served by the ONEP's water supply system (Goulmima-Tinejdad) of which source are three drilled wells.

Some local population in villages around Tinejdad currently depends on "Khettara" (traditional water supply system).

Azghar (No. 17)

Ribat El Kheir, the nearest municipality from the dam, is served by the ONEP's water supply system of which source are two wells. The local population in the irrigation area currently depends on springs and wells. At the most downstream irrigation area (Mghila village), there exists a water supply system that is managed by the Ouled Mkoudou commune.

IX.9 Rural Electrification

77. Among the four projects, the Taskourt and Azghar dams are selected for the study of power generation, because of their rather ample water resources with respect to annual inflow and storage volume.

It is understood that there exist concrete programs for rural electrification by the National Office of Electricity (ONE) to extend its 22 kV distribution lines around the sites of the Taskourt and Azghar dams in the framework of PERG.

Taskourt (No. 9)

Villages downstream of the dam, and upstream of the reservoir are already connected to the grid. ONE is implementing PERG2 (2000-2002) to electrify major villages in irrigation areas in Assif El Mal commune.

Villages in Assif El Mal commune and the reservoir area in Adassil commune are also to be electrified in PERG3 (2002-2004).

Azghar (No. 17)

Villages located around Ribat Al Khayr are already electrified. ONE is implementing PERG2 (2000-2002) to electrify villages in irrigation area. Villages upstream of the reservoir or outside of the irrigation area is also programmed to be electrified in PERG 4 and 5.

X Social Environmental Conditions

X.1 Socio-demographic

78. The education level in the four sites is low for both men and women. Literacy of the men is low and the women are illiterate. This low literacy rate is not conducive to empowering the populations to quickly to take care of themselves during the resettlement process. Access to health services is possible only in emergency cases.

X.2 Social Organization

79. Timkit has the most organized population where the traditional association (e.g, Jamaa Soulalia: inherited group) exits. The group settles the conflicts among people and seeks to develop relations with other communities. In Taskourt some individuals (as assaîs Fakih) possess the moral power amongst the population and therefore can organize people. These types of social cohesion can be supportive to facilitate resettlement plans. N'Fifikh and Azghar are not socially organized.

X.3 Women Conditions

80. The women participate in all the activities without any decisional role. Their practical conditions are very unfavorable and do not insure comfort. They don't take any advantage of the strategic conditions of Moroccan women. This situation is the result of the isolation of the sites, the general illiteracy of women, the willingness of men and resignation of women to maintain their position, considering respect of customs and traditions.

X.4 Perception of Populations:

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

XI. Development Plan of the Priority Projects

XI.1 Significance of PMH

82. According to the action plan concerning the rural development and irrigation in Five Year National Development Plan, new irrigation development of 33,850 ha are proposed to be conducted under small and medium irrigation perimeters (PMH), and an integrated rehabilitation program involving an area of 105,10000 ha of PMH is scheduled to be implemented.

83. PMH has a great potential for perennial irrigation. It accounts for 38% of perennial irrigation potential and mobilizes 35 to 40% of water resources of the country. They are scattered all over the country and developed by mobilizing water resources. From the viewpoint of social equity in terms of its investment and distribution, PMH irrigation can take advantage of consented investments by the Government.

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

XI.2 Alternative Studies for Irrigation Scheme of Each Project

85. In order to examine the irrigation extent and economic feasibility of the respective projects, alternative studies were conducted for the following 14 cases.

No.5 N'Fifikh Upstream

Four cases of the alternative study were carried out in the area. They consist of 1) gravity irrigation for the cropping pattern proposed by the JICA Study Team (NU1), 2) gravity irrigation for the existing cropping pattern (NU2), 3) gravity irrigation for the cropping pattern proposed by the DPA Ben Slimane (NU3), 4) mechanical irrigation for the cropping pattern proposed 1) above (NU4), and 5) gravity irrigation for the cropping pattern proposed 1) above at the highland areas located in the left bank of the N'Fifikh river (about 100 high) (NU5).

No.5 N'Fifikh Downstream

Two alternative studies were conducted in the area. They consist of 6) mechanical irrigation for the cropping pattern proposed by the JICA Study Team by lifting water directly from the N'Fifikh river (DN1), 7) and mechanical irrigation for the cropping pattern proposed 6) above by lifting water from a dam/reservoir to be constructed at N'Fifikh river near Rahal (DN2).

No. 9 Taskourt

Two alternative studies were conducted in the area. They consist of 8) gravity irrigation for the cropping pattern proposed by the JICA Study Team through the dam with a capacity of 34 Mm^3 (TA1), and 9) mechanical irrigation for the cropping pattern and through the same dam capacity proposed 8) above (AT2). In addition, two cases with a dam capacity of 24 Mm^3, consisting of 10) gravity irrigation for the cropping pattern proposed 8) above (AT3), and 11) mechanical irrigation for the cropping pattern 8) above (AT4).

No.10 Timkit

Two alternative studies were conducted in the area. They consist of 12) gravity irrigation by means of surface water from the Timkit dam and subsurface water recharged with floods through pump wells except the Ifegh area where is irrigated by surface water (Alternative TI1), and 13) gravity irrigation by means of subsurface water recharged with floods through pump wells except the Ifegh area where is irrigated by surface water (Alternative TI2). In case of both alternatives, cropping pattern are proposed by the JICA Study Team.

No.17 Azghar

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

XI.3 Agricultural Development Plan

86. Agricultural development plan is formulated in consideration of the present land use, actual farming practices, intentions of local authorities and farmers, and the strategies of the Government. The development plan has to contribute to the improvement of farmers' living condition and be appropriate and sustainable.

87. Selection of crops for adopting the proposed cropping patterns is made in due consideration of the present cultivated crops, agro-meteorological condition, technical level of farmers and social conditions of each project area. As principals of selection of crops, cereals, fodder, legumes, vegetables and fruits (tree crops) were considered.

XI.4 Irrigation Water Demand

88. Estimate of the water demand with project is based on the meteorological information of five stations of Fes (for Zone I), Marrakech and data on temperature recorded at the Sidi Jaber Station (for Zone II), Marrakech (for Zone III), Ouarzazate (for Zone IV) and Errachidia (for Zone V). Reference crop evapotranspiration (ET0) was worked out by the modified Penman method.

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

89. The project water requirements for the proposed cropping pattern by means of gravity irrigation for the four priority areas were calculated to examine the irrigation extent as well as economic feasibility.

No. 5 N'Fifikh (Gravity irrigation, Alternative NU3): 853.2 mm/year in case that dependable rainfall is 80%, and 653.7mm/year in case of 20% dependable rainfall.

No.9 Taskourt (Gravity irrigation through the dam with a capacity of 24 Mm3, Alternative TA3): 964.1 mm/year in case that dependable rainfall is 80%, and 794.0 mm/year in case that the dependable rainfall is 20%.

No.10 Timkit (Gravity irrigation by means of surface water from the Timkit dam and subsurface water recharged with floods, Alternative TI1): 1,121.2 mm/year for the Ifegh area, 915.6 mm/year for the Tinejdad area and 784.1 mm/year for the Chitam area.

No.17 Azghar (Gravity irrigation, Alternative AZ1): 730.4 mm/year in case that dependable rainfall is 80%, and 546.2 mm/year in case of 20% dependable rainfall.

XI.5 Agricultural Water Users' Association (AUEA)

90. The farmers in small and medium scale irrigation areas (PMH perimeters) were engaged in implementing irrigation facilities depending on their own experiences and know-how. Such traditional association was changed to Association of Jury by the promulgated law n^{o} 02-84 (May 13th, 1992).

This organization allows a wide partnership covering potentially all fields of creation and management of the perimeters.

In this regard, it is necessary to re-organize the existing AUEA for the projects of No.9 Taskourt and No.10 Timkit and to newly establish AUEA for the projects of No.5 N'Fifikh and No.17 Azghar in accordance with Law n^{o} 02-84.

XI.6 Recharging of Groundwater (in case Option TI1 in clause 95 of this Executive Summary)

91. For the Timkit basin (Refer to Fig. S3), it is recommended that 1.12 Mm^3 (80% of annual mean inflow to the basin excluding regulated water by Timkit dam) is to be exploited annually in the irrigation area by 7 wells of 30 liter/sec capacity with 4 hours operation a day in average.

It is allowed to maintain water exploitation at current level in the outside of the irrigation area.

92. For the Todrah basins (Refer to Fig. S3), it is recommended to restrict groundwater exploitation in the outside of the irrigation area to 50% of the year 2000 level.

In the irrigation area, 11.17 Mm^3 (80% of annual mean inflow to the basin excluding regulated water by Timkit dam) is to be exploited annually by 30 wells of 30 liters/sec capacity with 9 hours operation per day in average. In case of drought with 5-year probability, however, the water intake from the wells in the irrigation areas is to be reduced to 5.58 Mm^3 (50% of 11.17 Mm^3).

XI.7 Rural Water Supply

93. Small-scale water supply system is planned, utilizing water from dam conveyed through irrigation canal or river as its source. To secure its quality for drinking purpose, water purification by slow sand filter with settling tank and primary filtration (coarse filtration) will be adopted. Serious problem in water quality or quantity is recognized for the existing water source.

No.5 N'Fifikh

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

No. 9 Taskourt

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

XI.8 Water Balance Study

94. Duration of simultaneous calculation is taken as long as possible, in so far as the monthly inflow data are available. 50-year sedimentation volume is taken as dead storage volume for the N'Fifikh, Taskourt and Azghar dams. Meanwhile 20-year sedimentation volume is applied for the Timkit dam to avoid water loss due to excessive evaporation from reservoir surface. Criteria for supply guarantee for irrigation are set as follows, according to the common practice in Morocco:

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

XI.9 Determination of the Project Scale

95. No. 5 N'Fifikh

As a result of economic evaluation, Alternative NU3 brings the highest economic internal rate of return, accordingly suggested as the definitive plan. With cropping pattern that enhances vegetable cultivation, net irrigation area is calculated at 590 ha, and annual average irrigable area is 645 ha. Development scale of the irrigation facilities (Gross Area) is set as 1,000 ha.

No.9 Taskourt

Alternative TA1 and TA3 bring the highest economic internal rate of return. Considering the DGH's policy to implement the Taskourt dam as a medium-scale dam, and advantage to mitigate negative effect due to inundation, Alternative TA3 is suggested as the definitive plan. Net irrigation area is calculated at 2,500 ha and annual average irrigable area is 2,713 ha. Development scale of the irrigation facilities (Gross Area) is set as 4,500 ha.

No.10 Timkit

As a result of economic evaluation, Alternative TA1 brings the highest economic internal rate of return, therefore it is suggested as the definitive plan. Net irrigation area is calculated at 1,350 ha and annual average irrigable area is 1,690 ha. Development scale of the irrigation facilities (Gross Area) is set as 3,060 ha.

No.17 Azghar

Development scale of the irrigation facility area is set at 2,000ha, that is, the maximum limit from the topographic condition. The dam scale is fixed so as to provide the required regulated volume for this irrigation area. According to economic evaluation, this project scale brings high economic viability even if the negative impact on the existing Idriss 1ER dam in the downstream is also considered. Therefore, this scale is suggested as the definitive plan.

XII Environmental Impact and Resettlement Plan

XII.1 Natural Environment

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

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

XII.2 Social Environment and Resettlement Plans

97. In all the proposed projects, social incomes are very limited by the existing agricultural and breeding activities. These incomes are not viable enough for the local people in the sites under the existing natural and social conditions.

In order to identity the new resettlement areas, evaluation was made for the assets and number of families in the existing dam sites. According to the hearing survey at 4 dam sites, it can be said that if proper compensation would be made, people in the submerged areas would cooperate with dam constructions.

XIII Preliminary Design and Project Cost Estimates

XIII.1 Preliminary Design

98. No. 5 N'Fifikh

The dam site is located in the hilly area, 25 km southwest from Ben Slimene.The site was selected at just the upstream side of the narrow valley on the Daliya River where both abutments become closer. Many out-crop of quartzite, which is hard rocks are observed at both abutments and they run across the site with narrow width. However both upstream and downstream sides of the quartzite are deteriorated by faults. In order to avoid this, the dam axis is shifted to somewhat upstream side where impervious embankment may not be placed on the quartzite layer. In this case the foundation of the dam body is rather soft rock of weathered sandstone and pelite stone. This foundation rock may not have sufficient bearing capacity for a concrete gravity type dam. Accordingly, a fill type dam that can apply to these soft foundation is selected at this site. Principal features of the proposed dam are as follows:

Type of dam;	Center-cored rock fill
Elevation of dam crest;	EL 251.50 m
Elevation of dam foundation;	EL 204.00 m
Dam height;	47.50 m
Length of dam crest;	325.00 m

Irrigation facilities area (Upstream) is 1,000 ha (net).

No. 9 Taskourt

The dam site is located on the valley of the skirt of the High Atlas Mountains, about 70 km southwest from Marrakech. The site is selected on the Asif el Mal River at just downstream of the Taskourt village, where an efficient reservoir can be planned. Both the right and left abutments are rather steep slopes and the riverbed is narrow. The foot of left abutment is high upright slope where a mass of foundation rock is exposed widely. On the contrary, the right abutment has less exposure of rocks.

It is mostly covered with shallow talus deposits. Depth to reach foundation rock is shallow on both abutments. Judging from these geological condition, topography and scale of dam, it is recommended the dam should be a concrete gravity type. However, it is anticipated that the right abutment may possibly be covered with thickly fractured and weathered rocks beneath the talus deposits because of faults running across the right abutment. Principal features of the proposed dam are as follows:

Type of dam;	Concrete gravity by RCC
Elevation of dam crest;	EL 1,000.50 m
Elevation of dam foundation;	EL 927.00 m
Dam height;	73.50 m
Length of dam crest;	225.00 m

Irrigation facilities area is 4,500 ha (net).

No. 10 Timkit

The dam site is located on the Ifegh River in the mountain range 25 km northwest from Tinejdad. The dam site is selected in the downstream end of a series of gorges with very steep slope in the left abutment and moderately steep slope in the right abutment. The geology of this area mainly consists of limestone. However, clayey limestone layers that make wide impervious planes exist in the foundation of the dam. Strike of the planes is parallel with the dam axis dipping 20 to 30 degrees being declined to upstream. The dam axis should be properly selected so that the dam body could be connected with the impervious planes by grouting work. The base of dam body mostly sits on pervious limestone layer. As limestone itself is hard rock foundation, it could bear the load from both a concrete gravity dam and fill dam. In case of fill type dam, erosion and piping in the embankment, which may lead to fatal damage of dam, is anticipated. Accordingly a concrete gravity dam that is highly resistant to such erosion is selected for this dam site. Principal features of the proposed dam are as follows:

Type of dam;	Concrete gravity by RCC
Elevation of dam crest;	EL 1,259.50 m
Elevation of dam foundation;	EL 1,195.00 m
Dam height;	64.50 m
Length of dam crest;	210.00 m

Irrigation facilities area is 3,060 ha (net).

No. 17 Azghar

The dam site is located on the Zloul river in the hilly area, 7 km east from Ribat Al Khayre that is around 50 km eastward from Sefrou. A mountain range closes to the upstream end of the irrigation service area.

The valley in the mountain range carved by the Zloul River is the dam site. Geology of the dam site is blackish marl. Hard foundation rocks of the marl expose on the riverbed and on the slopes of both abutments. Lots of bedding stratification are observed in the marl, but their contacts are firm. Accordingly the foundation will bear both types of gravity dam and fill dam. Construction materials for the both dams could be obtained near the dam site. In order to select the dam type, fill type dam with center-core and concrete gravity type dam to be constructed by RCC are compared. From the result of the comparison study, the construction cost of the center-cored fill dam is cheaper by about 30 % than RCC, so a fill type dam for this site is recommendable. Principal features of the proposed dam are:

Type of dam;	Center-cored rock fill
Elevation of dam crest;	EL 859.50 m
Elevation of dam foundation;	EL 817.00 m
Dam height;	42.50 m
Length of dam crest;	325.00 m

Irrigation facilities area is 2,000 ha (net).

XIII.2 Project Cost

99. Project costs are estimated, including construction cost, resettlement cost, engineering
service cost, administration cost, physical contingency, price contingency, and value added tax based on the following conditions and assumptions:

1) The costs are estimated at the price level of April 2000.
2) The exchange rate used in the estimate is shown as below:
   US$1.00=DH10.68, JYen100=DH9.90
3) The construction costs are estimated based on the unit cost, which has been cautiously fixed considering the prices used in actual bidding.
4) Resettlement cost has been estimated on preliminary basis and it includes compensation for properties, compensation for earning shortage, and expenses for monitoring and guidance. The cost does not include the cost for infrastructure and public utilities at resettlement location.
5) Engineering service cost is estimated at 7% of the total costs of construction works.
6) Administration cost is assumed at 5% of the total costs of construction works and resettlement.
7) Physical contingency is assumed to be 10% of the total costs of construction works, resettlement, engineering services, and administration.
8) Price contingency is assumed to be 3% per annum for both foreign and local currency portions of all the costs.
9) Value added tax is calculated at 20% of the engineering service cost and 14% of all the other costs.

The estimated project costs are presented in Table S6 and summarized below:

Project Cost Unit: Million DH

Cost Item	N'Fifikh	Taskourt	Timkit	Azghar	Total
1. Construction cost	181.0	409.5	274.6	185.8	1,050.9
1.1 Dam and appurtenant facilities	143.1	275.4	162.3	112.5	693.3
1.2 Irrigation facilities	36.5	131.7	112.3	73.3	353.8
1.3 Water supply system	1.4	2.4	-	-	3.8
2. Resettlement cost	3.3	28.5	6.4	5.1	43.3
3. Engineering service cost	12.7	28.7	19.2	13.0	73.6
4. Administration cost	9.2	21.9	14.0	9.5	54.6
5. Physical contingency	20.7	48.9	31.4	21.3	122.3
Sub-total (1.- 5.)	226.9	537.5	345.6	234.7	1,344.7
6. Price contingency	44.3	101.0	77.5	46.3	269.1
Sub-total (1.- 6.)	271.2	638.5	423.1	281.0	1,613.8
7. Value added tax	38.9	91.6	60.8	40.4	231.7
Total (1.- 7.)	310.1	730.1	483.9	321.4	1,845.5

The annual disbursement schedule of the project costs is shown in Table S7.

XIV Economic and Financial Evaluation

XIV.1 Economic Analysis

100. The economic analyses of the projects have been conducted for both the cases of with and without the indirect benefit (economically induced benefit). The results are summarized below (it should be noted that DGH studied the economic analysis for the large-scale dams for both the cases of with and without the indirect benefit, and the JICA Study followed the analysis procedures):

Results of Economic Analysis

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

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

As a result of the economic analyses with the indirect benefit, all the projects show favarable economic efficiency with EIRR of more then 10%. The overall plan also has a favorable result with EIRR of 12% and NPV of 332 million DH. From the results, it can be judged that all the priority projects are economically feasible.

XIV.2 Financial Analysis

101. For evaluation of the project feasibility from the financial aspect of farmers, typical farm budget analyses are made classifying the farmers into three groups by size of farming. The results are summarized below:

Capacity to Pay

Project	Item	Scale of farming		
		Small	Medium	Large
N'Fifikh	1) Average size of farmland (ha)	0.9	2.4	14.6
	2) Capacity to pay (DH)	17,829	58,961	394,285
	3) Average annual water charge (DH/household)	2,791	7,442	45,271
	4) Ratio to the average capacity to pay	16%	13%	11%
Taskourt	1) Average size of farmland (ha)	0.8	2.6	11.3
	2) Capacity to pay (DH)	16,241	63,746	293,463
	3) Average annual water charge (DH/household)	2,094	6,804	29,572
	4) Ratio to the average capacity to pay	13%	11%	10%
Timkit	1) Average size of farmland (ha)	0.4	2.2	8.9
	2) Capacity to pay (DH)	6,225	59,005	251,614
	3) Average annual water charge (DH/household)	1,467	8,071	32,651
	4) Ratio to the average capacity to pay	24%	14%	13%
Azghar	1) Average size of farmland (ha)	0.8	2.5	10
	2) Capacity to pay (DH)	20,265	74,015	317,810
	3) Average annual water charge (DH/household)	1,600	5,000	20,000
	4) Ratio to the average capacity to pay	8%	7%	6%

The water charge, which covers the O&M and replacement costs of the irrigation facilities, will not place a heavy economic burden on the rural farmers in the project sites.

On the other hand, the repayment capability for the capital cost of the projects has been examined on a preliminaly basis. For the examination, the financial cash flow statements using the anticipated project revenue and fund requirement is prepared as shown in Table S8 based on the following conditions:

- 75% of the capital costs are financed by bilateral or international organization as far as the costs are not non-eligible items. The non-eligible items are costs for land acquisition, house compensation, administration, and any types of taxes and duties.

- The assumed condition of finance is with an interest rate of 2.2% per annum for a repayment period of 30 years including a grace period of 10 years.

The annual required fund for implementation of the projects and repayment of loan is moderate and if a soft loan is available, it will not be a heavy burden on the Moroccan Government.

XV Conclusions and Recommendations

XV.1 Conclusions

102. Among the proposed 25 dam projects for medium-scale dams for water resources development in the rural areas in Morocco, prioritization of these dams has been made from different levels and dams were grouped according to their priority into four groups namely, A, B, C, and D as shown in Section VII.2 of this Executive Summary. As a result, four projects of: 1) No.5 Upper N'Fifikh, 2) No.9 Taskourt, 3) No.10 Timkit, and 4) No.17 Azghar for group A were selected for further Feasibility Study.

103. The development plan, and the preliminary design and project cost estimate for these four priority projects are described in VIII to XIII of the Part II Feasibility Study of this Executive Summary.

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

The rural areas where these projects are located have annual mean rainfall ranging from 190 to 450 mm, being extremely low and are much devastated mountainous ones. Further, there are not usually available discharges in the rivers then for people to maintain their living in the rural areas, water resources developments by medium-scale dam construction to regulate and use floods occurring few times annually are very necessary.

Also, as under groundwater resources are scarce or almost exhausted in the rural areas and water transfers from other basins are not realistic, ensuring water resources by medium-scale dam construction are very important.

In this regard, the JICA Study Team proposed to formulate these four projects in the Group A projects as follows:

No.5 N'Fifikh

This project should be implemented mainly as an alternative plan for the devastated vegetable fields located at suburbs of big cities such as Casablanca and Rabat. The main components to be constructed are dam facilities, irrigation facilities, domestic water supply systems, etc. as shown in Tables S1 and S2, and Figure S6.

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

No.9 Taskourt

The main purposes of this project are the development of large-scale irrigation to the existing farmlands located about 30km downstream of the proposed dam considering possibility of the improvement of the social environment for about 1,000 inhabitants living in the anticipated reservoir area by means of settlement into a new living area. The main components to be constructed are a dam, rehabilitation of existing irrigation facilities, domestic water supply systems and social infrastructures in new settlement areas for the inhabitants in the reservoir, etc. as shown in Tables S1and S3, and Figure S7.

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

No.10 Timkit

The main purpose of this dam is irrigation to three existing oases. The beneficiary areas of this project are located immediately downstream, and about 30km and 40km downstream of the proposed dam, which will contribute to preventing expansion of the Sahara desert to the north. The main components to be constructed are dam facilities, and rehabilitation of existing irrigation facilities. as shown in Table S4 and Figure S8.

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

No.17 Azghar

This project should be implemented mainly for the development of medium-scale irrigation to the existing farmland, just downstream of the proposed dam. The main components to be constructed are dam facilities and irrigation facilities, as shown in Table S5 and Figure S9.

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

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

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

Social impact due to the implementation of the four priority projects and resettlement plan of inhabitants living in the proposed reservoir which are prepared by the JICA Study Team are described in clause 8.7.2 of Volume II Main Report. In particular, in case of Taskourt, although more or less 1,000 inhabitants are forced to be resettled for the dam construction, according to hearing by the JICA Study Team, they will cooperate with dam construction if they receive proper monetary compensation. Inhabitants living in proposed reservoir area have been maintaining a nomadic life until now and are not seemingly particular about their ancestral lands. This situation is the same for the other three projects.

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

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

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

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

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

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

106. These projects are justified from the economic and financial viewpoint as stated in Section XIV of this Executive Summary.

The water charge, which covers the O&M and replacement costs of the irrigation facilities, will not place a heavy economic burden on the rural farmers in the project sites. Meanwhile, the annual required fund for implementation of the whole projects and repayment of loan is approximately 100 to 150 million DH as shown in Table S8. If a soft loan is available, the implementation of the projects and the repayment of the loan will not be a heavy burden on the Government.

XV.2 Recommendations

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

Overall implementation schedule of priority projects and other medium-scale dam projects to be newly identified by the Moroccan government under the long-term water resources development plan until the target year 2020 is proposed as shown in Figure S10.

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

108. Project cost for the four priority projects and the annual disbursement schedules are shown in Tables S6 and S7.

As described in Section XIV.1 of this Executive Summary, economic viability by the direct benefit for the medium-scale dam projects are generally not so high, so the financial plan for each project is rather difficult to establish. It is, however, possible to justify the projects considering the indirect benefit such as the economically induced benefit or in view of the social aspects, which are above all the most serious matters in Morocco. Accordingly, soft loan with low interest and long repayment period from international financing agencies such as JBIC is very necessary.

109. According to present organization of the Government, the implementation agency for medium-scale dam project is DGH, the hydraulic sector of MOE. It is responsible for dam components, and other ministries or agencies are independently responsible for water usage components downstream. For example, MOA is responsible for irrigation component and ONEP for the component of the potable water supply, and so on.

For the smooth promotion and implementation of the medium-scale dam projects, a permanent and unified implementation committee chaired by DGH and comprised of the government staff dispatched from the related ministries and agencies should be established in the central government.

In addition, for the smooth implementation of the Projects, the Government should establish a Project Implementation Office (PIO) under the administrative agency for each hydraulic region to be established by the central government consisting of the Government Agencies concerned. General Directorate of Hydraulics, Ministry of Equipment would be the secretary of PIO and take overall responsibility for the implementation of the Projects. The PIO organization chart is shown in Figure S11.

110. As described in Section XII.1 of this Executive Summary, establishment of Environmental Management Plan (EMP) is the most important practice as a long-term mitigation of the environmental impacts. Establishment of Environmental Management Unit (EMU), development of tree planting program as a counter measure for erosion problem, and involvement of the Ministry of Forestry into such tree planting program should be also forwarded.

111. These days resettlement due to dam construction is a major issue not only in Japan but also in other countries. So the Moroccan government is strongly requested to make proper action on land acquisition including resettlement issues for these four priority projects by means of both monetary compensation under the current law for the land acquisition in Morocco and compensation of new resettlement area using collective lands. Further study on land acquisition planning should be forwarded based on the following options suggested in this Study.

No. 5 N'Fifikh (38 families, 187 persons)

- Resettlement to downstream irrigation area

No.9 Taskourt (205 families, 1,014 persons)

- Resettlement to upper hill of left bank of reservoir (Aazib) and downstream irrigation area

No.10 Timkit (64 families, 342 persons)

- Resettlement to downstream irrigation area (Ifegh)

No.17 Azghar (10 families, 42 persons)

- Monetary compensation under the current law for land acquisition in Morocco

112. Terms of references for the detailed design of the 4 priority projects, which should be conducted after this Study, are described in clause 11.2 of Volume II Main Report. In particular, prior to commencement of the detailed design for the irrigation facilities of these projects, water management study should be made considering existing water rights, existing water distribution system, and land consolidation to be made in future.

Tables

Table S1: Preliminary Project Features of Small-scale Water Supply System

Item	Unit	N'Fifikh	Taskourt		
Village		Tlet Ziaida	Dar Akimakh	Tamatoust	Tiguemi Oumrhar
Commune		Ziaida	Assif El Mal	Mzouda	Mzouda
Population	person				
1994		824	575	549	539
2000		1120	760	(292)	552
2020		1300	900	700	700
Consumption					
Daily	m^3/day	26	18	14	14
Annual	m^3/year	9,490	6,570	5,110	5,110
Water Source		N'Fifikh River	Seguia Tadraouit	Seguia Tamatoust	Seguia Taourdast
Reservoir Volume	m^3	26	18	14	14
Number of Stand Pipes	nos	4	3	3	3
Project Cost	mil DH	1.80	1.20	0.90	0.90

Table S2: Principal Features of No.5 N'Fifikh

Description			Remark
A. Dam			
1 General			
Province		Ben Slimane	
River		Oued Daliya	
Coordinate of dam site	Xl1	345,640	Location: direct distance 25km from Ben Slimane
	Yl1	311,800	
	Xr2	345,700	
	Yr2	312,200	
2 Hydrology			
Catchment area	km2	323.00	
Annual mean rainfall	mm	323.00	
Annual mean run-off	Mm3	13.32	
3 Reservoir			
Gross storage	m3	19,200,000.00	
Effective storage	m3	17,700,000.00	
Dead storage	m3	1,500,000.00	30,000m3/yr. x 50yrs
Reservoir surface area	ha	173.60	
Elevation of flood water level (FWL)	m	248.64	Hd=3.64m
Elevation of normal water level (NWL)	m	245.00	
Elevation of low water level (LWL)	m	225.50	
4 Dam Body			
Geology of foundation		Alternation of sandstone & Pelitic stone (Devonian to Carboniferous)	
Type of dam		Center-cored rock fill	
Elevation of dam crest	EL	251.50	Freeboard above FWL 2.86
Elevation of dam foundation	EL	204.00	above NWL 6.50
Height from proposed foundation	m	47.50	
Length of dam crest	m	325.00	
Upstream slope		1:2.50	
Downstream slope		1:2.00	
Width of dam crest	m	6.00	
Seismic intensity		0.10	(100yr.acceleration=42gal)
Embankment quantity (total)	m3	678,400.00	
Core	m3	142,500.00	
Filter & drain + Gravel, rock	m3	515,600.00	
Rip rap	m3	20,300.00	
5 Spillway			
Location		Right bank	
Geology of foundation		Sandstone & Pelitic stone of CL-CM	
Design inflow discharge (10,000yr)	m3/s	1,800.00	
Design outflow discharge(10,000yr)	m3/s	1,668.00	
Type of weir		Non gated side channal	
Weir length /width		120m x 25m	
Design overflow depth	m	3.64	
Type of stilling basin		Hydraulic jump type	
6 Intake/Outlet			
Type		Inclined conduit	
		D600mm slide gate x 2	
Intake location		Left bank	
Capacity	m3/s	1.61	
Outlet pipe		D1000mm x 270m	
Discharge control valve		D1000mmJFG	
Raw water facilities		D300mm pipe and D300 sluice valve	
7 Diversion			
Type		Cofferdam/Culvert	
Design inflow discharge(20yr/50yr)	m3/s	250.0/380.0	
Design outflow discharge(20yr/50yr)	m3/s	236.1/271.0	
Cofferdam crest elevation	m	226.50	
Upstream water level(20yr/50yr)	m	221.1/226.2	
Culvert location		Left abutment	
Culvert section/length		5m x 5m / 300m	
8 Dam Construction Cost			
1.Direct cost			
1.1 Diversion works	MDH	18.07	
1.2 Foundation excavation	MDH	7.65	
1.3 Foundation treatment	MDH	3.56	
1.4 Dam embankment	MDH	11.56	
1.5 Spill way	MDH	70.49	
1.6 Intake works	MDH	3.66	
1.7 Gate and pipe	MDH	8.56	
1.8Overhed and profit of contractor	MDH	19.60	
Sub-total	MDH	143.15	
2.Physical contingency	MDH	14.32	
3.Price contingency	MDH	36.20	
Total	MDH	193.67	
4.Value added tax(14%)	MDH	27.11	
Ground total	MDH	220.70	325 DH/m3
B. Irrigation			
9 Service Area			
Service area (Net)	ha	1,000.00	
10 Irrigation Construction Cost			
1.Direct cost			
1.1 Main canal	MDH	12.82	
1.2 Structures	MDH	21.29	
1.3Overhed and profit of contractor	MDH	2.39	
Sub-total	MDH	36.50	
2.Physical contingency	MDH	3.65	
3.Price contingency	MDH	9.23	
Total	MDH	49.38	
4.Value added tax(14%)	MDH	6.91	
Ground total	MDH	56.30	56,300 DH/ha

Table S3: Principal Features of No.9 Taskourt

Description			Remark
A. Dam			
1 General			
Province		Marrakech	
River		Oued Al Mal	
Coordinate of dam site	Xl1	206,800.00	Location: sidi Bou Othmane
	Yl1	69,900.00	
	Xr2	206,900.00	
	Yr2	69,600.00	
2 Hydrology			
Catchment area	km2	419.00	
Annual mean rainfall	mm	366.00	
Annual mean run-off	Mm3	44.65	
3 Reservoir			
Gross storage	m3	25,100,000.00	
Effective storage	m3	19,100,000.00	
Dead storage	m3	6,000,000.00	120,000m3/yr. x 50yrs
Reservoir surface area	ha	124.73	
Elevation of flood water level (FWL)	m	998.95	Hd=3.95m
Elevation of normal water level (NWL)	m	995.00	
Elevation of low water level (LWL)	m	973.00	
4 Dam Body			
Geology of foundation		Schist	(Ordovician)
Type of dam		Concrete gravity by RCC	
Elevation of dam crest	EL	1,000.50	Freeboard above FWL 1.55
Elevation of dam foundation	EL	927.00	above NWL 5.50
Height from proposed foundation	m	73.50	
Length of dam crest	m	225.00	
Upstream slope		1:0.20	
Downstream slope		1:0.84	
Width of dam crest	m	5.00	
Seismic intensity		0.12	(100yr.acceleration=102gal)
Dam concrete quantity (total)	m3	415,000.00	
Conventional concrete	m3	100,300.00	
RCC concrete	m3	314,700.00	
5 Spillway			
Location		Center of dam body	
Geology of foundation		Schist	
Design inflow discharge(1,000yr/10,000yr)	m3/s	1,700/2,300	
Design outflow discharge(1,000yr/10,000yr)	m3/s	1,569/2,138	
Type of weir		Non gate straight crest	
Weir length and width		100m x 80m	
Design overflow depth(1,000yr/10,000yr)	m	3.95/4.85	
Type of stilling basin		Hydraulic jump type	
6 Intake/Outlet			
Type		Intake tower	
		W2.5XH3.0m slide gate x 2	
Intake location		Right side of dam body	
Capacity	m3/s	6.76	
Outlet pipe		D2000mm x 125 m	
Discharge control valve		D2000mm JFG	
Raw water facilities		D300mm pipe and D300 sluice valve	
7 Diversion			
Type		Cofferdam/Buried culvert	
Design inflow discharge(10yr/20yr)	m3/s	400.0/600.0	
Design outflow discharge(10yr/20yr)	m3/s	339.7/474.2	
Cofferdam crest elevation	m	962.50	
Upstream water level(10yr/20yr)	m	955.4/962.3	
Culvert location		Right side of river	
Culvert section/length		7.2m x 7.2m/270m	
8 Dam Construction Cost			
1.Direct cost			
1.1 Diversion works	MDH	5.21	
1.2 Foundation excavation	MDH	17.22	
1.3 Foundation treatment	MDH	9.69	
1.4 Dam embankment	MDH	175.85	
1.5 Spill way	MDH	2.05	
1.6 Intake works	MDH	2.41	
1.7 Gate and pipe	MDH	12.40	
1.8Overhed and profit of contractor	MDH	50.55	
Sub-total	MDH	275.38	
2.Physical contingency	MDH	27.54	
3.Price contingency	MDH	69.63	
Total	MDH	372.55	
4.Value added tax(14%)	MDH	52.16	
Ground total	MDH	424.60	1023 DH/m3
B. Irrigation			
9 Service Area			
Service area (Net)	ha	4,500	
10 Irrigation Construction Cost			
1.Direct cost			
1.1 Main canal	MDH	38.55	
1.2 Structures	MDH	84.54	
1.3Overhed and profit of contractor	MDH	8.62	
Sub-total	MDH	131.71	
2.Physical contingency	MDH	13.17	
3.Price contingency	MDH	33.32	
Total	MDH	178.20	
4.Value added tax(14%)	MDH	24.94	
Ground total	MDH	203.10	45,100 DH/ha

Table S4: Principal Features of No.10 Timkit

Description			Remark
A. Dam			
1 General			
Province		Errachidia	
River		Assif N'ifer	
Coordinate of dam site	Xr1	507,335.00	Location: Tinjdid
	Yr1	515,200.00	
	Xl2	507,550.00	
	Yl2	515,500.00	
2 Hydrology			
Catchment area	km2	572.00	
Annual mean rainfall	mm	186.00	
Annual mean run-off	Mm3	10.11	
3 Reservoir			
Gross storage	m3	27,500,000.00	
Flood storage	m3	20,000,000.00	
Effective storage	m3	3,500,000.00	
Dead storage	m3	4,000,000.00	200,000m3/yr. x 20yrs
Reservoir surface area	ha	172.50	
Elevation of flood water level (FWL)	m	1,258.12	Hd=2.32m
Elevation of surcharge water level (SWL)	m	1,255.80	
Elevation of normal water level (NWL)	m	1,245.00	
Elevation of low water level (LWL)	m	1,240.30	
4 Dam Body			
Geology of foundation		Limestone	(Lower Jurassic)
Type of dam		Concrete gravity by RCC	
Elevation of dam crest	EL	1,259.50	Freeboard above FWL 1.38
Elevation of dam foundation	EL	1,195.00	above NWL 14.50
Height from proposed foundation	m	64.50	
Length of dam crest	m	210.00	
Upstream slope		1:0.20	
Downstream slope		1:0.86	
Width of dam crest	m	5.00	
Seismic intensity		0.10	(100yr.acceleration=88gal)
Dam concrete quantity (total)	m3	227,600.00	
Conventional concrete	m3	44,900.00	
RCC concrete	m3	182,700.00	
5 Spillway			
Location		Center of dam body	
Geology of foundation		Limestone	
Design inflow discharge(1,000yr/10,000yr	m3/s	2,000/2,800	
Design outflow discharge(1,000yr/10,000yr)	m3/s	426/826	
Type of weir		Non gate straight crest	
Weir length	m	60.00	
Design overflow depth(1,000yr/10,000yr	m	2.32/3.61	
Type of stilling basin		Hydraulic jump type	
6 Intake/Outlet			
Type		Intake tower	
		D400mm slide gate x 1	
Intake location		Right side of dam body	
Capacity	m3/s	0.45	
Outlet pipe		D600 mm x 60 m	
Discharge control valve		D300mmJFG	
Flood control gate		4m x 4m slide gate and pressure conduit	
Raw water facilities		D400mm pipe and D400 sluice valve	
Sediment flush pipe		D800mm	
7 Diversion			
Type		Cofferdam/Buried culvert	
Design inflow discharge(10yr/20yr)	m3/s	300.0/500.0	
Design outflow discharge	m3/s	300.0/348.4	
Cofferdam crest elevation	m	1,230.50	
Upstream water level	m	1,217.8/1,230.2	
Culvert location		Left side of river	
Culvert section/length		6.0mm x 6.00mm/200m	
8 Dam Construction Cost			
1.Direct cost			
1.1 Diversion works	MDH	3.32	
1.2 Foundation excavation	MDH	10.50	
1.3 Foundation treatment	MDH	17.67	
1.4 Dam embankment	MDH	85.70	
1.5 Spill way	MDH	0.99	
1.6 Intake works	MDH	0.59	
1.7 Gate and pipe	MDH	3.44	
1.8 Sabo dam works	MDH	18.86	
1.9 Overhead and profit of contractor	MDH	21.31	
Sub-total	MDH	162.38	
2.Physical contingency	MDH	16.24	
3.Price contingency	MDH	41.06	
Total	MDH	219.68	
4.Value added tax(14%)	MDH	30.75	
Ground total	MDH	250.30	1,100 DH/m3
B. Irrigation			
9 Service Area			
Service area (Net)	ha	3,060	
10 Irrigation Construction Cost			
1.Direct cost			
1.1 Main canal	MDH	15.89	
1.2 Structures	MDH	89.07	
1.3Overhed and profit of contractor	MDH	7.35	
Sub-total	MDH	112.31	
2.Physical contingency	MDH	11.23	
3.Price contingency	MDH	28.41	
Total	MDH	151.95	
4.Value added tax(14%)	MDH	21.27	
Ground total	MDH	173.20	56,600 DH/ha

Table S5: Principal Features of No.17 Azghar

Description			Remark
A. Dam			
1 General			
Province		Sefrou	
River		Oued Zloul	
Coordinate of dam site	Xr1	598,750.00	Location: Sefrou
	Yr1	3,573,500.00	
	Xl2	599,103.00	
	Yl2	3,570,500.00	
2 Hydrology			
Catchment area	km2	263.00	
Annual mean rainfall	mm	447.00	
Annual mean run-off	Mm3	53.21	
3 Reservoir			
Gross storage	m3	11,700,000.00	
Effective storage	m3	5,200,000.00	
Dead storage	m3	6,500,000.00	130,000m3/yr. x 50yrs
Reservoir surface area	ha	118.27	
Elevation of flood water level (FWL)	m	856.89	Hd=2.89m
Elevation of normal water level (NWL)	m	854.00	
Elevation of low water level (LWL)	m	848.50	
4 Dam Body			
Geology of foundation		Marl	(Lower Liassic)
Type of dam		Center-cored rock fill	
Elevation of dam crest	EL	859.50	Freeboard above FWL 2.61
Elevation of dam foundation	EL	817.00	above NWL 5.50
Height from proposed foundation	m	42.50	
Length of dam crest	m	325.00	
Upstream slope		1:2.80	
Downstream slope		1:2.40	
Width of dam crest	m	6.00	
Seismic intensity		0.12	(100yr.acceleration=66gal)
Embankment quantity (total)	m3	769,800.00	
Core	m3	130,900.00	
Filter & drain + Gravel, rock	m3	615,800.00	
Rip rap	m3	23,100.00	
5 Spillway			
Location		Right bank	
Geology of foundation		Marl of CM-CH	
Design inflow discharge(10,000yr)	m3/s	700.00	
Design outflow discharge(10,000yr)	m3/s	592.00	
Type of weir		Non gated side channel	
Weir length and width		60m x 15m	
Design overflow depth(10,000yr)	m	2.89	
Type of stilling basin		Hydraulic jump with roller bucket	
6 Intake/Outlet			
Type		Composite type inclined tower D1000mmslide gate x 1	
Intake location		Left bank	
Capacity	m3/s	2.60	
Outlet pipe		D1000 mm x 480 m	
Discharge control valve		D1000mm Sleeve valve	
Raw water facilities		D300mm pipe and D300 sluice valve	
Sediment flush pipe		D800mm	
7 Diversion			
Type		Cofferdam/Culvert	
Design inflow discharge(20yr/50yr)	m3/s	250.0/300.0	
Design outflow discharge(20yr/50yr)	m3/s	212.6/221.6	
Cofferdam crest elevation	m	835.00	
Upstream water level(20yr/50yr)	m	831.5/834.7	
Culvert location		Right side of Riverbed	
Culvert section/length		5m x 5m / 240m	
8 Dam Construction Cost			
1.Direct cost			
1.1 Diversion works	MDH	19.36	
1.2 Foundation excavation	MDH	9.59	
1.3 Foundation treatment	MDH	5.42	
1.4 Dam embankment	MDH	16.03	
1.5 Spill way	MDH	35.29	
1.6 Intake works	MDH	1.21	
1.7 Gate and pipe	MDH	12.42	
1.8Overhed and profit of contractor	MDH	13.18	
Sub-total	MDH	112.50	
2.Physical contingency	MDH	11.25	
3.Price contingency	MDH	28.45	
Total	MDH	152.20	
4.Value added tax(14%)	MDH	21.30	
Ground total	MDH	173.40	225 DH/m3
B. Irrigation			
9 Service Area			
Service area (Net)	ha	2,000	
10 Irrigation Construction Cost			
1.Direct cost			
1.1 Main canal	MDH	12.22	
1.2 Structures	MDH	56.32	
1.3Overhed and profit of contractor	MDH	4.80	
Sub-total	MDH	73.34	
2.Physical contingency	MDH	7.33	
3.Price contingency	MDH	18.55	
Total	MDH	99.22	
4.Value added tax(14%)	MDH	13.89	
Ground total	MDH	113.10	56,600 DH/ha

Table S6: Project Cost (1/2)

Cost Item	Foreign Currency	Local Currency	Total
N'fifikh (Upstream)			
1. Construction cost			
1.1 Dam and appurtenant facilities	93.0	50.1	143.1
1.2 Irrigation facilities	18.3	18.2	36.5
1.3 Water supply system	0.0	1.4	1.4
2. Resettlement cost	0.0	3.3	3.3
3. Engineering services cost	8.2	4.5	12.7
4. Administration cost	0.0	9.2	9.2
5. Physical contingency	12.0	8.7	20.7
Sub-total of (1.- 5.)	131.5	95.4	226.9
6. Price Contingency	25.7	18.6	44.3
Sub-total of (1.- 6.)	157.2	114.0	271.2
7. Value Added Tax	0.0	38.9	38.9
Total of (1.- 7.)	157.2	152.9	310.1
Taskourt			
1. Construction cost			
1.1 Dam and appurtenant facilities	179.0	96.4	275.4
1.2 Irrigation facilities	65.9	65.8	131.7
1.3 Water supply system	0.0	2.4	2.4
2. Resettlement cost	0.0	28.5	28.5
3. Engineering services cost	18.6	10.1	28.7
4. Administration cost	0.0	21.9	21.9
5. Physical contingency	26.4	22.5	48.9
Sub-total of (1.- 5.)	289.9	247.6	537.5
6. Price Contingency	55.8	45.2	101.0
Sub-total of (1.- 6.)	345.7	292.8	638.5
7. Value Added Tax	0.0	91.6	91.6
Total of (1.- 7.)	345.7	384.4	730.1
Timkit			
1. Construction cost			
1.1 Dam and appurtenant facilities	105.5	56.8	162.3
1.2 Irrigation facilities	56.2	56.1	112.3
2. Resettlement cost	0.0	6.4	6.4
3. Engineering services cost	12.5	6.7	19.2
4. Administration cost	0.0	14.0	14.0
5. Physical contingency	17.4	14.0	31.4
Sub-total of (1.- 5.)	191.6	154.0	345.6
6. Price Contingency	43.2	34.3	77.5
Sub-total of (1.- 6.)	234.8	188.3	423.1
7. Value Added Tax	0.0	60.8	60.8
Total of (1.- 7.)	234.8	249.1	483.9
Azghar			
1. Construction cost			
1.1 Dam and appurtenant facilities	73.1	39.4	112.5
1.2 Irrigation facilities	36.7	36.6	73.3
2. Resettlement cost	0.0	5.1	5.1
3. Engineering services cost	8.5	4.5	13.0
4. Administration cost	0.0	9.5	9.5
5. Physical contingency	11.8	9.5	21.3
Sub-total of (1.- 5.)	130.1	104.6	234.7
6. Price Contingency	25.9	20.4	46.3
Sub-total of (1.- 6.)	156.0	125.0	281.0
7. Value Added Tax	0.0	40.4	40.4
Total of (1.- 7.)	156.0	165.4	321.4

Table S6: Project Cost (2/2)

ost Item		Foreign Currency	Local Currency	Total
TOTAL				
1.	Construction cost			
1.1	Dam and appurtenant facilities	450.6	242.7	693.3
1.2	Irrigation facilities	177.1	176.7	353.8
1.3	Water supply system	0.0	3.8	3.8
2.	Resettlement cost	0.0	43.3	43.3
3.	Engineering services cost	47.8	25.8	73.6
4.	Administration cost	0.0	54.6	54.6
5.	Physical contingency	67.6	54.7	122.3
	Sub-total of (1.- 5.)	743.1	601.6	1,344.7
6.	Price Contingency	150.6	118.5	269.1
	Sub-total of (1.- 6.)	893.7	720.1	1,613.8
7.	Value Added Tax	0.0	231.7	231.7
	Total of (1.- 7.)	893.7	951.8	1,845.5

Note: 1. Price level: as of April 2000, US$1.0 = 10.68 DH, J. Yen100 = 9.90 DH

2. Both foreign and local currency portions are expressed in million Dirhams.

3. Engineering service fee is estimated as 7 % of total construction cost

4. Administration cost is estimated as 5 % of construction cost and resettlement cost.

5. Physical contingency: 10% of all items

6. Price contingency: 3% per annum for all items

7. Value added tax: 20% for engineering services and 14% for all other items

Table S7: Annual Disbursement Schedule (1/3
(Financial Price, million DH

N'Fifikh

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	93.0	50.1	143.1	-	-	-	-	-	-	-	-	-	-	-	-	22.3	12.0	34.3	47.4	25.6	73.0	23.3	12.5	35.8	-	-	-
Irrigation facilities	18.3	18.2	36.5	-	-	-	-	-	-	-	-	-	-	-	-	3.7	3.6	7.3	9.2	9.1	18.3	5.4	5.5	10.9	-	-	-
Water supply facilities	-	1.4	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	1.4	-	-	-
Sub-total of 1	111.3	69.7	181.0	-	-	-	-	-	-	-	-	-	-	-	-	26.0	15.6	41.6	56.6	34.7	91.3	28.7	19.4	48.1	-	-	-
2. Resettlement cost	-	3.3	3.3	-	-	-	-	-	-	-	-	-	-	1.7	1.7	-	1.6	1.6	-	-	-	-	-	-	-	-	-
3. Engineering services cost	8.2	4.5	12.7	-	-	-	-	-	-	-	-	-	-	-	-	1.9	1.0	2.9	4.1	2.3	6.4	2.2	1.2	3.4	-	-	-
4. Administration cost	-	9.2	9.2	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	2.2	2.2	-	4.6	4.6	-	2.3	2.3	-	-	-
5. Physical contingency	12.0	8.7	20.7	-	-	-	-	-	-	-	-	-	-	0.2	0.2	2.8	2.0	4.8	6.1	4.2	10.3	3.1	2.3	5.4	-	-	-
Sub-total of (1.- 5.)	131.5	95.4	226.9	-	-	-	-	-	-	-	-	-	-	2.0	2.0	30.7	22.4	53.1	66.8	45.8	112.6	34.0	25.2	59.2	-	-	-
6. Price contingency	25.7	18.6	44.3	-	-	-	-	-	-	-	-	-	-	0.3	0.3	4.9	3.6	8.5	13.0	8.9	21.9	7.8	5.8	13.6	-	-	-
Sub-total of (1.- 6.)	157.2	114.0	271.2	-	-	-	-	-	-	-	-	-	-	2.3	2.3	35.6	26.0	61.6	79.8	54.7	134.5	41.8	31.0	72.8	-	-	-
7. Value Added Tax	-	38.9	38.9	-	-	-	-	-	-	-	-	-	-	0.3	0.3	-	8.8	8.8	-	19.3	19.3	-	10.5	10.5	-	-	-
Total of (1.- 7.)	157.2	152.9	310.1	-	-	-	-	-	-	-	-	-	-	2.6	2.6	35.6	34.8	70.4	79.8	74.0	153.8	41.8	41.5	83.3	-	-	-

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Taskourt

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	179.0	96.4	275.4	-	-	-	-	-	-	-	-	-	19.7	10.6	30.3	41.2	22.2	63.4	59.1	31.8	90.9	59.0	31.8	90.8	-	-	-
Irrigation facilities	65.9	65.8	131.7	-	-	-	-	-	-	-	-	-	-	-	-	13.2	13.2	26.4	33.0	32.9	65.9	19.7	19.7	39.4	-	-	-
Water supply facilities	-	2.4	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.4	2.4	-	-	-
Sub-total of 1.2	244.9	164.6	409.5	-	-	-	-	-	-	-	-	-	19.7	10.6	30.3	54.4	35.4	89.8	92.1	64.7	156.8	78.7	53.9	132.6	-	-	-
2. Resettlement cost	-	28.5	28.5	-	-	-	-	-	-	-	14.3	14.3	-	14.2	14.2	-	-	-	-	-	-	-	-	-	-	-	-
3. Engineering services cost	18.6	10.1	28.7	-	-	-	-	-	-	-	-	-	1.4	0.7	2.1	4.1	2.2	6.3	7.1	3.9	11.0	6.0	3.3	9.3	-	-	-
4. Administration cost	-	21.9	21.9	-	-	-	-	-	-	-	0.7	0.7	-	2.2	2.2	-	4.5	4.5	-	7.8	7.8	-	6.7	6.7	-	-	-
5. Physical contingency	26.4	22.5	48.9	-	-	-	-	-	-	-	1.5	1.5	2.1	2.8	4.9	5.9	4.2	10.1	9.9	7.6	17.5	8.5	6.4	14.9	-	-	-
Sub-total of (1.- 5.)	289.9	247.6	537.5	-	-	-	-	-	-	-	16.5	16.5	23.2	30.5	53.7	64.4	46.3	110.7	109.1	84.0	193.1	93.2	70.3	163.5	-	-	-
6. Price contingency	55.8	45.2	101.0	-	-	-	-	-	-	-	1.5	1.5	2.9	3.8	6.7	10.3	7.4	17.7	21.2	16.3	37.5	21.4	16.2	37.6	-	-	-
Sub-total of (1.- 6.)	345.7	292.8	638.5	-	-	-	-	-	-	-	18.0	18.0	26.1	34.3	60.4	74.7	53.7	128.4	130.3	100.3	230.6	114.6	86.5	201.1	-	-	-
7. Value Added Tax	-	91.6	91.6	-	-	-	-	-	-	-	2.5	2.5	-	8.6	8.6	-	18.4	18.4	-	33.2	33.2	-	28.9	28.9	-	-	-
Total of (1.- 7.)	345.7	384.4	730.1	-	-	-	-	-	-	-	20.5	20.5	26.1	42.9	69.0	74.7	72.1	146.8	130.3	133.5	263.8	114.6	115.4	230.0	-	-	-

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Table S7: Annual Disbursement Schedule (2/3
(Financial Price, million DH

Timkit

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	105.5	56.8	162.3	-	-	-	-	-	-	-	-	-	-	-	-	17.9	9.7	27.6	23.2	12.5	35.7	34.8	18.7	53.5	29.6	15.9	45.5
Irrigation facilities	56.2	56.1	112.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.2	11.2	22.4	28.1	28.1	56.2	16.9	16.8	33.7
Sub-total of 1.3	161.7	112.9	274.6	-	-	-	-	-	-	-	-	-	-	-	-	17.9	9.7	27.6	34.4	23.7	58.1	62.9	46.8	109.7	46.5	32.7	79.2
2. Resettlement cost	-	6.4	6.4	-	-	-	-	-	-	-	-	-	-	3.2	3.2	-	3.2	3.2	-	-	-	-	-	-	-	-	-
3. Engineering services cost	12.5	6.7	19.2	-	-	-	-	-	-	-	-	-	-	-	-	1.3	0.7	2.0	2.6	1.4	4.0	5.0	2.7	7.7	3.6	1.9	5.5
4. Administration cost	-	14.0	14.0	-	-	-	-	-	-	-	-	-	-	0.2	0.2	-	1.5	1.5	-	2.9	2.9	-	5.5	5.5	-	3.9	3.9
5. Physical contingency	17.4	14.0	31.4	-	-	-	-	-	-	-	-	-	-	0.3	0.3	1.9	1.5	3.4	3.7	2.8	6.5	6.8	5.5	12.3	5.0	3.9	8.9
Sub-total of (1.- 5.)	191.6	154.0	345.6	-	-	-	-	-	-	-	-	-	-	3.7	3.7	21.1	16.6	37.7	40.7	30.8	71.5	74.7	60.5	135.2	55.1	42.4	97.5
6. Price contingency	43.2	34.3	77.5	-	-	-	-	-	-	-	-	-	-	0.5	0.5	3.4	2.6	6.0	7.9	6.0	13.9	17.2	13.9	31.1	14.7	11.3	26.0
Sub-total of (1.- 6.)	234.8	188.3	423.1	-	-	-	-	-	-	-	-	-	-	4.2	4.2	24.5	19.2	43.7	48.6	36.8	85.4	91.9	74.4	166.3	69.8	53.7	123.5
7. Value Added Tax	-	60.8	60.8	-	-	-	-	-	-	-	-	-	-	0.6	0.6	-	6.3	6.3	-	12.3	12.3	-	23.9	23.9	-	17.7	17.7
Total of (1.- 7.)	234.8	249.1	483.9	-	-	-	-	-	-	-	-	-	-	4.8	4.8	24.5	25.5	50.0	48.6	49.1	97.7	91.9	98.3	190.2	69.8	71.4	141.2

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Azghar

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	73.1	39.4	112.5	-	-	-	-	-	-	-	-	-	-	-	-	17.5	9.5	27.0	27.8	15.0	42.8	27.8	14.9	42.7	-	-	-
Irrigation facilities	36.7	36.6	73.3	-	-	-	-	-	-	-	-	-	-	-	-	7.3	7.3	14.6	18.4	18.3	36.7	11.0	11.0	22.0	-	-	-
Sub-total of 1.4	109.8	76.0	185.8	-	-	-	-	-	-	-	-	-	-	-	-	24.8	16.8	41.6	46.2	33.3	79.5	38.8	25.9	64.7	-	-	-
2. Resettlement cost	-	5.1	5.1	-	-	-	-	-	-	-	-	-	-	2.6	2.6	-	2.5	2.5	-	-	-	-	-	-	-	-	-
3. Engineering services cost	8.5	4.5	13.0	-	-	-	-	-	-	-	-	-	-	-	-	1.9	1.0	2.9	3.6	1.9	5.5	3.0	1.6	4.6	-	-	-
4. Administration cost	-	9.5	9.5	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	2.2	2.2	-	4.0	4.0	-	3.2	3.2	-	-	-
5. Physical contingency	11.8	9.5	21.3	-	-	-	-	-	-	-	-	-	-	0.3	0.3	2.7	2.3	5.0	5.0	3.9	8.9	4.1	3.0	7.1	-	-	-
Sub-total of (1.- 5.)	130.1	104.6	234.7	-	-	-	-	-	-	-	-	-	-	3.0	3.0	29.4	24.8	54.2	54.8	43.1	97.9	45.9	33.7	79.6	-	-	-
6. Price contingency	25.9	20.4	46.3	-	-	-	-	-	-	-	-	-	-	0.4	0.4	4.7	3.9	8.6	10.6	8.4	19.0	10.6	7.7	18.3	-	-	-
Sub-total of (1.- 6.)	156.0	125.0	281.0	-	-	-	-	-	-	-	-	-	-	3.4	3.4	34.1	28.7	62.8	65.4	51.5	116.9	56.5	41.4	97.9	-	-	-
7. Value Added Tax	-	40.4	40.4	-	-	-	-	-	-	-	-	-	-	0.5	0.5	-	9.0	9.0	-	16.8	16.8	-	14.1	14.1	-	-	-
Total of (1.- 7.)	156.0	165.4	321.4	-	-	-	-	-	-	-	-	-	-	3.9	3.9	34.1	37.7	71.8	65.4	68.3	133.7	56.5	55.5	112.0	-	-	-

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Table S7: Annual Disbursement Schedule (3/3
(Financial Price, million DH

Overall Plan

Cost Item	Total			2001			2002			2003			2004			2005			2006			2007			2008		
	F.C.	L.C.	Total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total
1. Construction cost																											
Dam and appurtenant faciliti	450.6	242.7	693.3	-	-	-	-	-	-	-	-	-	19.7	10.6	30.3	98.9	53.4	152.3	157.5	84.9	242.4	144.9	77.9	222.8	29.6	15.9	45.5
Irrigation facilities	177.1	176.7	353.8	-	-	-	-	-	-	-	-	-	-	-	-	24.2	24.1	48.3	71.8	71.5	143.3	64.2	64.3	128.5	16.9	16.8	33.7
Water supply facilities	-	3.8	3.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.8	3.8	-	-	-
Sub-total of 1	627.7	423.2	1,050.9	-	-	-	-	-	-	-	-	-	19.7	10.6	30.3	123.1	77.5	200.6	229.3	156.4	385.7	209.1	146.0	355.1	46.5	32.7	79.2
2. Resettlement cost	-	43.3	43.3	-	-	-	-	-	-	-	14.3	14.3	-	21.7	21.7	-	7.3	7.3	-	-	-	-	-	-	-	-	-
3. Engineering services cost	47.8	25.8	73.6	-	-	-	-	-	-	-	-	-	1.4	0.7	2.1	9.2	4.9	14.1	17.4	9.5	26.9	16.2	8.8	25.0	3.6	1.9	5.5
4. Administration cost	-	54.6	54.6	-	-	-	-	-	-	-	0.7	0.7	-	2.6	2.6	-	10.4	10.4	-	19.3	19.3	-	17.7	17.7	-	3.9	3.9
5. Physical contingency	67.6	54.7	122.3	-	-	-	-	-	-	-	1.5	1.5	2.1	3.6	5.7	13.3	10.0	23.3	24.7	18.5	43.2	22.5	17.2	39.7	5.0	3.9	8.9
Sub-total of (1.- 5.)	743.1	601.6	1,344.7	-	-	-	-	-	-	-	16.5	16.5	23.2	39.2	62.4	145.6	110.1	255.7	271.4	203.7	475.1	247.8	189.7	437.5	55.1	42.4	97.5
6. Price contingency	150.6	118.5	269.1	-	-	-	-	-	-	-	1.5	1.5	2.9	5.0	7.9	23.3	17.5	40.8	52.7	39.6	92.3	57.0	43.6	100.6	14.7	11.3	26.0
Sub-total of (1.- 6.)	893.7	720.1	1,613.8	-	-	-	-	-	-	-	18.0	18.0	26.1	44.2	70.3	168.9	127.6	296.5	324.1	243.3	567.4	304.8	233.3	538.1	69.8	53.7	123.5
7. Value Added Tax	-	231.7	231.7	-	-	-	-	-	-	-	2.5	2.5	-	10.0	10.0	-	42.5	42.5	-	81.6	81.6	-	77.4	77.4	-	17.7	17.7
Total of (1.- 7.)	893.7	951.8	1,845.5	-	-	-	-	-	-	-	20.5	20.5	26.1	54.2	80.3	168.9	170.1	339.0	324.1	324.9	649.0	304.8	310.7	615.5	69.8	71.4	141.2

Note: 1) F.C. means foreign currency portion and L.C. means local currency portion.
2) Physical contingency of 10 % and price contingency of 3% per annum are assumed for both foreign and local currency portions.

Table S8: Financial Cash Flow Statement for Implementation of the Projects (1/5)

N'Fifikh **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Cash Inflow Water supply	Cash Inflow Government subsidy	Cash Inflow Total (c)	Balance (c) - (b)
1	2001										-		-			-	-	-
2	2002										-		-			-	-	-
3	2003										-		-			-	-	-
4	2004		2.6	2.6	-	2.6					-		-			-	-	-
5	2005	35.6	34.8	70.4	54.7	15.7					-		-			-	-	-
6	2006	79.8	74.0	153.8	170.1	38.4					1.2		1.2			1.2	1.2	-
7	2007	41.8	41.5	83.3	232.5	20.9					3.7		3.7			3.7	3.7	-
8	2008				232.5		1.0	0.5	0.1		5.1		6.7	0.9	0.1	5.7	6.7	-
9	2009				232.5		1.0	0.7	0.1		5.1		6.9	1.3	0.1	5.5	6.9	-
10	2010				232.5		1.1	0.9	0.1		5.1		7.2	1.6	0.1	5.5	7.2	-
11	2011				232.5		1.1	0.9	0.1		5.1		7.2	1.6	0.1	5.5	7.2	-
12	2012				232.5		1.1	1.0	0.1		5.1		7.3	1.7	0.1	5.5	7.3	-
13	2013				232.5		1.2	1.0	0.1		5.1		7.4	1.7	0.2	5.6	7.4	-
14	2014				232.5		1.2	1.1	0.1		5.1		7.5	1.8	0.2	5.6	7.5	-
15	2015				220.8		1.2	1.3	0.1		5.1	11.7	19.4	2.0	0.2	17.3	19.4	-
16	2016				209.1		1.3	1.3	0.1		4.9	11.7	19.3	2.0	0.2	17.1	19.3	-
17	2017				197.4		1.3	1.3	0.1		4.6	11.7	19.0	2.0	0.2	16.8	19.0	-
18	2018				185.7		1.3	1.4	0.2		4.3	11.7	18.9	2.0	0.2	16.8	18.9	-
19	2019				174.0		1.4	1.4	0.2		4.1	11.7	18.8	2.0	0.2	16.6	18.8	-
20	2020				162.3		1.4	1.5	0.2		3.8	11.7	18.6	2.0	0.2	16.5	18.6	-
21	2021				150.6		1.5	1.5	0.2		3.6	11.7	18.5	2.0	0.2	16.3	18.5	-
22	2022				138.9		1.5	1.5	0.2		3.3	11.7	18.2	2.0	0.2	16.1	18.2	-
23	2023				127.2		1.6	1.6	0.2		3.1	11.7	18.2	2.0	0.2	16.0	18.2	-
24	2024				115.5		1.6	1.6	0.2		2.8	11.7	17.9	2.0	0.2	15.7	17.9	-
25	2025				103.8		1.6	1.7	0.2		2.5	11.7	17.7	2.0	0.2	15.6	17.7	-
26	2026				92.1		1.7	1.7	0.2		2.3	11.7	17.6	2.0	0.2	15.4	17.6	-
27	2027				80.4		1.7	1.8	0.2		2.0	11.7	17.4	2.0	0.2	15.3	17.4	-
28	2028				68.7		1.8	1.8	0.2		1.8	11.7	17.3	2.0	0.2	15.1	17.3	-
29	2029				57.0		1.9	1.9	0.2		1.5	11.7	17.2	2.0	0.2	15.1	17.2	-
30	2030				45.3		1.9	1.9	0.2		1.3	11.7	17.0	2.0	0.2	14.8	17.0	-
31	2031				33.6		2.0	2.0	0.2		1.0	11.7	16.9	2.0	0.2	14.7	16.9	-
32	2032				21.9		2.0	2.1	0.2		0.7	11.7	16.7	2.0	0.2	14.6	16.7	-
33	2033				10.2		2.1	2.1	0.2	31.5	0.5	11.7	48.1	2.0	0.2	45.9	48.1	-
34	2034				-		2.2	2.2	0.2		0.2	10.2	15.0	2.0	0.2	12.9	15.0	-
35	2035				-		2.2	2.3	0.3				4.8	2.0	0.2	2.6	4.8	-
36	2036				-		2.3	2.3	0.3				4.9	2.0	0.2	2.7	4.9	-
37	2037				-		2.4	2.4	0.3				5.1	2.0	0.2	2.9	5.1	-

Note: 1) F.C. means foreign currency components and L.C. means local currency components.

2) 75% of the capital costs are assumed to be financed by bilateral or international organization as far as the costs are not non-eligible items.

3) The non-eligible items are costs for land acquisition, house compensation, administration, and any type of taxes and duties.

4) The assumed condition of finance is with an interest rate of 2.2% per annum for repayment period of 30 years including a grace period of 10 years.

5) The price escalation of 3% per annum is assumed for the capital cost, O & M cost, and replacement cost of facilities

6) Annual irrigation water charges are set to cover O & M and replacement cost of irrigation facilities for 25 years.

Table S8: Financial Cash Flow Statement for Implementation of the Projects (2/5)

Taskourt **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Cash Inflow Water supply	Cash Inflow Government subsidy	Cash Inflow Total (c)	Balance (c) - (b)
1	2001										-		-			-	-	-
2	2002										-		-			-	-	-
3	2003		20.5	20.5	-	20.5					-		-			-	-	-
4	2004	26.1	42.9	69.0	40.1	28.9					-		-			-	-	-
5	2005	74.7	72.1	146.8	162.6	24.3					0.9		0.9			0.9	0.9	-
6	2006	130.3	133.5	263.8	375.0	51.4					3.6		3.6			3.6	3.6	-
7	2007	114.6	115.4	230.0	547.5	57.5					8.3		8.3			8.3	8.3	-
8	2008				547.5	-	1.9	1.9	0.2		12.0		16.0	3.8	0.3	12.0	16.0	-
9	2009				547.5		2.0	2.7	0.2		12.0		16.9	5.0	0.3	11.7	16.9	-
10	2010				547.5		2.0	3.2	0.2		12.0		17.4	5.9	0.3	11.3	17.4	-
11	2011				547.5		2.1	3.7	0.2		12.0		18.0	6.6	0.3	11.2	18.0	-
12	2012				547.5		2.2	4.1	0.2		12.0		18.5	7.1	0.3	11.2	18.5	-
13	2013				547.5		2.2	4.3	0.2		12.0		18.7	7.1	0.3	11.4	18.7	-
14	2014				520.1		2.3	4.4	0.2		12.0	27.4	46.3	7.1	0.3	39.0	46.3	-
15	2015				492.7		2.4	4.5	0.2		11.4	27.4	45.9	7.1	0.3	38.6	45.9	-
16	2016				465.3		2.4	4.6	0.2		10.8	27.4	45.4	7.1	0.3	38.1	45.4	-
17	2017				437.9		2.5	4.8	0.2		10.2	27.4	45.1	7.1	0.3	37.8	45.1	-
18	2018				410.5		2.6	4.9	0.3		9.6	27.4	44.8	7.1	0.3	37.5	44.8	-
19	2019				383.1		2.7	5.1	0.3		9.0	27.4	44.5	7.1	0.3	37.2	44.5	-
20	2020				355.7		2.7	5.2	0.3		8.4	27.4	44.0	7.1	0.3	36.7	44.0	-
21	2021				328.3		2.8	5.4	0.3		7.8	27.4	43.7	7.1	0.3	36.3	43.7	-
22	2022				300.9		2.9	5.6	0.3		7.2	27.4	43.4	7.1	0.3	36.0	43.4	-
23	2023				273.5		3.0	5.7	0.3		6.6	27.4	43.0	7.1	0.3	35.6	43.0	-
24	2024				246.1		3.1	5.9	0.3		6.0	27.4	42.7	7.1	0.3	35.3	42.7	-
25	2025				218.7		3.2	6.1	0.3		5.4	27.4	42.4	7.1	0.3	35.0	42.4	-
26	2026				191.3		3.3	6.2	0.3		4.8	27.4	42.0	7.1	0.3	34.6	42.0	-
27	2027				163.9		3.4	6.4	0.3		4.2	27.4	41.7	7.1	0.3	34.3	41.7	-
28	2028				136.5		3.5	6.6	0.3		3.6	27.4	41.4	7.1	0.3	34.0	41.4	-
29	2029				109.1		3.6	6.8	0.4		3.0	27.4	41.2	7.1	0.3	33.8	41.2	-
30	2030				81.7		3.7	7.0	0.4		2.4	27.4	40.9	7.1	0.3	33.5	40.9	-
31	2031				54.3		3.8	7.2	0.4		1.8	27.4	40.6	7.1	0.3	33.2	40.6	-
32	2032				26.9		3.9	7.5	0.4		1.2	27.4	40.4	7.1	0.3	33.0	40.4	-
33	2033				-		4.0	7.7	0.4	78.6	0.6	26.9	118.2	7.1	0.3	110.8	118.2	-
34	2034				-		4.1	7.9	0.4				12.4	7.1	0.3	5.0	12.4	-
35	2035				-		4.3	8.2	0.4				12.9	7.1	0.3	5.5	12.9	-
36	2036				-		4.4	8.4	0.4				13.2	7.1	0.3	5.8	13.2	-
37	2037				-		4.5	8.6	0.4				13.5	7.1	0.3	6.1	13.5	-

Note: 1) F.C. means foreign currency components and L.C. means local currency components.
2) 75% of the capital costs are assumed to be financed by bilateral or international organization as far as the costs are not non-eligible items.
3) The non-eligible items are costs for land acquisition, house compensation, administration, and any type of taxes and duties.
4) The assumed condition of finance is with an interest rate of 2.2% per annum for repayment period of 30 years including a grace period of 10 years.
5) The price escalation of 3% per annum is assumed for the capital cost, O & M cost, and replacement cost of facilities
6) Annual irrigation water charges are set to cover O & M and replacement cost of irrigation facilities for 25 years.

Table S8: Financial Cash Flow Statement for Implementation of the Projects (3/5)

Timkit **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Water supply	Government subsidy	Total (c)	Balance (c) - (b)
1	2001										-		-			-	-	-
2	2002										-		-			-	-	-
3	2003										-		-			-	-	-
4	2004		4.8	4.8	-	4.8					-		-			-	-	-
5	2005	24.5	25.5	50.0	37.7	12.3					-		-			-	-	-
6	2006	48.6	49.1	97.7	114.3	21.1					0.8		0.8			0.8	0.8	-
7	2007	91.9	98.3	190.2	257.0	47.5					2.5		2.5			2.5	2.5	-
8	2008	69.8	71.4	141.2	362.9	35.3					5.7		5.7			5.7	5.7	-
9	2009				362.9		1.2	1.8			8.0		11.0	3.5		7.5	11.0	-
10	2010				362.9		1.2	2.6			8.0		11.8	4.8		7.0	11.8	-
11	2011				362.9		1.2	3.1			8.0		12.3	5.6		6.7	12.3	-
12	2012				362.9		1.3	3.4			8.0		12.7	6.0		6.7	12.7	-
13	2013				362.9		1.3	3.6			8.0		12.9	6.2		6.7	12.9	-
14	2014				362.9		1.4	3.7			8.0		13.1	6.2		6.9	13.1	-
15	2015				344.7		1.4	3.8			8.0	18.2	31.4	6.2		25.2	31.4	-
16	2016				326.5		1.4	4.0			7.6	18.2	31.2	6.2		25.0	31.2	-
17	2017				308.3		1.5	4.1			7.2	18.2	31.0	6.2		24.8	31.0	-
18	2018				290.1		1.5	4.2			6.8	18.2	30.7	6.2		24.5	30.7	-
19	2019				271.9		1.6	4.3			6.4	18.2	30.5	6.2		24.3	30.5	-
20	2020				253.7		1.6	4.5			6.0	18.2	30.3	6.2		24.1	30.3	-
21	2021				235.5		1.7	4.6			5.6	18.2	30.1	6.2		23.9	30.1	-
22	2022				217.3		1.7	4.7			5.2	18.2	29.8	6.2		23.6	29.8	-
23	2023				199.1		1.8	4.9			4.8	18.2	29.7	6.2		23.5	29.7	-
24	2024				180.9		1.8	5.0			4.4	18.2	29.4	6.2		23.2	29.4	-
25	2025				162.7		1.9	5.2			4.0	18.2	29.3	6.2		23.1	29.3	-
26	2026				144.5		1.9	5.3			3.6	18.2	29.0	6.2		22.8	29.0	-
27	2027				126.3		2.0	5.5			3.2	18.2	28.9	6.2		22.7	28.9	-
28	2028				108.1		2.0	5.7			2.8	18.2	28.7	6.2		22.5	28.7	-
29	2029				89.9		2.1	5.8			2.4	18.2	28.5	6.2		22.3	28.5	-
30	2030				71.7		2.2	6.0			2.0	18.2	28.4	6.2		22.2	28.4	-
31	2031				53.5		2.2	6.2			1.6	18.2	28.2	6.2		22.0	28.2	-
32	2032				35.3		2.3	6.4			1.2	18.2	28.1	6.2		21.9	28.1	-
33	2033				17.1		2.4	6.6			0.8	18.2	28.0	6.2		21.8	28.0	-
34	2034				-		2.4	6.8		58.1	0.4	17.1	84.8	6.2		78.6	84.8	-
35	2035				-		2.5	7.0					9.5	6.2		3.3	9.5	-
36	2036				-		2.6	7.2					9.8	6.2		3.6	9.8	-
37	2037				-		2.7	7.4					10.1	6.2		3.9	10.1	-

Note: 1) F.C. means foreign currency components and L.C. means local currency components.
2) 75% of the capital costs are assumed to be financed by bilateral or international organization as far as the costs are not non-eligible items.
3) The non-eligible items are costs for land acquisition, house compensation, administration, and any type of taxes and duties.
4) The assumed condition of finance is with an interest rate of 2.2% per annum for repayment period of 30 years including a grace period of 10 years.
5) The price escalation of 3% per annum is assumed for the capital cost, O & M cost, and replacement cost of facilities
6) Annual irrigation water charges are set to cover O & M and replacement cost of irrigation facilities for 25 years.

Table S8: Financial Cash Flow Statement for Implementation of the Projects (4/5)

Azghar **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Cash Inflow Water supply	Cash Inflow Government subsidy	Cash Inflow Total (c)	Balance (c) - (b)
1	2001										-		-			-	-	-
2	2002										-		-			-	-	-
3	2003										-		-			-	-	-
4	2004		3.9	3.9	-	3.9					-		-			-	-	-
5	2005	34.1	37.7	71.8	56.7	15.1					-		-			-	-	-
6	2006	65.4	68.3	133.7	157.0	33.4					1.2		1.2			1.2	1.2	-
7	2007	56.5	55.5	112.0	241.0	28.0					3.5		3.5			3.5	3.5	-
8	2008				241.0		0.8	0.7			5.3		6.8	1.4		5.4	6.8	-
9	2009				241.0		0.8	1.2			5.3		7.3	2.2		5.1	7.3	-
10	2010				241.0		0.8	1.5			5.3		7.6	2.8		4.8	7.6	-
11	2011				241.0		0.9	2.0			5.3		8.2	3.5		4.7	8.2	-
12	2012				241.0		0.9	2.3			5.3		8.5	4.0		4.5	8.5	-
13	2013				241.0		0.9	2.4			5.3		8.6	4.0		4.6	8.6	-
14	2014				241.0		0.9	2.4			5.3		8.6	4.0		4.6	8.6	-
15	2015				228.9		1.0	2.5			5.3	12.1	20.9	4.0		16.9	20.9	-
16	2016				216.8		1.0	2.6			5.0	12.1	20.7	4.0		16.7	20.7	-
17	2017				204.7		1.0	2.7			4.8	12.1	20.6	4.0		16.6	20.6	-
18	2018				192.6		1.1	2.7			4.5	12.1	20.4	4.0		16.4	20.4	-
19	2019				180.5		1.1	2.8			4.2	12.1	20.2	4.0		16.2	20.2	-
20	2020				168.4		1.1	2.9			4.0	12.1	20.1	4.0		16.1	20.1	-
21	2021				156.3		1.2	3.0			3.7	12.1	20.0	4.0		16.0	20.0	-
22	2022				144.2		1.2	3.1			3.4	12.1	19.8	4.0		15.8	19.8	-
23	2023				132.1		1.2	3.2			3.2	12.1	19.7	4.0		15.7	19.7	-
24	2024				120.0		1.3	3.3			2.9	12.1	19.6	4.0		15.6	19.6	-
25	2025				107.9		1.3	3.4			2.6	12.1	19.4	4.0		15.4	19.4	-
26	2026				95.8		1.3	3.5			2.4	12.1	19.3	4.0		15.3	19.3	-
27	2027				83.7		1.4	3.6			2.1	12.1	19.2	4.0		15.2	19.2	-
28	2028				71.6		1.4	3.7			1.8	12.1	19.0	4.0		15.0	19.0	-
29	2029				59.5		1.5	3.8			1.6	12.1	19.0	4.0		15.0	19.0	-
30	2030				47.4		1.5	3.9			1.3	12.1	18.8	4.0		14.8	18.8	-
31	2031				35.3		1.5	4.0			1.0	12.1	18.6	4.0		14.6	18.6	-
32	2032				23.2		1.6	4.2			0.8	12.1	18.7	4.0		14.7	18.7	-
33	2033				11.1		1.6	4.3		37.8	0.5	12.1	56.3	4.0		52.3	56.3	-
34	2034				-		1.7	4.4			0.2	11.1	17.4	4.0		13.4	17.4	-
35	2035				-		1.7	4.5					6.2	4.0		2.2	6.2	-
36	2036				-		1.8	4.7					6.5	4.0		2.5	6.5	-
37	2037				-		1.8	4.8					6.6	4.0		2.6	6.6	-

Note: 1) F.C. means foreign currency components and L.C. means local currency components.
2) 75% of the capital costs are assumed to be financed by bilateral or international organization as far as the costs are not non-eligible items.
3) The non-eligible items are costs for land acquisition, house compensation, administration, and any type of taxes and duties.
4) The assumed condition of finance is with an interest rate of 2.2% per annum for repayment period of 30 years including a grace period of 10 years.
5) The price escalation of 3% per annum is assumed for the capital cost, O & M cost, and replacement cost of facilities
6) Annual irrigation water charges are set to cover O & M and replacement cost of irrigation facilities for 25 years.

Table S8: Financial Cash Flow Statement for Implementation of the Projects (5/5)

Overall Plan **Unit: Million DH**

Year in order	Year	Capital Cost F.C.	Capital Cost L.C.	Capital Cost Total (a)	Foreign Loan Accumulated 75% of (a)	A part of capital cost allocated by the Government	Cash Outflow O & M cost Dam	O & M cost Irrigation	O & M cost Water sup.	Replace-ment cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (b)	Cash Inflow Irrigation water	Cash Inflow Water supply	Cash Inflow Government subsidy	Cash Inflow Total (c)	Balance (c) - (b)
1	2001												-				-	-
2	2002												-				-	-
3	2003	-	20.5	20.5	-	20.5							-				-	-
4	2004	26.1	54.2	80.3	40.1	40.2							-				-	-
5	2005	168.9	170.1	339.0	311.7	67.4					0.9		0.9			0.9	0.9	-
6	2006	324.1	324.9	649.0	816.4	144.3					6.9		6.9			6.9	6.9	-
7	2007	304.8	310.7	615.5	1,278.0	153.9					18.0		18.0			18.0	18.0	-
8	2008	69.8	71.4	141.2	1,383.9	35.3	3.7	3.1	0.3		28.1		35.2	6.1	0.4	28.7	35.2	-
9	2009				1,383.9		5.0	6.4	0.3		30.4		42.1	12.0	0.4	29.7	42.1	-
10	2010				1,383.9		5.1	8.2	0.3		30.4		44.0	15.1	0.4	28.5	44.0	-
11	2011				1,383.9		5.3	9.7	0.3		30.4		45.7	17.3	0.4	28.0	45.7	-
12	2012				1,383.9		5.5	10.8	0.3		30.4		47.0	18.8	0.4	27.8	47.0	-
13	2013				1,383.9		5.6	11.3	0.3		30.4		47.6	19.0	0.4	28.2	47.6	-
14	2014				1,356.5		5.8	11.6	0.3		30.4	27.4	75.5	19.1	0.4	56.0	75.5	-
15	2015				1,287.1		6.0	12.1	0.3		29.8	69.4	117.6	19.3	0.4	97.9	117.6	-
16	2016				1,217.7		6.1	12.5	0.3		28.3	69.4	116.6	19.3	0.4	96.9	116.6	-
17	2017				1,148.3		6.3	12.9	0.3		26.8	69.4	115.7	19.3	0.4	96.0	115.7	-
18	2018				1,078.9		6.5	13.2	0.5		25.3	69.4	114.9	19.3	0.4	95.1	114.9	-
19	2019				1,009.5		6.8	13.6	0.5		23.7	69.4	114.0	19.3	0.4	94.3	114.0	-
20	2020				940.1		6.8	14.1	0.5		22.2	69.4	113.0	19.3	0.4	93.3	113.0	-
21	2021				870.7		7.2	14.5	0.5		20.7	69.4	112.3	19.3	0.4	92.5	112.3	-
22	2022				801.3		7.3	14.9	0.5		19.2	69.4	111.3	19.3	0.4	91.5	111.3	-
23	2023				731.9		7.6	15.4	0.5		17.6	69.4	110.5	19.3	0.4	90.8	110.5	-
24	2024				662.5		7.8	15.8	0.5		16.1	69.4	109.6	19.3	0.4	89.9	109.6	-
25	2025				593.1		8.0	16.4	0.5		14.6	69.4	108.9	19.3	0.4	89.1	108.9	-
26	2026				523.7		8.2	16.7	0.5		13.0	69.4	107.8	19.3	0.4	88.1	107.8	-
27	2027				454.3		8.5	17.3	0.5		11.5	69.4	107.2	19.3	0.4	87.5	107.2	-
28	2028				384.9		8.7	17.8	0.5		10.0	69.4	106.4	19.3	0.4	86.7	106.4	-
29	2029				315.5		9.1	18.3	0.6		8.5	69.4	105.9	19.3	0.4	86.1	105.9	-
30	2030				246.1		9.3	18.8	0.6		6.9	69.4	105.0	19.3	0.4	85.3	105.0	-
31	2031				176.7		9.5	19.4	0.6		5.4	69.4	104.3	19.3	0.4	84.6	104.3	-
32	2032				107.3		9.8	20.2	0.6		3.9	69.4	103.9	19.3	0.4	84.1	103.9	-
33	2033				38.4		10.1	20.7	0.6	147.9	2.4	68.9	250.6	19.3	0.4	230.8	250.6	-
34	2034				-		10.4	21.3	0.6	58.1	0.8	38.4	129.6	19.3	0.4	109.9	129.6	-
35	2035				-		10.7	22.0	0.7				33.4	19.3	0.4	13.7	33.4	-
36	2036				-		11.1	22.6	0.7				34.4	19.3	0.4	14.7	34.4	-
37	2037				-		11.4	23.2	0.7				35.3	19.3	0.4	15.6	35.3	-

Note: 1) F.C. means foreign currency components and L.C. means local currency components.

2) 75% of the capital costs are assumed to be financed by bilateral or international organization as far as the costs are not non-eligible items.

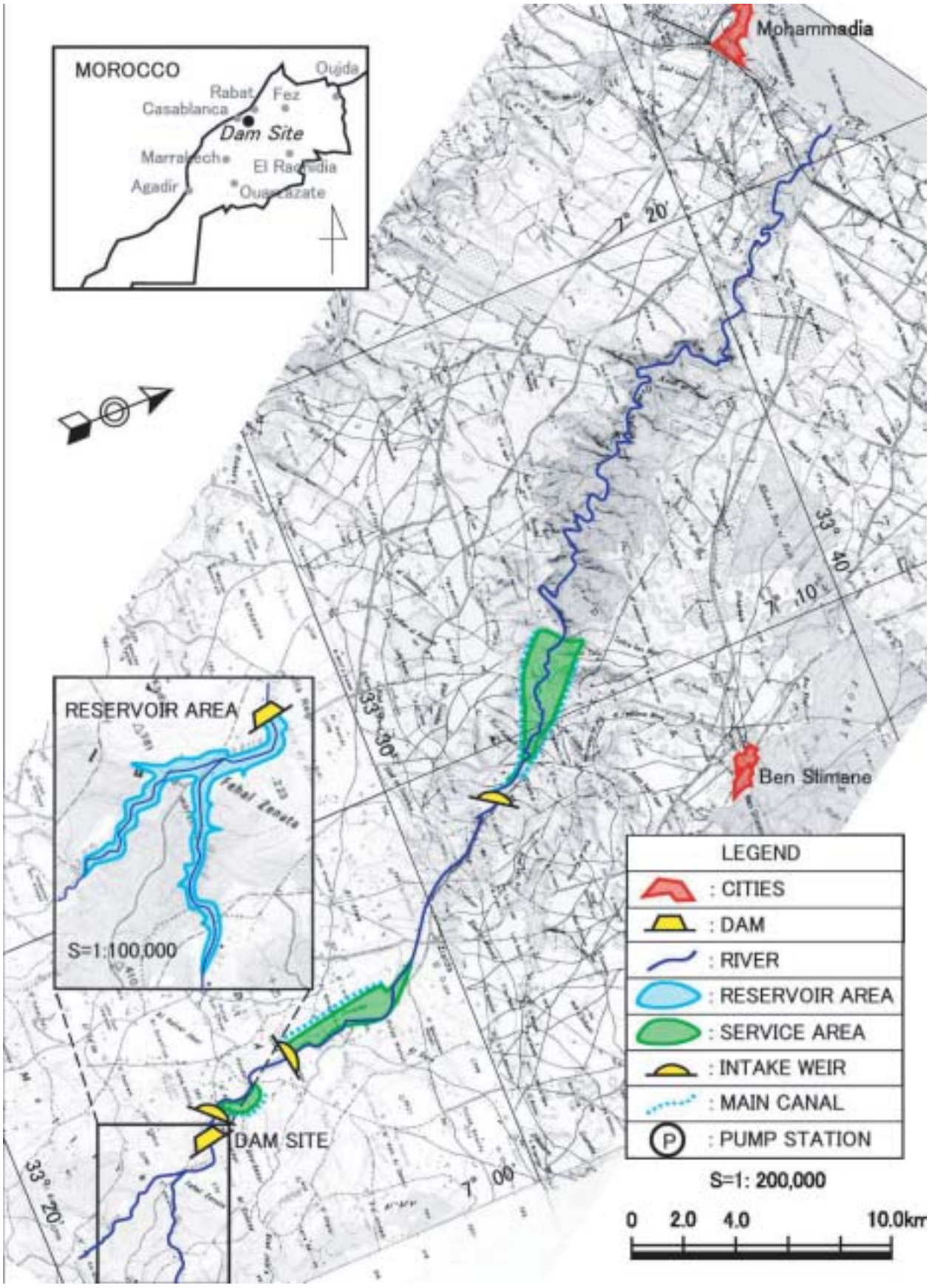
3) The non-eligible items are costs for land acquisition, house compensation, administration, and any type of taxes and duties.

4) The assumed condition of finance is with an interest rate of 2.2% per annum for repayment period of 30 years including a grace period of 10 years.

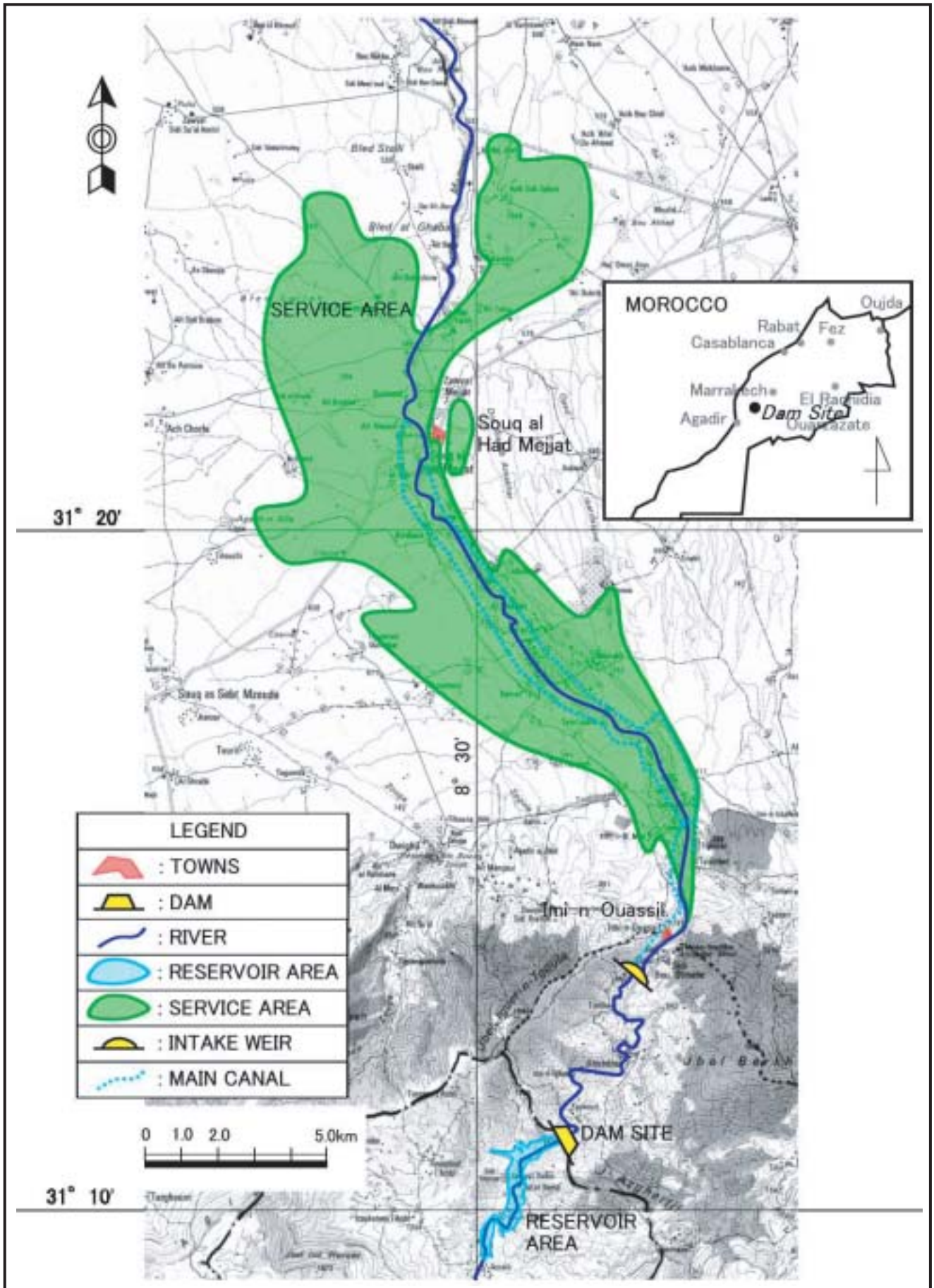
5) The price escalation of 3% per annum is assumed for the capital cost, O & M cost, and replacement cost of facilities

6) Annual irrigation water charges are set to cover O & M and replacement cost of irrigation facilities for 25 years.

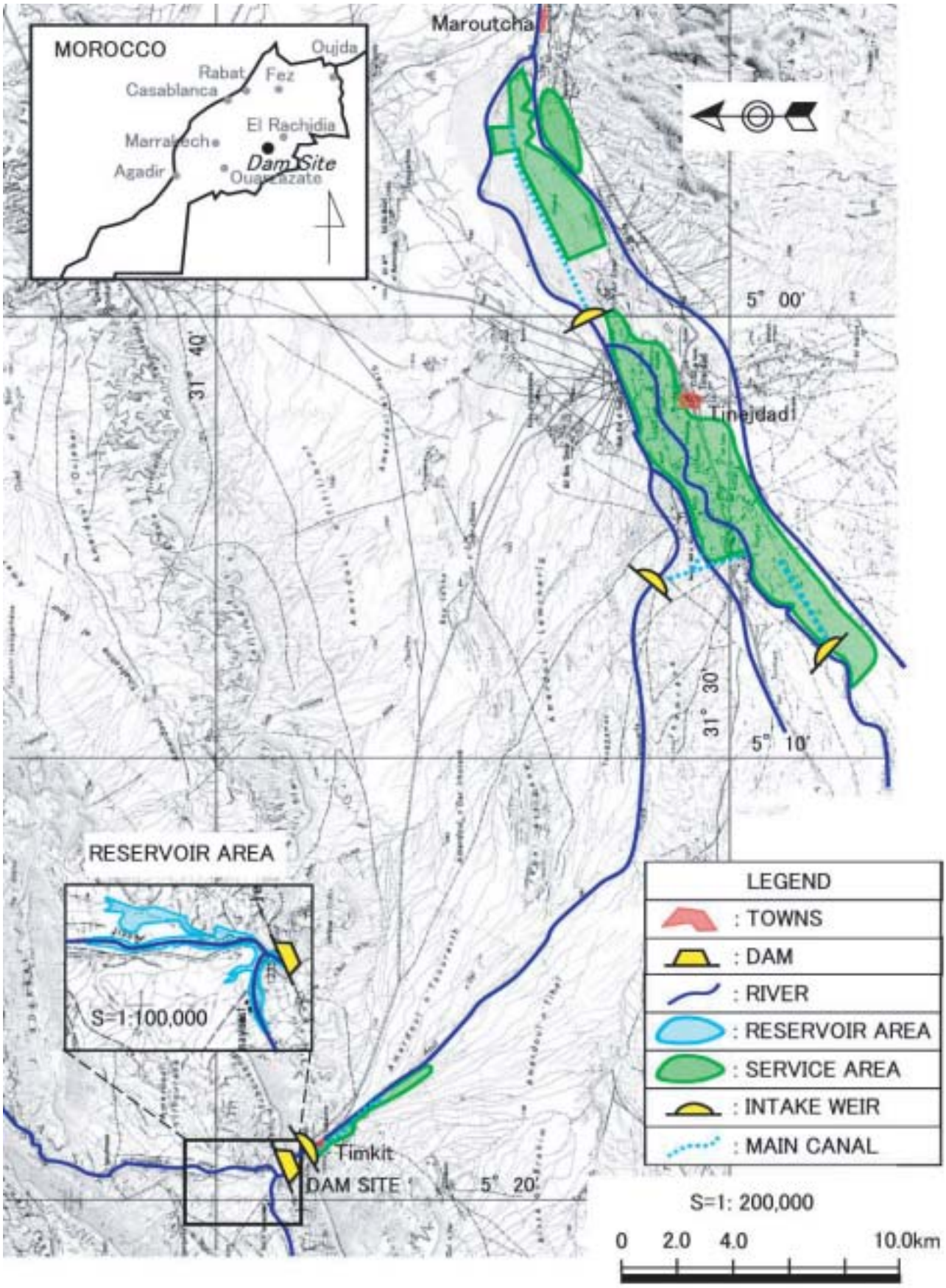
Figures



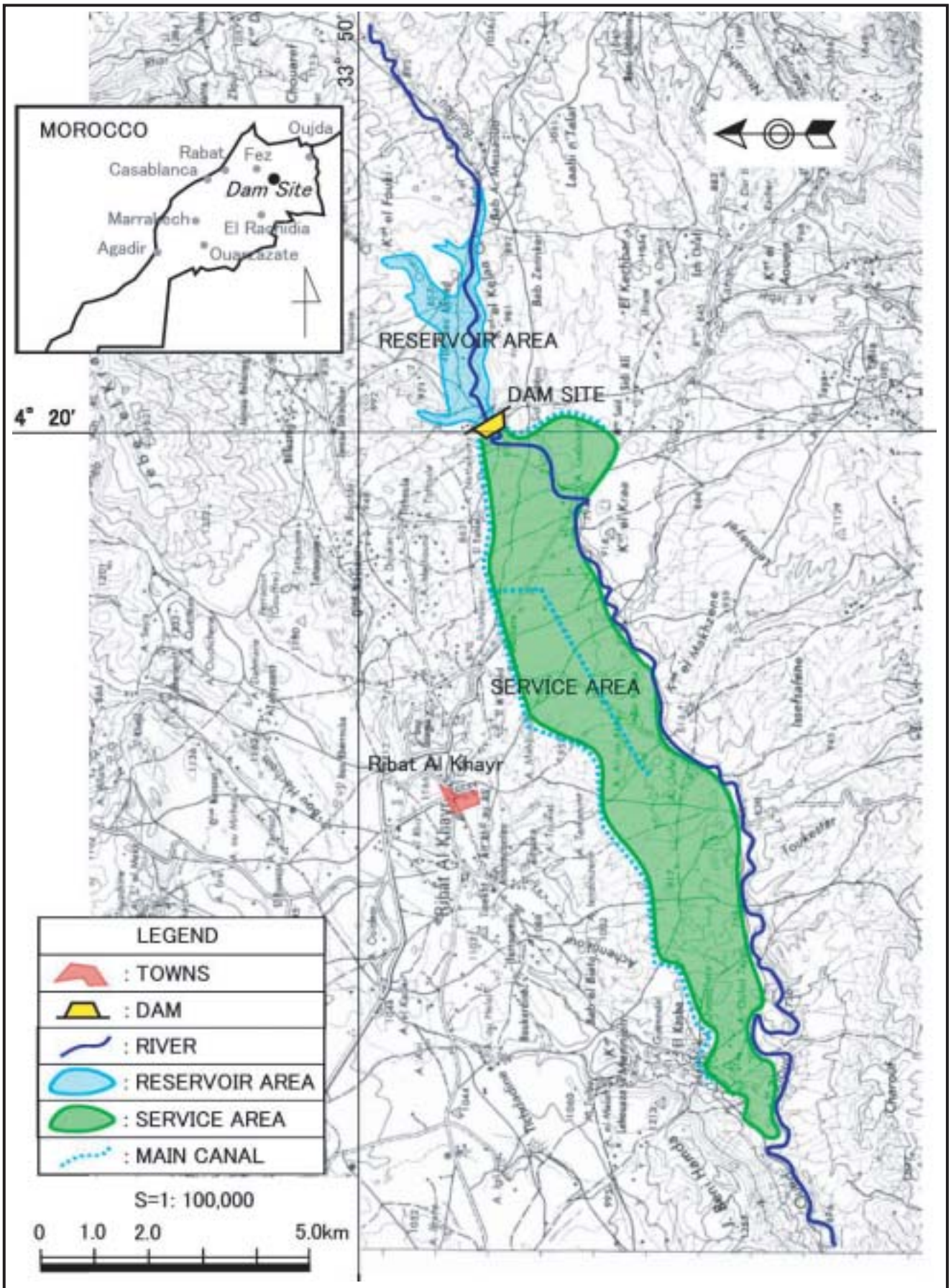
FEASIBILITY STUDY ON WATER RESOURCES DEVELOPMENT IN RURAL AREA	**Figure S1** **General Plans of N'Fifikh (No.5)**
JAPAN INTERNATIONAL COOPERATION AGENCY	



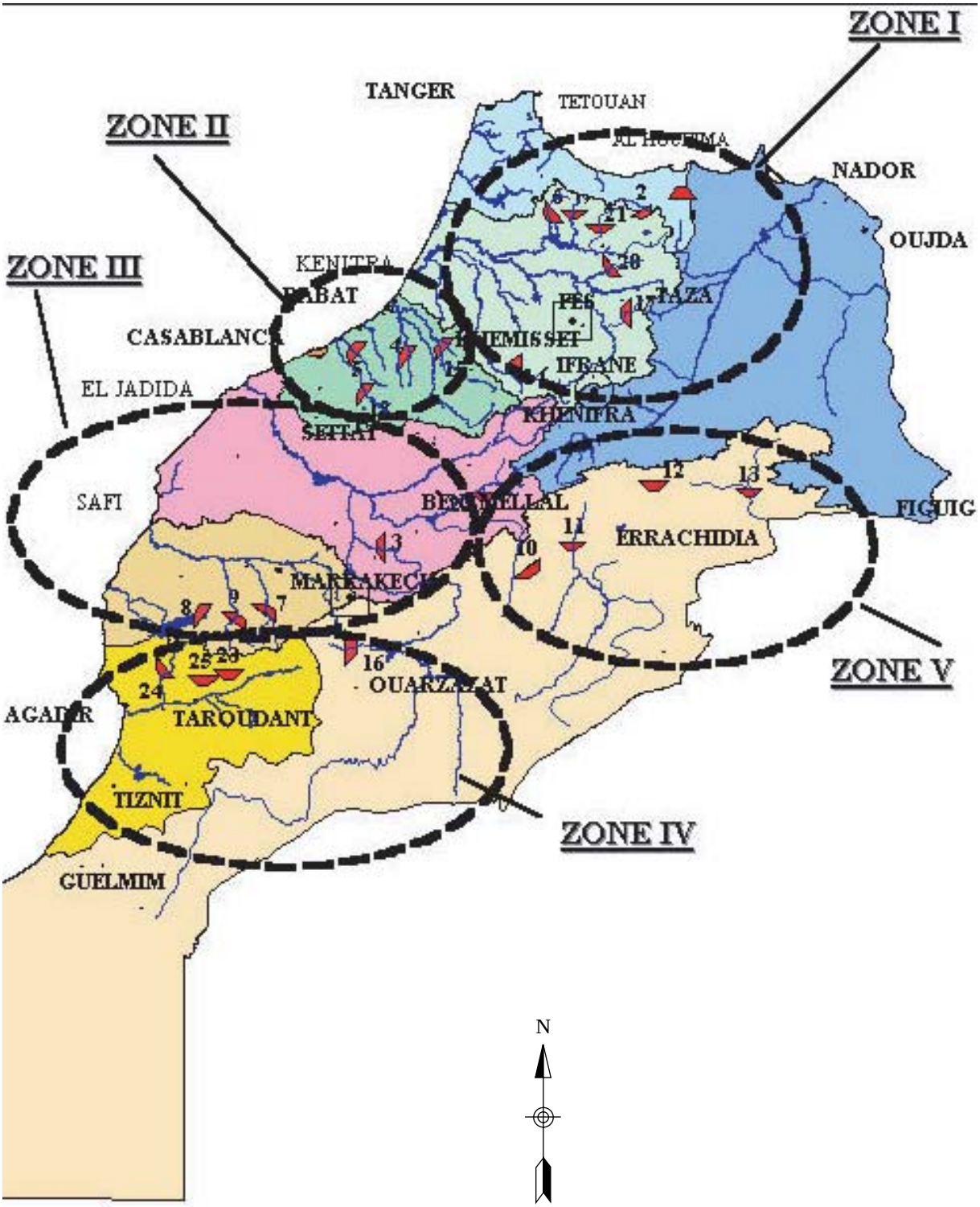
FEASIBILITY STUDY ON WATER RESOURCES DEVELOPMENT IN RURAL AREA	**Figure S2** **General Plans of Taskourt (No.9)**
JAPAN INTERNATIONAL COOPERATION AGENCY	



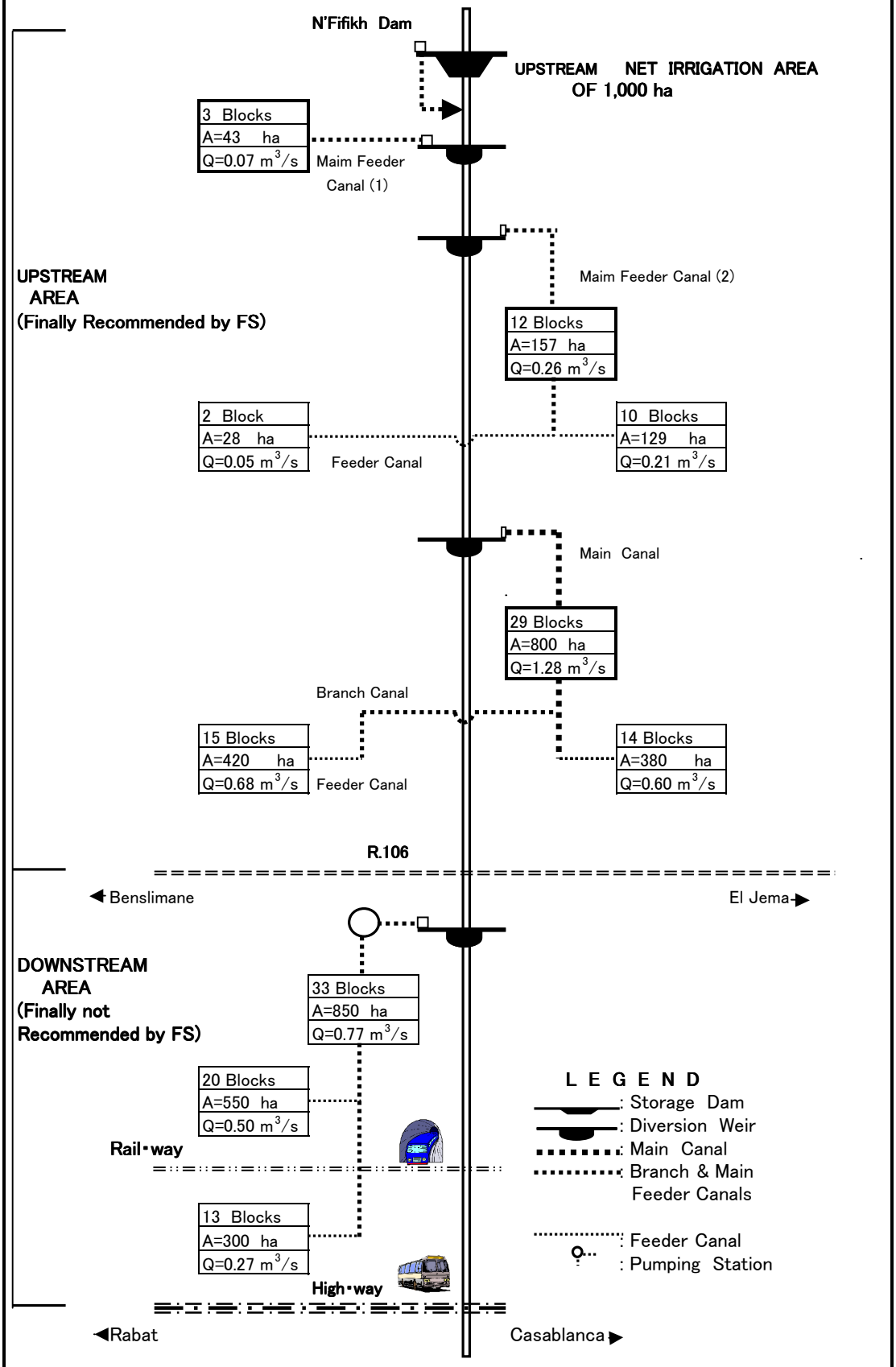
FEASIBILITY STUDY ON WATER RESOURCES DEVELOPMENT IN RURAL AREA	**Figure S3** **General Plans of Timkit (No.10)**
JAPAN INTERNATIONAL COOPERATION AGENCY	



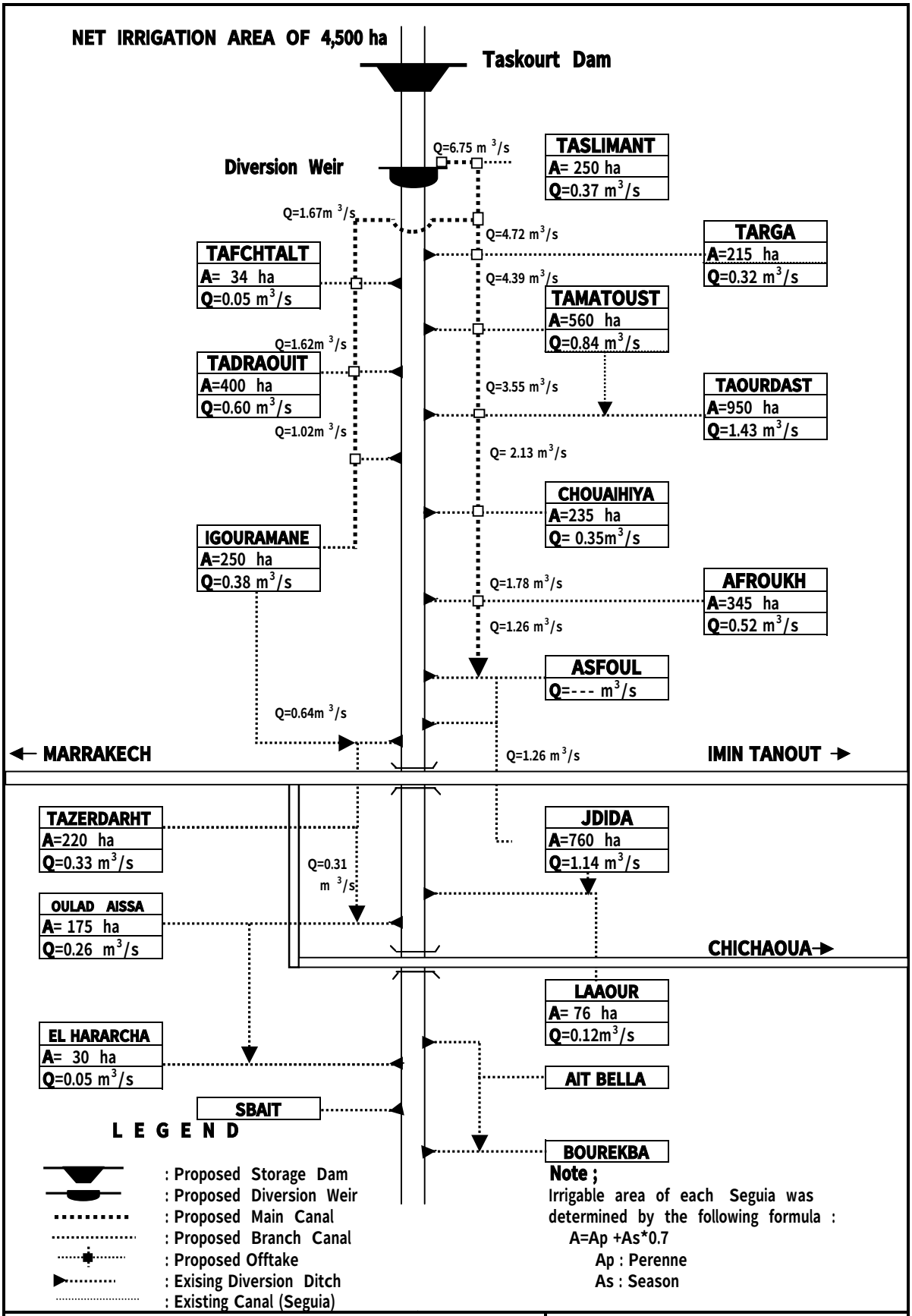
FEASIBILITY STUDY ON WATER RESOURCES DEVELOPMENT IN RURAL AREA	**Figure S4** **General Plans of Azghar (No.17)**
JAPAN INTERNATIONAL COOPERATION AGENCY	



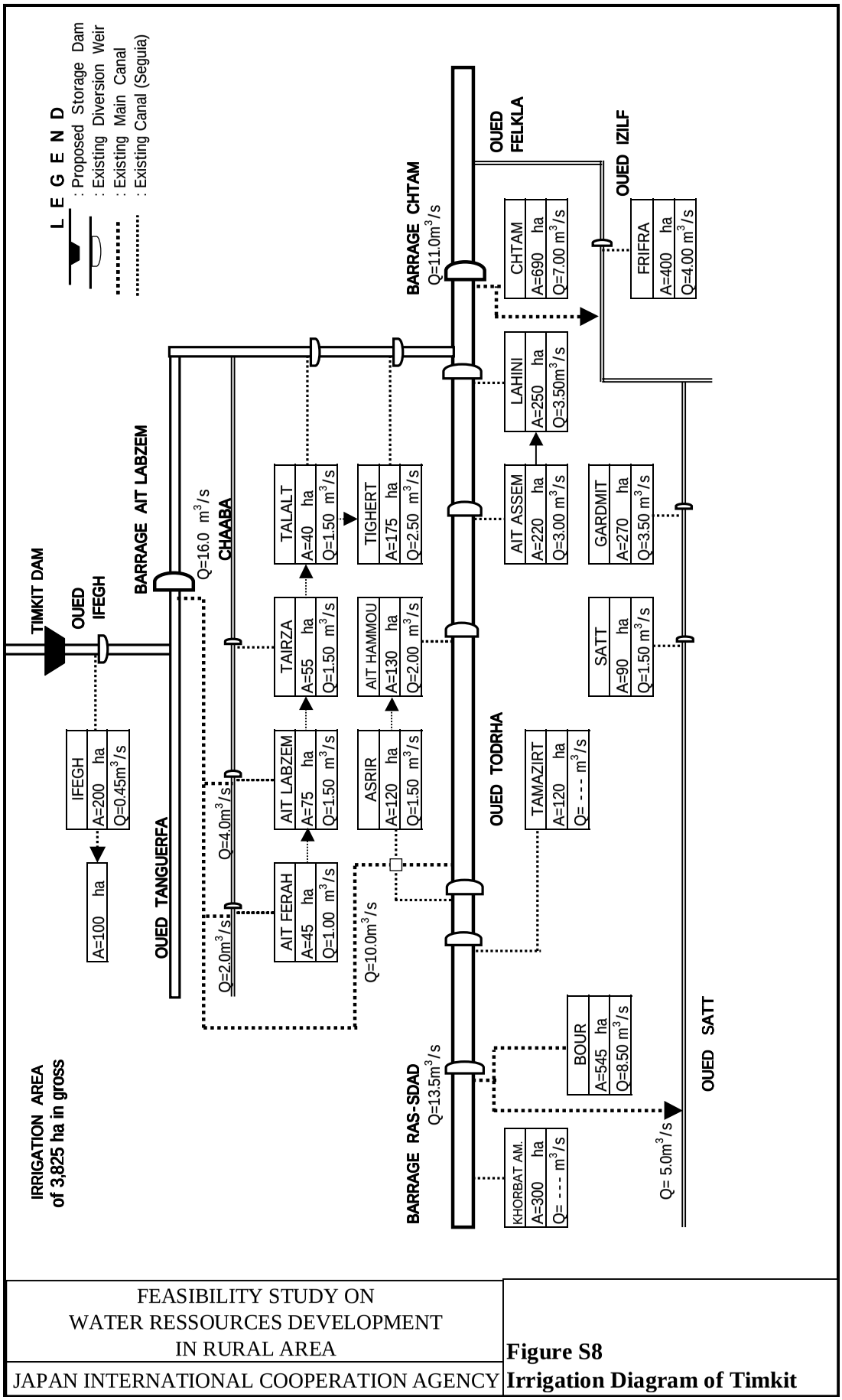
FEASIBILITY STUDY ON WATER RESOURCES DEVELOPMENT IN RURAL AREA	**Figure S5** **Agencies Boundaries and Study Zones**
JAPAN INTERNATIONAL COOPERATION AGENCY	



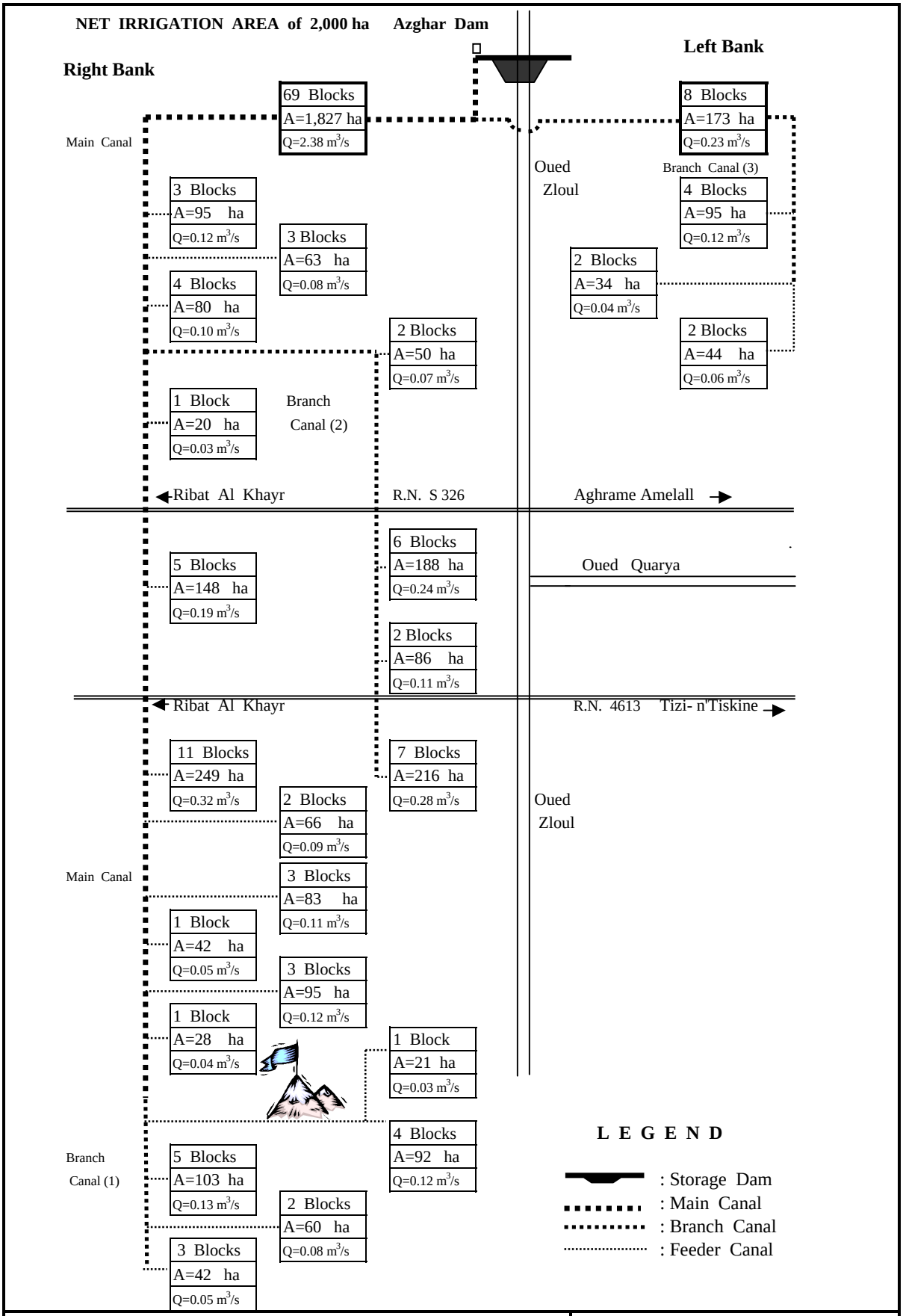
FEASIBILITY STUDY ON WATER RESSOURCES DEVELOPMENT IN RURAL AREA JAPAN INTERNATIONAL COOPERATION AGENCY	**Figure S6** **Irrigation Diagram of N'Fifikh**



FEASIBILITY STUDY ON WATER RESSOURCES DEVELOPMENT IN RURAL AREA	**Figure S7** **Irrigation Diagram of Taskourt**
JAPAN INTERNATIONAL COOPERATION AGENCY	



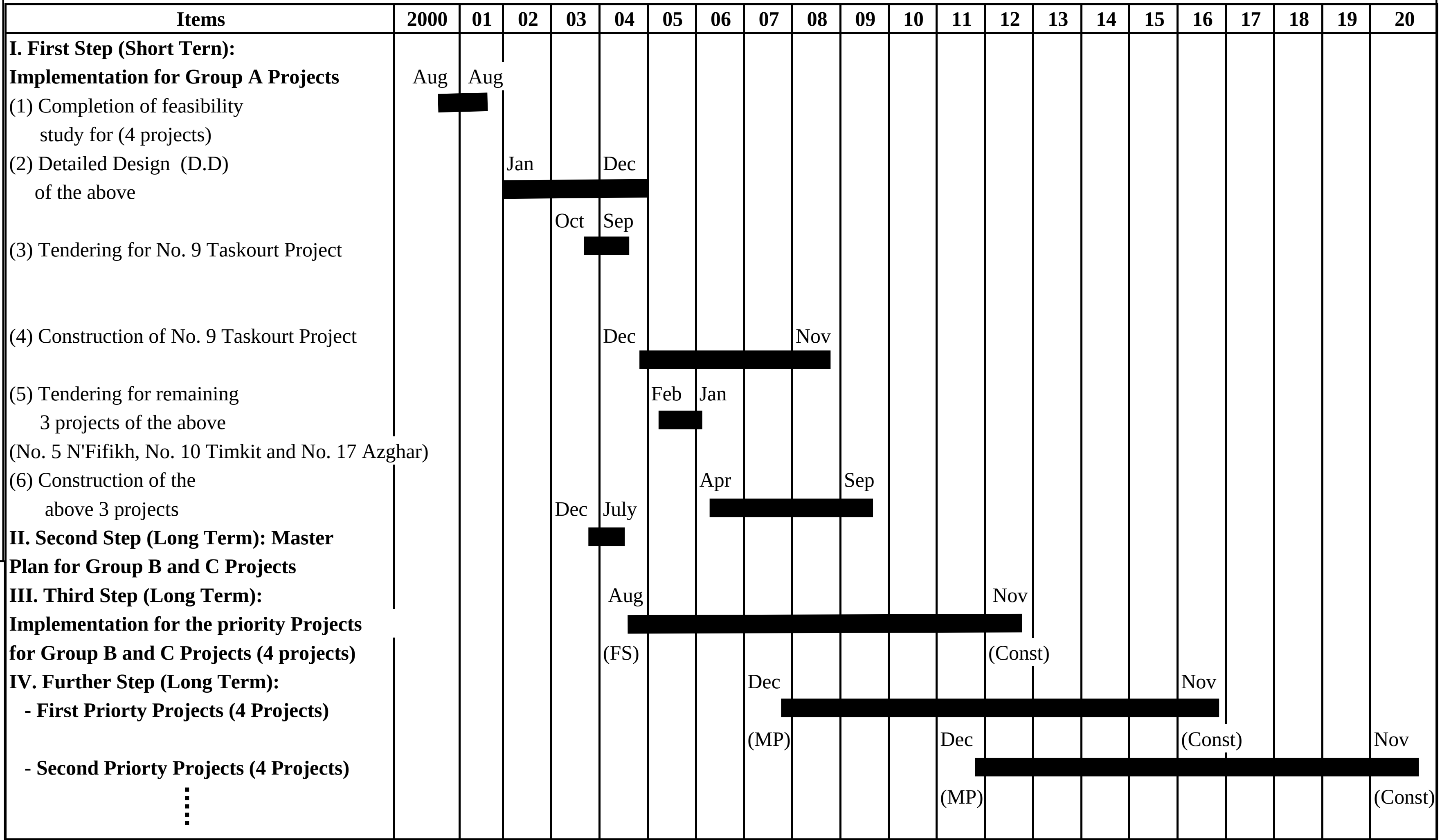
FEASIBILITY STUDY ON WATER RESSOURCES DEVELOPMENT IN RURAL AREA	**Figure S8**
JAPAN INTERNATIONAL COOPERATION AGENCY	**Irrigation Diagram of Timkit**



FEASIBILITY STUDY ON WATER RESSOURCES DEVELOPMENT IN RURAL AREA JAPAN INTERNATIONAL COOPERATION AGENCY	**Figure S9** **Irrigation Diagram of Azghar**

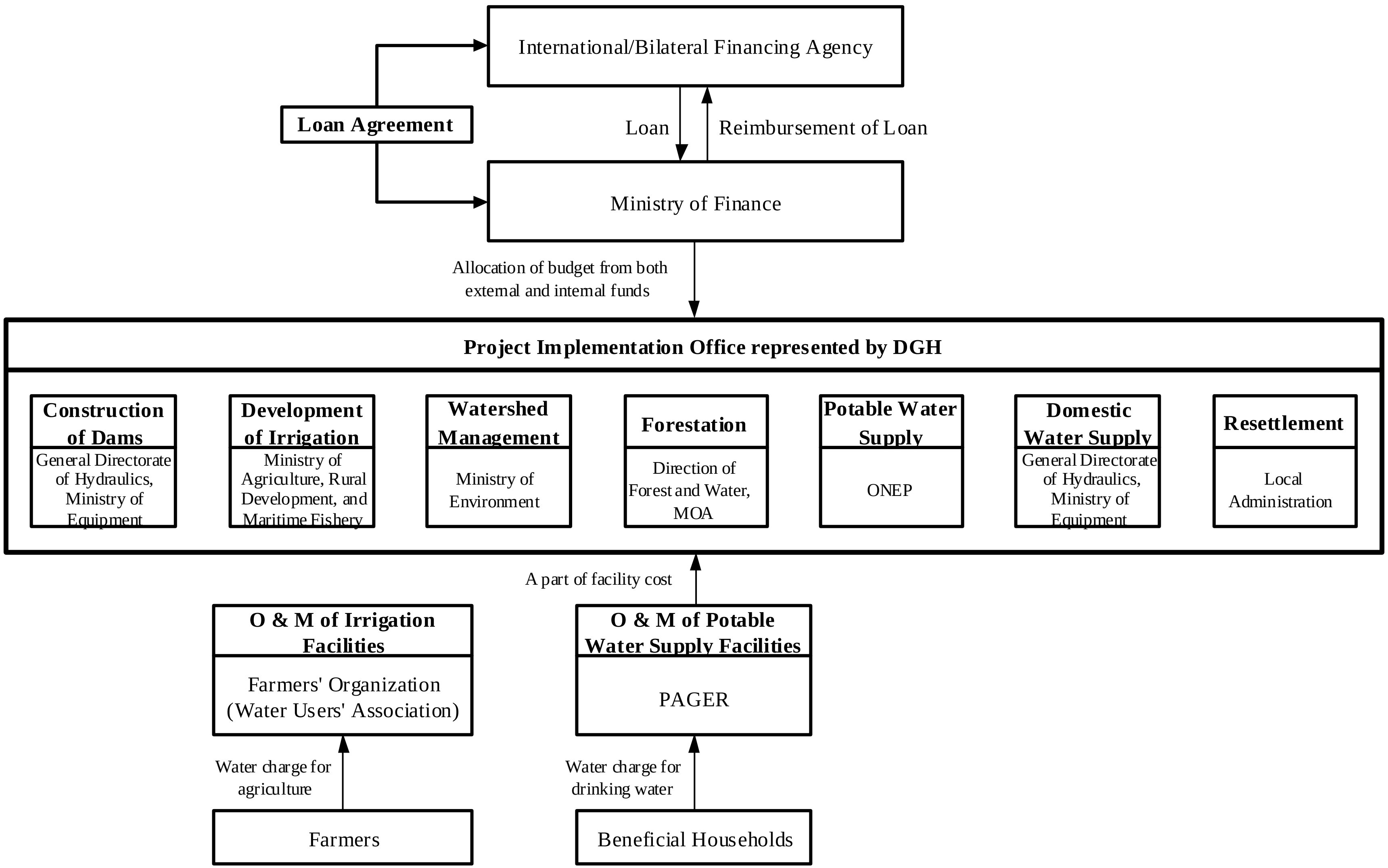
JAPAN INTERNATIONAL COOPERATION AGENCY

FEASIBILITY STUDY ON
WATER RESOURCES DEVELOPMENT
IN RURAL AREA



Remarks:
1) FS: Feasibility Study
2) MP: Master Plan Study
3) Const: Construction

Figure S10
Overall Implementation Schedule for Medium-Scale Dams



FEASIBILITY STUDY ON
WATER RESOURCES DEVELOPMENT
IN RURAL AREA

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Figure S11
Organization for Project Implementation