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 II

MAIN REPORT

AUGUST, 2001

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

LIST OF FINAL REPORT VOLUMES

Volume I: Executive Summary

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Data Book AR:	***Aero-Photo and Ground Survey***
Data Book GC:	***Geology and Construction Materials***
Data Book HY:	***Hydrology***
Data Book SO:	***Soil Survey***
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.

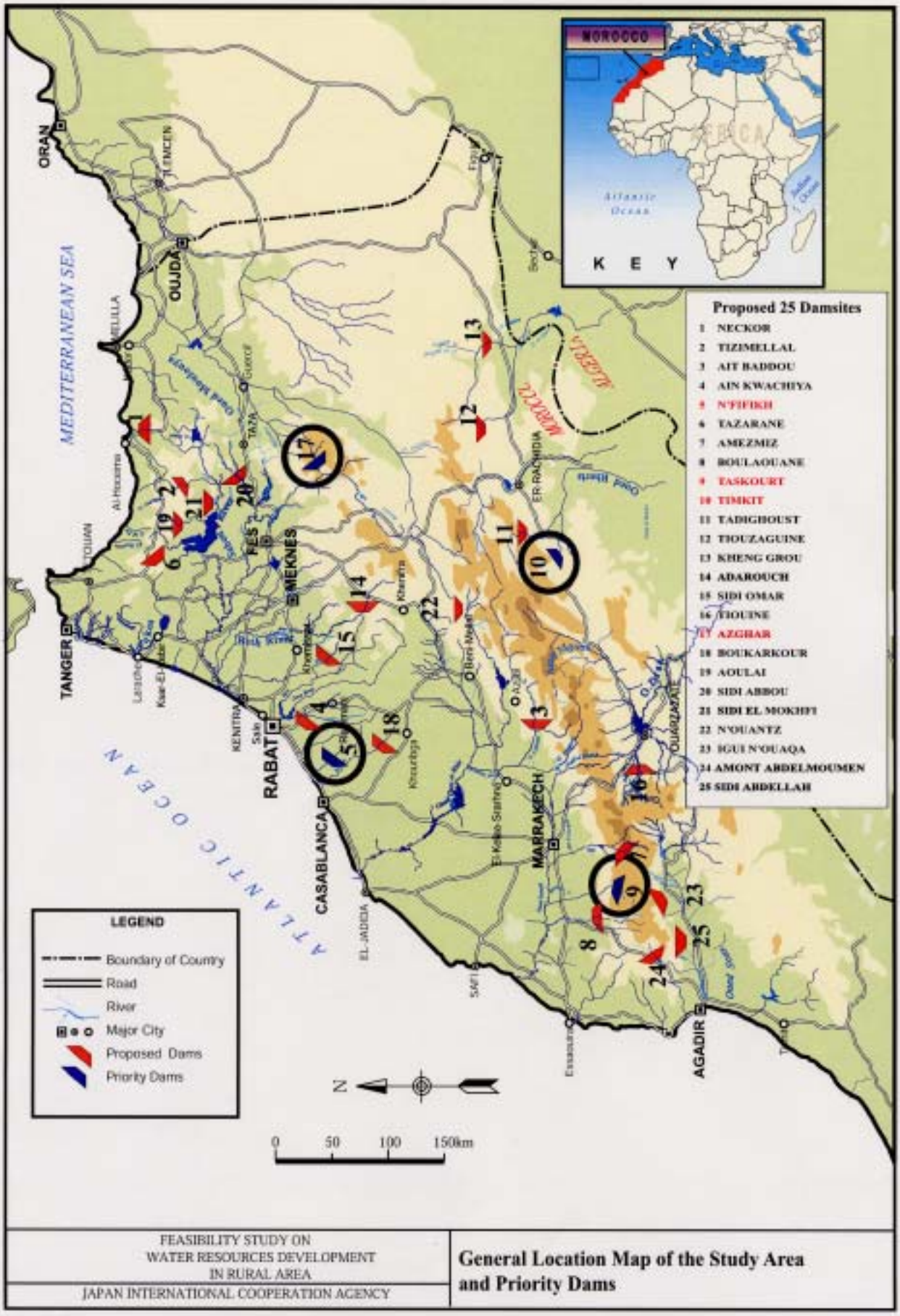
We hope that this report will be helpful for water resources development in rural areas in the Kingdom of Morocco.

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

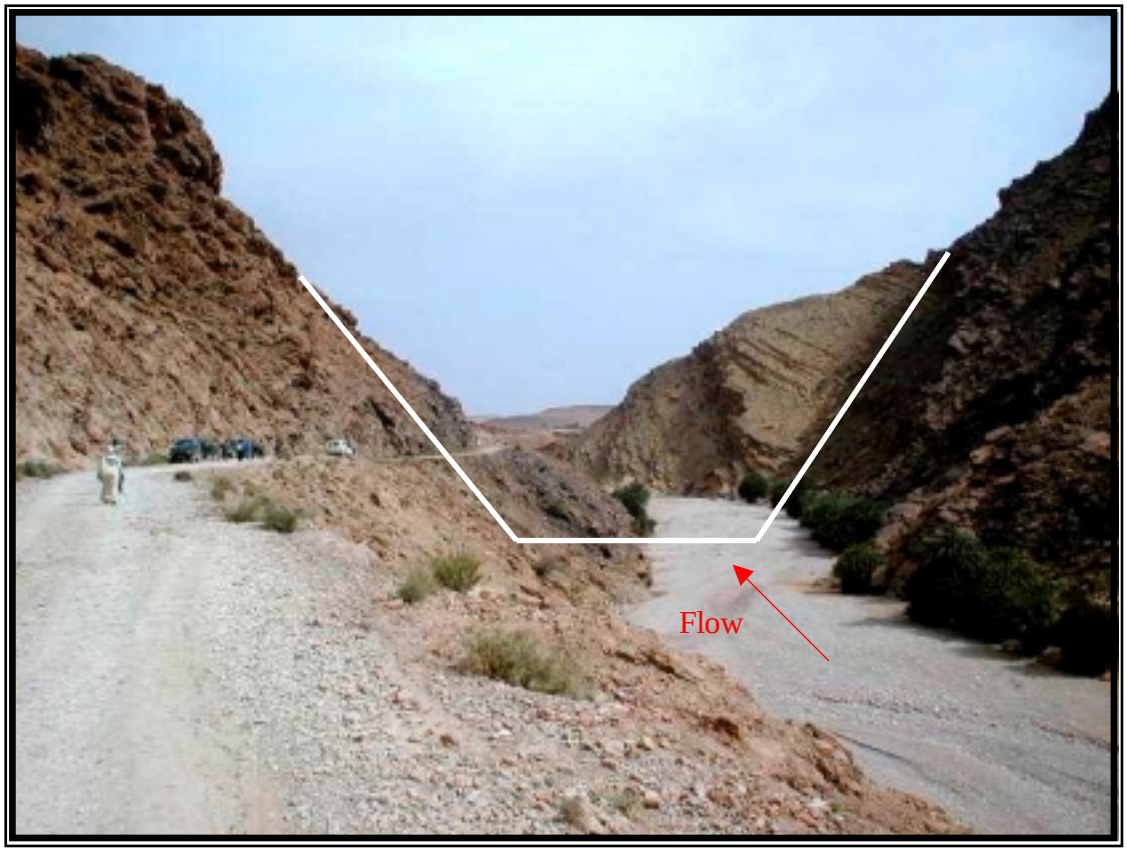
General Location Map of the Study Area and Priority Dams

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
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THE KINGDOM OF MOROCCO

FINAL REPORT
VOULME II
MAIN REPORT

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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 DevelopmentCenter	**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

CHAPTER 1 INTRODUCTION

1.1 Authority

This is the Final Report on the Feasibility Study on the Water Resources Development in Rural Areas in the Kingdom of Morocco (hereinafter referred to as "the Study"). The Report was prepared in accordance with the Scope of Work agreed upon between the Ministry of Equipment (hereinafter referred to as the "MOE") and Japan International Cooperation Agency (hereinafter referred to as "JICA") on September 16, 1999 as shown in Attachment A and B. The JICA advisory committee and persons in charges in JICA, and steering committee in the Moroccan government are listed in Table 1.1.1.

Part I of this Final Report presents the results of the Basic Study on the 25 dam projects carried out in the Phase I work. The presentation is made for examination of the basic development strategy with respect to zoning of the Study area, dams development, domestic water and agriculture, control of flood and sedimentation, and recharging of groundwater. It also presents the criteria for prioritization of the 25 dam projects from various aspects to select the four priority projects for the Feasibility Study that was conducted in the Phase II work. These four projects were identified as N'Fifikh (No. 5), Taskourt (No. 9), Timkit (No. 10) and Azghar (No. 17).

Part II of this Report incorporates the results of the Feasibility Study for the selected four priority projects. It presents the findings of natural and socio-economic conditions, examination of water resources, development plan of dams, domestic water supply, agriculture and mini-hydro power, control of flood and sedimentation, and recharging of groundwater. Part II also illustrates the preliminary design and cost estimates, economic evaluation, and natural and social environmental assessments.

Further, in the Part II, the conclusions and recommendations of this Study are described. It consists of implementation projects, implementation schedule, organization of project implementation, financing of project cost, construction supervision and evaluation as well as operation and maintenance.

1.2 Scope of Work

1.2.1 Objectives of the Study

The Study has two phases, Phase I and Phase II, with the following objectives:

(1) to formulate the water resources development plans for the middle-scale dam projects proposed by 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 based on the water resources development plans by mid July 2001 (Phase II, Feasibility Study), and

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

1.2.2 Study Area

The Study Area covers the river basins for 25 dam sites investigated and proposed by MOE. Location of the Study Area and the four identified priority dams are shown in the location map. The principal features of the respective dam projects presented by MOE are listed in Table 1.2.1. Development plans of the priority selected dams of N'Fifikh (No. 5), Taskourt (No. 9), Timkit (No. 10) and Azghar (No. 17) are shown in Figures 1.2.1 to 1.2.4, respectively.

1.2.3 Scope of Work

The Scope of Work for the Study and the Minutes of Meeting signed on September 16, 1999 are shown in Attachment-A and Attachment-B, respectively. The Scope of Work stipulates Objectives of the Study, Study Area, Scope of the Study, and Schedule of the Study, Reports, the undertaking of both the Moroccan and Japanese sides.

1.3 Field Investigation and Study

1.3.1 Phase I: Basic Study

The Study was commenced in December 1999 by the preparation of the Inception Report in Japan. The Work Schedule and list of the Study Team Experts and their counterpart personnel are shown in Tables 1.3.1 and 1.3.2. The Study Team dispatched the first mission to Rabat in February 2000 for the initiation of the Phase I work.

The Directorate General of Hydraulics (DGH) of MOE organized a steering committee for the project inviting personnel from the Ministry of Agriculture, Rural Development and Marine Fisheries (MOA), and National Office of Potable Water (ONEP) in accordance with the Scope of Work.

Discussions were made on the study principle, basic approach, methodology, work plan, study team structure, study reports and other necessary arrangements, which were incorporated in the Inception Report. Discussion was held among MOE, other concerned organizations (steering committee), Advisory Committee of JICA and the Study Team. Minutes of Meeting were prepared and signed in February 21, 2000 as shown in Attachment-C.

The Study Team carried out the Study in collaboration with the officials of DGH, MOA and ONEP by holding meetings of the parties, including the Steering Committee members, and submitted a Progress Report (1) to MOA on May 29, 2000. A joint meeting was held on June 1st, 2000 for presentation and discussion on the report. Minutes of Meeting were prepared and signed on June 2, 2000 as shown in Attachment-D.

The Team continued the Study in Japan to further examine the development scenario to formulate a basic plan for the development of water resources in the rural areas as the output of the Phase I work. The output was compiled in the Interim Report, and submitted to JICA at the end of July 2000.

1.3.2 Phase II: Feasibility Study

The Phase II fieldwork in Morocco was carried out for five months commencing from September 2000. The JICA Study Team explained the output of the basic study in a meeting held on September 14, 2000 to the Steering Committee (DGH, MOA and ONEP) in the presence of the Advisory Committee of JICA on the basis of the Summary of the Interim Report. Discussion focused on the evaluation of the 25 dam projects and the selection of the four priority projects of N'Fifikh (No.5), Taskourt (No.9), Timkit (No.10) and Azghar (No.17) for the Feasibility Study. Minutes of Meeting were prepared and signed on September 15, 2000 as shown in Attachment-E.

The project features of Feasibility Study, such as beneficial areas, and location, type as well as scale of facilities were discussed with the Steering Committee members. The major points of the discussion were to identify the issues involved in the implementation, operation and maintenance and to find respective solutions for the Feasibility Study. The confirmation work with the related agencies was made to minimize the adverse effect and to maximize the integrated benefit with other projects. Several Minutes of Meeting were prepared for the important meetings for the confirmation of the projects features.

At the end of the Phase II fieldwork, the Team submitted Progress Report (2) to MOE. An official joint meeting was held on January 18, 2001 for the confirmation of the important matters regarding the four projects and further studies to be carried out in Japan. Minutes of Meeting were prepared and signed on January 19, 2001 as shown in Attachment-F.

The Team continued the Study in Japan for two months in February and March 2001 to prepare the Draft Final Report, which compiled all the results of the Basic Study as well as the Feasibility Study of the four projects.

The JICA Study Team dispatched the final mission to Rabat in May 2001 for submission of the Draft Final Report to MOE. The report was explained to and discussed with member agencies of the Steering Committee for the Project such as DGH, MOA and ONEP, individually and jointly, in a series of meetings held during the stay of the Study Team accompanied by representative of the Advisory Committee of JICA. Minutes of Meeting was signed between DGH and Study Team representatives in June 1, 2001 as shown in Attachment-G.

Finalization of the report was conducted in Japan incorporating comments and suggestions of the Steering Committee and the Final Report was submitted to JICA at the end of July 2001.

1.3.3 Transfer of Technology Seminars

According to the scope of work, two Transfer of Technology seminars had to be conducted during the course of the study. The first transfer of technology seminar was carried out on September 21, 2000. The seminar presentation consisted of four subjects of:

(1) Dam planning and its comparison between Morocco and Japan;

(2) Hydrological characteristics and flood control in Morocco;

(3) Irrigation planning and water demands; and

(4) Significance of resettlement plans in dam construction.

The second transfer of technology seminar was carried out on May 25, 2001. The topics of the seminar presentation consisted of three subjects of:

(1) Introduction for the Feasibility Study (FS) on Water Resources Development in Rural Area in the Kingdom of Morocco

(2) Economic Evaluation; and

(3) Sub-surface Dam in Japan

Part I Basic Study

PART I BASIC STUDY

CHAPTER 2 NATURAL CONDITIONS AND EXISTING WATER RESOURCES FACILITIES

2.1 Physiography and Geology

Morocco is located at the northwestern end of the African Continent. Morocco, which occupies an area of 710,850 ^{km2}, stretches between 1°00' and 17°00' west longitudes and between 21°30' and 35°05' north latitudes.

It is characterized largely by the four mountain chains of "Rif", "Moyen Atlas", "Haute Atlas", and "Anti Atlas". Two other areas extend among them, one of which is Morocco Central Area in the western side, and the other is Olanaise Plateau in the eastern. The Sahara Desert occuupies a large area in the southern side (Figure 2.1.1).

The Rif Mountains is one of the Alps Orogenic Mountains. Their northern slopes generally face the Mediterranean Sea, forming a rocky coastline, with rivers pouring into the sea. The southern slopes gradually go down to the Prérif-hillock area and all the rivers are confluent to the Ouergha River.

The Atlas Mountains extending in the south are divided into Haute Atlas and Moyen Atlas. The Haute Atlas extends 800 km from east to west, 40 to 80 km wide, having their higher peaks around 4,000 m. The Moyen Atlas extends about 200 km to the northeast, some 10 km wide, with peaks ranging from 2,000 to 3,000 m (Figure 2.1.2).

The Morocco Central Area extends to the south from "South Rif Depression", so called as "Central Morocco Méséta". Olanaise Plateau is the highland with elevation of more than 1,000 m between the Haute Atlas and the Moyen Atlas.

The Anti Atlas forms the periphery of Western Africa Craton orienting parallel with the Haute Atlas having their peaks around 2,500 m.

Morocco's geology is structurally divided into four regions as follows:

(1) Rif Province of Northern Morocco is the area of the islands arc from Rif Mountains to Prérif Hillocks, which consist of the overthrust and metamorphosed mass with Ophiolite. Basement rocks are of the orthogeosynclinal deposits of Hercynian to Caledonian, or partly of Precambrian.

The northern part of Rif province ranges Limestone–Dolomite of Triassic, Lias and Paleozoic group composed of Crystalline Schist, or partly Ultarabasics. The central part is composed of Schist and Marl, which is so-called "Rif Facies". Its northern side is the so-called "Flysh Nappe" composed of Flysh and Pelagic Sediments Facies napped from Mediterranean Sea, while southern side is of autochtonous rocks of Cretaceous, Jurassic to Miocene. The southern part is hillock area composed mainly of Mudstone and/or Marl undulating gently, which is so-called "Prérif Zone". Inside zone is of autochtonous Jurassic and Cretaceous, and Outside zone is of allochtonous Nappe until Lower to Middle Miocene.

(2) The Méséta, Haute Atlas and Moyen Atlas belong to Central Morocco. Méséta Province is the Caledonian to Hercynian geosynclinal zone with strongly folded Flysh deposits. The Atlantic coast side is composed of Triassic, the northern side towards Rif is of Lower to Middle Jurassic, and the southern side of the border with Haut Atlas is of Upper Jurassic and Lower Cretaceous and "Phosphate Plateau" of Upper Cretaceous to Eocene. Basement rocks are of Paleozoic partly granitized.

The Haute Atlas is structurally divided into:

- Ancient Massif of Western Haut Atlas; precambrian and partly granitized Paleozoic.
- Central and Eastern Haute Atlas (Calcareous Haute Atlas); very thick marine deposits of Lower to Middle Jurassic; Limestone is dominant; covered by the geosyncline of Cretaceous and the geoanticline of Triassic.

The Moyen Atlas a Triassic to Jurassic mountain. Olanaise Méséta, belonging to Atlas Mountains Province, consists of structural plain, highland and hills. Atlas Mountains Province is limited south by the "South Atlasic Fault". Then along this, some depressed areas are developed and Alluviums extend in this area. These faults may be compatible with the Hercynian Lateral Fault.

(3) Anti-Atlas Province in Southern Morocco consists of Paleozoic and Infracambrian, which were deformed by Hercynian Orogeny. As a result, some middle scale of folding and fault develops and vertical schistosity is accompanied.

(4) Sahara Structural Plain extending further southwards is the area of Western Africa Craton.

The details of the geological study are shown in Supporting Report I.

2.2 Climate and Hydrology

2.2.1 Climate

General climatic features are described for each hydrological region. The detail results of the hydrological study are shown in Supporting Report II.

(1) Northern Rif Region:

Mediterranean sub-humid type climate prevails in the west, becoming semi-arid toward the east near Al Hoceima City. Climate of this region is characterized by a wet season from September to April and a dry season for the rest of the year. This region receives a large amount of rainfall with annual mean of 700 – 800 mm, though the rainfall reduces to about 350 – 400 mm east of the Lao river. Due to the high rainfall, the region' surface water is one of the most productive of the country. While having only 2.9% of the national territory, the region has about 20% of country's water resources potential.

(2) North-Central Atlantic Region:

The climate is influenced by both the Mediterranean and Atlantic Ocean. The mean annual rainfall is about 500 mm, varying significantly by locations from 2,000 mm in the Rif mountains to 250 mm in Haouz. The region is the biggest recipients of water resources produced in the mountainous ranges of the Rif and the Atlas. The region, with 19% of the national territory, has 56% of the water resources potential of the country.

(3) Eastern Region:

This region, represented by a single river basin of the Moulouya, is located in the east of the Rif and the Atlas mountains. The climate is arid with Mediterranean type in the northeast, continental type in the middle Moulouya and mountain type in the upper Moulouya. The annual rainfall is about 250 mm. However, it varies from 400 mm in the Mediterranean and high Atlas areas to 200 mm in the middle Moulouya. The seasonal flow distribution is significantly irregular.

(4) West-South Atlantic Region:

The climate is arid type attenuated by the influences of the Atlantic Ocean as well as the relief altitude. The annual rainfall is about 230 mm on average with significant variation toward the east and south. The eastern region situated in the High Atlas has more rainfall of about 400 mm.

(5) South-Atlantic and Sahara Region:

The climate is classified generally as arid type with some moderate arid areas in higher places. Rainfall is the lowest in the country with annual average of 85 mm, which occures irregularly, concentrating in some days of the year. However, annual rainfall is relatively high in the Draa (400 mm) and Guir basins (200 mm).

2.2.2 Hydrology

The surface area of Morocco is divided into 13 major river basins grouped in five regions. The 25 dam sites selected for the present Study are distributed over 9 of these basins, excluding those of Tangerois, Lukkos, Moulouya and Sahara. The detail results of the hydrological study are shown in Supporting Report II.

For most of the rivers in Morocco, source of flow is rainfall. Some of the central-western basins such as the Sebou and Oum Er Rbia rivers receive snowmelt water. General characteristics of annual flows by regions are shown below:

General Characteristics of Annual Flow by Regions

Region	Basin Area (km^2)	Annual Rainfall	Annual Flow	
		(mm/yr)	(Mm^3/yr)	(mm/yr)
Northern Rif Region	20,600	700 - 800	4,200	204
North-Central	132,500	500 - 2,000	11,500	87
Atlantic Region				
Eastern Region	57,500	250 - 400	1,650	29
West-South Atlantic Region	35,400	200 - 400	780	22
Atlantic Region				
South-Atlantic - Sahara Region	464,850	85 - 200	2,400	5.2

2.3 Soils

French Soil Classification (C,P,C,S, 1967) was applied to classify the soils of Morocco. The basic concept of this classification is based on the soil morphological conditions concerning with the climatic conditions, topographic features and parent materials, etc. Major soils in Morocco are Sols Peu Evolues, Vertisols, Sols Calcimagnesiques and Sols Isohumiques. The Sols Peu Evolues D'Erosion (Entisols in the soil classification of United States taxonomy system (Soil Taxonomy)), which have A and C layers widely lie on the internal mountain areas. These soils are not well developed with less weathering and show the characteristics of parent rocks.

They have relatively shallow soil layer and are easily eroded. Sols Peu Evolues D'Apport (Entisols, Aridisols), which have alluvial deposits that lie on the area along the rivers, show similar characteristics with Sols Peu Evolues D'Erosion and are rather weathered. The vertisols lie on the northern areas of Fes and southern areas of Casablanca and El Jadia. These soils have A[B]C profile, which have high water holding capacity. The soils have high clay contents (35–40%) and high cation exchange capacity ranging from 35 to 40 me/100g. The Sols Calcimagnesiques (Inceptisols, Mollisols) widely lie on the areas covering the northeast areas in Nador and Taza. These soils are developed on the parent rock and have the AR or AC profile, in which B-horizon does not occur. Surface soil has light texture and accumulation of organic matters, which are linked with minerals. The soils are more than 90% saturated with calcium and magnesium.

The Sols Sesquioxydes de Fer (Alfisols) mainly lie on the costal areas from northern Tanger to El Jadia, and have ABC or A[B]C horizons. These soils are gray or brown in color due to minerals and high base saturation (more than 50%) and low organic matter contents. The Sols Isohumiques (Inceptisols, Mollisols) lie on the areas of Fes, Beni Mellal, Marrakech and Taroudant. These soils are developed on the limestone or enriched limestone by the alternation of constitutive minerals. The soil profile shows A[B]C or ABC which contains more than 15% of organic matters in A horizon. Exchangeable bases are mostly saturated by calcium and magnesium, but there are some soils which content exchangeable sodium.

The Sols Brunifies lie on the areas located between Khemisset and Kenitra. These soils have developed horizons with A[B]C or ABC and are characterized by humus with strong biological activities. The characteristics of the parent rock are not so prominent, though they are of high humus and clay complex.

The Sols Hydromophes (Inceptisols, Arfisols) lie on the areas of Benslimane and south of Casablanca. These soils have developed under the condition of strong effect of hydromorphic phenomenon. They have accumulation of organic matter with anaerobic condition. The Sols Sodiques can be found only near Tanger with high salt contents in the soil layer. The soils lie near the border of Algeria and Mauritania, and the areas of south Sahara have not been surveyed well. It seems that the soils developed on these areas show similar characteristics of Sols Mineraux Bruts Entisols, which are only physically weathered with less precipitation and high temperature. The map on the soil map in Morocco is shown in Figure 2.3.1.

2.4 Water Resources Potential and Present Development Condition

Full-scale development of water resources has commenced since 1980 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, approximately 8 billion m^3 have been developed, 7 billion m^3 for irrigation and 1.0 billion m^3 for domestic and industrial water. Out of 5.0 billion 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. Therefore, total amount developed so far is estimated at approximately 11.8 billion m^3.

2.5 Natural Environment Conditions

The Government of Morocco has a management network system for the areas that are biologically and ecologically representative in Morocco. The primary objective of this system, sites of biological and Ecological Interests (SIBE), is to form a conservation network to ensure protection and sustainability of the significant ecosystems in Morocco. SIBE was established in 1995 covering 22 biological zones with 160 sites with three categories (Priority A: 48 sites, Priority B: 50 sites; Priority C: 62 sites). Sites classified into Priority A 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 B and Priority C are also protected, and activities such as hunting and fishing are restricted within the area. The detail results of the environmental study are shown in Supporting Report IV.

CHAPTER 3 SOCIAL AND RURAL CONDITIONS

3.1 Socio-economy

3.1.1 General

The capital of the Kingdom of Morocco is Rabat. The country is divided into 16 regions that consist of 50 provinces and 17 urban prefectures. They are further divided into 160 Circles that consist of 1,544 rural and urban communes. The locations of the major cities and provinces are shown in Figure 3.1.1.

3.1.2 Population

(1) Population of Morocco

The total population of Morocco was 26,073,717 according to the latest population census in 1994. The population censuses were conducted in the years of 1960, 1971, 1982, and 1994. The results of the censuses are summarized below.

Population of Morocco, Urban and Rural

Year	Urban		Rural		Total Population
	Population	%	Population	%	
1960	3,389,613	29.1	8,236,857	70.9	11,626,470
1971	5,409,725	35.1	9,969,534	64.9	15,379,259
1982	8,730,399	42.7	11,689,156	57.3	20,419,555
1994	13,407,835	51.4	12,665,882	48.6	26,073,717
Annual mean growth rate (%)					
1960-1971	4.3		1.8		2.6
1971-1982	4.4		1.5		2.6
1982-1994	3.6		0.7		2.1

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

The population growth in the urban area has been remarkably high through all the census periods. It is probably due to influx of population from rural areas.

(2) Population in the Study Area

The population of the provinces and prefectures located approximately in the zones defined in this Study is summarized in Table 3.1.1. The population growth of the urban areas in Zone IV and Zone V is remarkably high at more than 6 % annually through all periods.

Table 3.1.2 shows the population and number of households by the provinces and prefectures in the Study Area in 1994. The average family size in urban area is 5.3 persons while that in rural area is 6.6 persons.

The population projection made by the Statistics Bureau (Direction de la Statistique) is presented in Table 3.1.3 and summarized below.

Population Projection by Provinces and Prefectures in the Study Area

Zone	Population Census in 1994 (1,000)	Population Projection (1,000)		Annual Average Growth Rate		
		2000	2010	1994-2000	2000-2010	1994-2010
Zone I	5,044	5,532	6,340	1.6%	1.4%	1.4%
Zone II	5,293	5,932	7,148	1.9%	1.9%	1.9%
Zone III	7,171	7,727	8,561	1.3%	1.0%	1.1%
Zone IV	2,636	2,683	3,267	0.3%	2.0%	1.4%
Zone V	639	684	750	1.1%	0.9%	1.0%
Total	20,783	22,558	26,066	1.4%	1.5%	1.4%

Relatively lower population growth has been estimated comparing with the previous results. The provinces and prefectures in Zone II and Zone IV have the highest population growth projections while those in Zone V have the lowest.

3.1.3 Labor Force

The economically active population is defined as persons aged 7 years and over who are working and persons aged 15 years and over who are working or looking for a job. The economically active population in Morocco was 8.3 million and it accounted for 32% of the total population aged 7 years and over in 1994 as shown in Table 3.1.4.

The population of the economically active women is small at 1.75 million and it accounts for only 13% of the population of women. The unemployment ratio of Morocco was high at 16% in 1994. The unemployment of women was remarkably high at 23.1%. The unemployment in 1982 and 1994 is shown in Table 3.1.5. The unemployment in the urban area increased remarkably during these 12 years between 1982 to 1994. Probably this occurred due to rapid population growth of the urban area with influx of population from rural areas.

3.1.4 Economic Conditions

(1) Gross Domestic Product

Gross Domestic Product (GDP) of Morocco in 1998 was 341,385 million DH (approximately US$ 33 billion) and GDP per capita in the same year can be estimated at 12,291 DH (approximately US$ 1,170) as shown in Table 3.1.6.

Average annual growth rate of GDP during the 10 years from 1988 to 1998 was 2.7% at 1980 constant price basis. However, the average annual growth rate of GDP per capita was 0.9% on the same basis. This shows that the economic growth has not caught up with the rapid population growth.

Table 3.1.7 and Table 3.1.8 show GDP by industrial origin in current and 1980 constant price. The secondary and tertiary industries had been stable and growing favorably. However, the primary industry including agricultural sector had fluctuated much according to the weather conditions, GDP, and the performance of the agricultural sector. However, agriculture performance is very significant since it is providing a living for approximately 40% of the labor force.

(2) Export and Import

The merchandise trades balance of Morocco runs a structural deficit, with exports covering approximately two-thirds of imports. Exports had been increasing slightly faster than imports and the trade deficit had narrowed by 1997. However, it widened again in 1998 as shown in the table below:

Merchandise Trade of Morocco (Million DH)

	1994	1995	1996	1997	1998	Annual mean growth
Export (FOB)	50,965	58,672	60,013	67,057	68,608	7.7%
Import (CIF)	76,059	85,493	84,612	90,712	98,676	6.7%
Balance	-25,094	-26,821	-24,599	-23,655	-30,068	

Source: Annuaire Statistique du Maroc 1999

The export of phosphates and phosphate by-products accounted for 20% of total exports in 1998. The second largest items were textiles and leather. The import of energy and lubricant accounted for 42% of total imports in 1998. The second largest import was wheat and it accounted for 5% of total imports.

Details results are shown in Supporting Report III.

3.2 Existing Water Resources Development Plans

Master Plans for basin-wide water resources development were prepared after the 1980s, while sector basis plans were prepared before then. The water resources development master plan is prepared by the Ministry of Equipment incorporating policies and plans of the government agencies relevant to water resources development such as Ministry of Equipment (dam), Ministry of Agriculture (irrigation), Ministry of Energy (hydro-power), Ministry of Commerce and Industry (industrial water), Ministry of Health, Ministry of Environment, Ministry of Interior, ONEP (municipal water), etc., on the following process.

1) Evaluation of existing conditions of water resources.
2) Study on water resources.
3) Site investigation.

4) Study on water demand: Municipal (potable and industrial) water, irrigation water, hydropower generation, etc.
5) Water balance study.
6) Development scenario.
7) Comparison of alternative schemes and selection of an optimum scheme.

The master plan is put into practice after approval of the Superior Council for Water and Climate (CSES) presented by His Majesty the King. The master plan has already been prepared for all basins, and some of them have been approved by the CSES.

Dams in Morocco are primarily classified into small and large dams. The dams which are more than 30 m in height and have annual inflow that exceeds 1 million m^3 are generally classified as a large dam. Medium-scale dams are those of the large dams, which are constructed directly by the Ministry of Equipment because of immediate need for implementation and other reasons. The dams to be constructed directly by the Ministry would be generally of medium scale.

A total of 89 dams are listed as existing large dams including medium-scale dams. The total storage capacity amounts to 14,160 million m^3.

According to the available data for the existing dams, annual regulated volume is on average about 53% of the storage capacity. If this ratio is assumed, the total regulated volume of the existing dams amounts to about 7,500 million m^3/year. Furthermore, 107 large dams with total capacity of 15,572 million m^3 are proposed for future water resources development. For their implementation, the country is administratively divided into seven (7) hydraulic regions as follows:

1) Regional Hydraulic Directions of Loukkos: Tetouan
2) Regional Hydraulic Directions of Moulouya-Neckor: Oujda
3) Regional Hydraulic Directions of Sebou: Fes
4) Regional Hydraulic Directions of Bou Regreg and La Chaouia: Benslimane
5) Basin Hydraulic Agency of Oum Er Rbia: Beni Mellal
6) Regional Hydraulic Directions of Tensift: Marrakech
7) Regional Hydraulic Directions of Souss Massa and Draa: Agadir

An agency will be established for each of the region. The agency is to be managed on a self-paying basis. The first agency has been established in the Oum Er Rbia River Basin. All the planning procedures and institutions mentioned above are based on the Act 10-95. The details are shown in Supporting Report VI.

3.3 Rural Water Supply

The Government of Morocco has intensively implemented potable water supply projects, especially in urban areas. As a result, quality and safe potable water is being supplied to almost all inhabitants in urban areas at this moment.

Total production of potable water in urban areas was 780 million m^3 per year for 13.7 million inhabitants in 1997. This production volume was secured by ONEP (80% in share), state own companies (12%), a private sector corporation (Elyo, 5%), and urban communes (3%). Meanwhile its distribution was secured by the state own companies (for large cities, 40% in terms of subscribers number), two private sector corporations (Lydec for Casablanca and Redal for Rabat, 31%), ONEP (for medium and small size cities, 26%) and communes. Rate of urban population connected to potable water network in home was 83% in 1997, and it is targeted to increase up to 96% in 2010.

In rural areas, however, development of adequate potable water supply had been rather frustrated due to their characteristics. Therefore in 1990, the Government of Morocco launched a study on "Master Plan for the Development of Rural Potable Water Supply", which is the so-called "National Master Plan", aimed at a new strategy of development in rural potable water sector. That study, conducted by the Ministry of Equipment with support of UNDP, confirmed extent of difficulties experienced by the rural populations.

As reported in this National Master Plan, only 14% of the rural populations were at the time satisfactorily provided with public water supply facilities. The rest were inadequately supplied by extracting from private wells, springs, stocked rain, river water or transportation from other areas beyond administrative boundaries. Out of about 40,000 villages in total throughout the country, 46% had less than 200 inhabitants per village, 49% had between 100 and 200 inhabitants and barely 6% had more than 1,000 inhabitants. Such low population per village has been a major factor restricting implementation of potable water supply project in rural area.

The Superior Counsel for Water and Climate (CSES) approved the National Master Plan study result in the 8^{th} session in 1994. Based on that, the Government of Morocco launched Program of Group Water Potable Supply to Rural Population (PAGER) in 1995 aiming at increasing access rate to public water supply system in rural area from 14% up to 80% by providing 31,000 adequate water sources for 11 millions rural populations. The PAGER consists of the following two major components:

(1) Execution by ONEP of 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.

(2) Development by the General Directorate of Hydraulics (DGH) of water points from various sources such as springs and wells, etc., in the vicinity of villages located in areas where no ONEP main water pipe exists, and provision accordingly the necessary pumping equipments.

Due to intensive execution of the PAGER up to now, access rate of rural population to public water supply system has increased from 14% to 38%. Production and distribution is much secured by communes (96%), meanwhile ONEP intervenes above by 4%.

Even the access rate has been increased greatly in the rural area, the value itself is still far lower compared to the urban area; therefore, further endeavors in project implementation is highly needed.

3.4 Agriculture

3.4.1 Land Use

The total area of farmland in Morocco is approximately 8.7 million ha. The forest area (including natural and afforested area) and rangeland cover approximately 3.7 million ha and 0.50 million ha, respectively.

In recent five years, the total farmland has not been changed, although the cropped area has changed year by year depending on agro-climate condition.

According to the agricultural survey carried out in 1997/98, the cultivated area of cereal crops occupied 67% of the total farmland. The area for cereal cultivation including wheat (hard and soft), barley and maize is 6.22 million ha. Barley is the major cereal, followed by soft wheat, hard wheat, and maize.

Fruits cultivation occupies the second largest area, which covers 9% of the total farmland or approximately 815,000ha. In fruits land, olive is cultivated throughout the country, whereas other fruits such as almond, grapes and dates are cultivated depending on the agro-climate conditions as well as geographical variations. Olive occupies about 57% of fruits land, followed by almond (14%), citrus (8%), grapes (7%) and dates (4%).

Olive trees cultivated in the flat areas are dense and those cultivated in mountainous areas are scattered. Almond trees are basically cultivated in the mountainous and hilly areas where soil and topographical conditions are relatively poor.

Legumes, vegetables and fodder cultivation are the third largest in land use. Cultivated areas for legumes, vegetable and fodder are approximately 255,000ha, 241,000ha and 220,000ha respectively.

Vegetables are mainly cultivated in northern coastal areas facing the Atlantic Ocean, Agadir and Marrakech areas where large cities are located, and Oujda areas in northern part of Morocco.

3.4.2 Irrigation

Since the last 20's, the politics of irrigation of large areas has entered the economic and social politics of the country and has continued to gain importance priority by the mid 60's. Since then, irrigation has maintained its status in economic politics. Irrigated areas in the perimeters of large hydraulics (GH) have increased year by year until now. Furthermore, irrigated areas in the perimeters of small and medium hydraulics (PMH) have expanded since the late 80's.

Irrigation water in the perimeters of the GH and PMH come from dams and/or from pumped groundwater. The majority of the perimeters are supplied by dam water while pumped groundwater is used as a complement with an amount depending on the humidity level of the years and seasons. Therefore, during the drought years, the farmers resort more to groundwater to alleviate or overcome the negative effects of drought. In Morocco, irrigation area is classified into three categories in terms of irrigated condition

(1) Perennial irrigation,

(2) Seasonal irrigation and

(3) Flooding irrigation.

The perennial irrigation is defined that the beneficiary area is perennially irrigated by means of impounding water in a reservoir together with supplemental groundwater. The seasonal irrigation is defined that the beneficiary area is irrigated using water from non-perennial small rivers without storing water. The flooding irrigation is defined as irrigable only when the flooding water reached to the beneficiary area, where some ditches are excavated to convey floodwater.

Of the total arable land with an area of 8.7 million ha, irrigation area at present is approximately 1.3 million ha consisting of 1,000,000 ha (large scale irrigation: 670,000ha, and small and medium scale irrigation: 330,000 ha) of perennial irrigation, and 300,000 ha of seasonal and flood spreading irrigation (Figure 3.2.1).

The relatively limited hydraulic potential available in the country remains insufficient with respect to the potentiality of land pedologically suitable for irrigation. Also, different uses of water and consumptive needs for drinking and industrial water limit the potentiality of continuous irrigation to 1,360,000 ha divided as 850,000ha for the GH and 510,000ha for PMH. In addition to this potential of continuous irrigated land, there are about 300,000 ha of lands irrigable seasonally and by spreading floodwater.

3.4.3 Agricultural Production

(1) Crop Production

Cereals are the major crop produced in Morocco. As mentioned in the proceeding paragraphs, about 67% of farmland has been occupied by cereal cultivation. However, the production has been strongly affected by weather condition. The production of cereals in recent 11 years has changed between 1.75 million tons (1994/95) and 9.98 million tons (1995/96) and the yield of cereals has also changed between 0.4 and 1.6 ton/ha. Total production of cereals was 5.09 million tons in 1998/99. Out of this production, wheat (hard), wheat (soft), barley and maize occupied 21%, 32%, 40% and 7%, respectively. The trend of production and yield of each cereal crops from 1988/90 to 1998/99 shows similar situations.

Major fruits are olive and citrus, which produced 550,000 tons and 1,591,000 tons in 1997/98, respectively. The cultivated area of fruits was increased, while the yields are changing year by year, which may be caused by the change of climate and affect of diseases. Main vegetable crops are potato, tomato, onion, sweet melon and watermelon. The productions of these vegetables in 1995/99 are 1,141,000 tons, 857,000 tons, 523,000 tons, 467,000 tons and 230,000 tons, respectively. Recently, the vegetable cultivation in green houses increased and its total cultivated area and production were 7,800 ha and 652,000 tons in 1998/99, respectively. Major vegetables produced in green houses are tomato, pepper, sweet melon, cucumber and green beans. Major production areas are Massa, El Jadida, Lopukkor and Gharb.

(2) Livestock

Livestock is also important agricultural activity in Morocco. Breeding of cattle, poultry and goat/sheep has been widely carried out and these numbers are approximately 2.56, 16.58 and 5.11 million heads in 1999. Camel breeding has mainly carried out in the dry land areas including Ouarzazate, Essaouira, Er Rachidia and south Sahara, and total number of camels is approximately 149,000 heads. Horse, mull and donkey have been utilized for cultivation and transportation, and their total numbers is 1.68 million heads. Beside, the feeding of goat and sheep by nomads has been still carried out in Morocco.

3.4.4 Agricultural Economy

(1) Import and Export of Agricultural Production

The import and export of agricultural products are shown in Figure 3.4.1. Morocco has imported a large amount of wheat, which amounted for 1.19 million tons in 1994 and increased to 2.58 million tons in 1998 equivalent to 3,728 million DH. This value represents almost half of the total agricultural products imports.

Sugar, seeding potatoes and milk products were followed and their import values were 1,470 million, 137 million and 644 million DH, respectively. Total import value of agricultural products occupies 14% of the total value of imports. Amount of imported wheat is large as 35% of total domestic consumption. Important agricultural commodities including staple foods such as wheat and livestock product (milk) also depends on the imports, nonetheless these production has been main agricultural production in Morocco. Major exports of agricultural product from Morocco are citrus, fresh tomato and shellfish. Fruits and vegetables are mainly exported to Europe, and fisheries products are exported to Japan. Total export value of agricultural products covers 3.2 % of total value of exports.

(2) Land Ownership and Farm Mechanization

- Size of Land Hold

The average size of land hold per farmer is 5.78 ha in Morocco. Small farmers who consist of 58% of total farmers with less than 3 ha occupied only 12% of total farmland. While, the large scale land hold farmers who have more than 20 ha occupied 32% of total farmland against 4% of total number of farmers. Tenant farmers also exist and their number is 64,400. Figure 3.4.2 illustrates the rate of land occupancy by size of landowner.

- Land Ownership: Land ownership in Morocco summarized as follows;

Private farm (Melk):	Private property farm owned by person
Grouping farm (Collectif):	The rural community farm operated under rain-fed cultivation. Farmers divide benefit, but once the area is irrigated, land will be distributed to farmers and farmers have responsibility for its expense.
Habous:	Land for Islamic properties.
Guish:	The area distributed to soldiers from old king. System is not existing, but land ownership is still remaining.
Public farm: (Domain de L'Etat)	Public farm under local government

The occupancies of these land ownerships are private farm (75%). grouping farm (18%), Habous (1%), Guish (3%) and public farm (3%).

(3) Farm Economy

- Farming Input

Ministry of Agriculture, Rural Development and Fisheries have so-called "Standard" which estimates the general condition without and with project at traditional and modern cultivation. According to their information on this, almost no ertilizers and agricultural chemicals are applied in the cultivation of cereal and legume. In vegetable cultivation, manure and chemical fertilizers (N, P, K) are applied in the amounts of 10 to 20 tons/ha, 37kg/ha as N, 28kg/ha as P2O5, 14kg/ha as K2O, respectively.

- Non-agricultural activities of farmers

Many farmers are getting a certain income to help their activities beside agricultural income. About 79% of total farmers are only engaging in agricultural activity and depending on their income. Remaining 21% of farmers are working and getting income other than agricultural activity. Major jobs are services, governmental administration, private business and construction. However, their actual value of income has not identified.

- Farm Income and Expenditure

The Study Team has estimated the farm income and expenditure to find out the present situation of farmer's economic condition on 25 proposed project sites. The estimate is based on distribution of cultivated crop area, yield, actual and estimated farm-gate price, total consumption of fertilizer in Morocco and estimated farmer's expenditures. The net income in 25 proposed project sites varied from 1,556 DH/ha to 9,575DH/ha with an average of 4,871DH/ha. Major incomes are from cereals, fodder and fruits cultivations. Income from vegetable cultivation represents also important income source in some area.

3.4.5 Agricultural Extension and Supporting Services

(1) Institutional Arrangements for Extension Services

The Directorate of Development, Education and Research under the ministry of Agriculture, Rural Development and Fisheries has overall responsibility for extension related activities. There are four Divisions under the said Directorate (Figure 4.7.2), Division of Extension, Division of Professional Education, Division of Research and Higher Education and Division of Employment Education. At the Regional level there are nine Regional Offices for Agricultural Development (ORMVA) and at the Provincial level there are 40 Provincial Directorates of Agriculture (DPA), which are responsible for agricultural extension activities.

The main responsibilities of ORMVA are to develop irrigation infrastructures, promote and improve livestock and crop practices. It formulates, monitors and coordinates hydro-agricultural development activities, agricultural developments, water related administration etc. The extension activities for irrigated areas are the responsibility of ORMVA and it is represented by 180 Agriculture Development Centers (CDA) in local level. Each CDA has extension services in irrigated areas.

Extension activities for non-irrigated or rain-fed areas are the responsibility of DPA. At the Circle or Commune level there are 122 Work Centers and sub-centers staffed by technicians who provide all agricultural and livestock extension services. A Director heads each Work Center and there is a multidisciplinary team to carry out the extension services. There are altogether 4,200 extension workers of which 2,300 are in Work Centers and 1,900 under ORMVA.

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 etc.

(2) Development of Agricultural Extension Services

Soon after the independence from France in 1956, the Moroccan Government started national Agricultural Extension Services. Those services included not only technological advices but also supply of inputs, credits, marketing information, farmers' association etc. In recent years, between 1990 and 1998 Extension-Research Project (PRV) and Agricultural Development Support Project (PSDA) were implemented. PRV introduced Training and Visit (T&V) method. PRV was implemented in 56 Work Centers i.e., half of the 122 Work Centers. Those Works Centers were distributed into three groups i.e., Pilot Work Centers (17), Test Area (25) and Work Centers of Integrated Project Areas (14). The World Bank financed PRV, which reinforced the relationship between the services of extension, research, training and the farmers for a better transfer of technology. It introduced "Training and Visit (TV) method.

PSDA encouraged the farmers to develop professional organizations. During the same period, eight Regional Centers for Agricultural Development (CREPA) were established at Benslimane, Amezmiz, Oued Amlil, Tanant, Chefchaouen, Khenifra, Khemisset and Tlet El Hanchane to train the young farmers. During eight years (1990-1998), 4,000 persons were trained. To counsel rural women on agricultural matters female extension workers' teams were established.

(3) Agricultural Extension in Agricultural/Rural Development Programs

Several Integrated Agricultural /Rural Development Projects were implemented in Morocco from the late 1970's. The trend of the development of Extension Services was intensified by the implementation of Integrated Agriculture/Rural Development Projects. Under the Projects, priority was accorded to the agricultural development, livestock development, irrigation, extension services, employment generation, education etc. Recent Integrated Rural/Agriculture Development Projects, such as "Integration of Population Education in Agricultural Extension Program (1993-96)", "Tafilalet and Dades Valley Rural Development Program (1993-99)", "Agricultural Development Back-up Project (PSDA, 1994-98)" and "Occidental Rief Mountain Area Development Project (1995-2001) has intensified extension services.

(4) Agricultural Research

There are several well-established research institutions in Morocco. The Directorate of Education, Research and Development under the MOA is in charge of guidance, coordination, follow-up and evaluation of research programs and activities. The National System of Agricultural Research (SNRA) comprises, the National Institute of Agronomic Research (INRA), the National Center of Forestry Research (CNRF), and the Department of Experiment, Tests and Standardization (SEEN). INRA has produced significant results on genetic improvement of cereals as well as fruit trees. Specialized consulting laboratories are opened for farmers in the various regional centers of the INRA. Various commodity specific, subject specific and area specific research programs have led the development of some improved technologies in major cereal crops, fruits etc. For the purpose of technology transfer, the Regional Research Centers of INRA work in collaboration with extension workers.

Besides the research institute under MOA, there are three higher educational institutions, the Hassan II Agronomic and Veterinary Institute (IAV Hassan II), the Meknes National School of Agriculture (ENAM) and the National Forestry School of Engineers (ENFI) and there are 14 Agricultural Technical Institutes (ITA), nine Agricultural High Schools, 18 Centers of Agricultural Qualification (CQA) and three Centers of Formation, Research and Development (CFRD).

3.4.6 Agricultural Credit

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 9 DRD (DRD: Decentralized Regional Directorate), 81 CRCAs and 285 CLCA of which 132 are permanently established and 153 are temporarily established. CNCA is the biggest lending agency for the agricultural sector in Morocco. It is the main source of credit in rural areas. CNCA provides credit both to the large scale and small-scale farmers.

Loans are provided for agricultural production such as the purchase of seeds, fertilizer, insecticide, farming machinery and land improvement. It also grants loans for domestic marketing of products, product processing, packing and exports as well as fishing, forestry and rural tourism. The maximum amount of the loan to be provided by the Bank depends upon various factors i.e., risk factor, types of customers, types of loan to be granted and mortgage capacity of the farmers. Credit is provided for short term (1 year or less), medium term (less then 5 years), and for long term (more then 5 years), and the rate of interest varies between 9% and 12 % according to the period and the type of loans provided. Farmers who need a comparatively small loan use CLCA and big farmers as well as agricultural industries that need a large one use CRCA. The outstanding loans in 1999 were 18 billion DH and recovery rate was about 70%. The credits granted by the CNCA only represent 14% to 20 % of the agricultural funding needs while commercial banks contribute up to 3%. Although farmers in Morocco utilize non-institutional loans, which are from relatives or friends without paying any interests, its share is estimated to be very nominal.

CNCA also provides banking services, such as deposits, saving accounts, letters of guarantee and currency exchange. The main source of funds is borrowings from international development agencies, deposits and bonds.

3.4.7 Agricultural Marketing

(1) Marketing of Agricultural Products

The marketing system of all agricultural commodities have been fully liberalized, however there exists some control for soft quality wheat as the staple in Morocco. The government has a policy to keep 10 thousand tons of soft quality wheat for lower income families. ONICL (L'Office Nationale Interprofessionele des Cereals et des Legumineuses) under the supervision of MOA 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. It is estimated that about 80% of the soft quality wheat goes through the free markets. The share of soft quality wheat collected by cooperatives is in decreasing trend. In 1986 it was about 50% and in 1996 it declined to 20%, while the share of traders and mills is in increasing trend. Mills were authorized to collect only from 1994.

Private small traders dominate the marketing of other food crops, including vegetables, fruits and livestock products. The procurement at village level is typically direct contact between traders and farmers. There are weekly markets called "Souk" in the rural areas.

Most of the agricultural products are sold there. Some retailers from the town area contact those markets for vegetables, fruits and food grains collection. The prices are determined by bargaining. The marketing of industrial crops like olive and sunflower is quite different. Agro industries make direct contact with the producer or buy through the farmers' cooperatives.

(2) Marketing of Agricultural Inputs

The marketing of agricultural inputs, i.e., fertilizer and pesticides has been completely liberalized. Government roles are confined to provision of market information, monitoring of market performances, quality control, research and promotion etc. However, the Government provides subsidies for cereal seeds. Fertilizer, which is the mixture of imports and domestic production, is distributed through FERTIMA and other sources. It is estimated that about 70% of fertilizer is distributed through the nationwide network of FERTIMA. There are also other private companies who import directly from foreign countries or buy from the main supplier and sell it in retail. More than 50% of the fertilizers are imported which is in increasing trend. In 1998/99 418,150 ton was imported.

The importation share of Ammonitrate (33.5%) was the biggest followed by Urea (46%) Sulamm (21%). The domestic production of ASP (14-28-14) was the biggest followed by SSP (18%), ASP (19-38-0) and DAP (18-46-0). Other agro chemicals and seeds are obtained through authorized private shops and there is an association of seed traders (SONACOS). There is an annual variation in sales quantity due to the weather conditions.

3.4.8 Farmers' Organizations

In local level, Work Centers, the MOA and ORMVA initiate, assist and help farmers to organize and form cooperative or associations. According to the documents Project de Plan de Development Economique et Social: Periode 1999-2003, Commission "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' associations and 540 water users' associations. There are several professional farmers' organizations in rural areas, such as service cooperatives, dairy cooperatives, sheep breeding, apple marketing cooperatives etc. In irrigated areas there are water users' associations (AUEA) either recognized or traditional. Even traditional associations have internal regulations transmitted from generations to generation.

Those associations take care of all the management problems, planning, allocation of irrigation water and maintenance of canal etc. According to the above-mentioned document, the major actions undertaken to strengthen the agricultural cooperatives and professional associations are as follows:

(1) working out an action plan for the reform, adjustment and development of cereal cooperatives dealing mainly with the improvement of management

(2) The upgrading of production capacities and the extension of farmers' participation

(3) Achievement of studies and audits regarding wine-producing cooperatives and some milk cooperatives

(4) The follow-up of the main cooperatives management

(5) The development of partnership with some professional associations in the sectors of stockbreeding, oleaginous plants and seeds

(6) The elaboration of work-plans for the professional development of olives, sugar, oleaginous, textiles and Seeds plants…etc sectors.

There are 37 Chambers of Agriculture in 16 Economic Regions in the country and there is a Federation of Chamber of Agriculture established in 1919 and reorganized in 1962 soon after the independence. Its major role is to be the bridge between the government and the farmers.

3.5 Social Environment Conditions

The recent studies of the BM, BAD and FAO (Report BM, No. 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 formers. 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 population supply, the population demand and the imbalance between the two.

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 a frame structure and farmer have not been clarified. Actually, farmers do not know exactly what is expected to the public service of popularization.

Concerning the gender in development, essential role of the farming women has shown many things for the family plan, economic and social culture. 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/< PR/014).

Conscious of these problems, the MADRPM has organized cells for feminine animation in the DPAS and the ORMVAS from the 1980s. Recent study has pursued the feminine animation since its creation in the Ministry of Agriculture in general and in the ORMVAS in particular. The study revealed that these activities are often left far from the priority or not adapted to their socioeconomic environment. Thus, the women do not strengthen their status in their domestic nor communal cell.

The present irrigation project may trouble the women. Some factors related to the woman' s situation were pointed out in the DP achieved by the FAO (DERD, 1999). Among these are:

(1) Illiteracy of women: 90 %;

(2) Needs for the most elementary practice of women who are not adjustable to various situations: AEP, electricity, clinic, etc;

(3) Women who still have obstacles to family planning and limitation of births; Their access to the resources is limited and they do not have sufficient goods on their name, which limits their access to the credit and makes them a most vulnerable group;

(4) Women are not householder, and when it happens (widowed woman, absent husband, husband indebts or non profitable home running requiring exodus) they fall into difficulties. When the householder is a woman, she is rarely invited to meetings organized by the technical services;

(5) Women are less employed in the communal activities (association, cooperatives) in spite of their status of householder, which makes them difficult to get communal status;

(6) Themes of popularization do not target the importance for women, because their activities and ability are not known; and

(7) This situation is resulting from absence of lucid strategy in favor of the woman and weak representative of popularization in quantity and quality.

CHAPTER 4 GOERNMENT POLICY

4.1 Long Term Government Policy

The objectives of the 2020 Government strategy for rural development are to mitigate rural differentials by alleviating poverty, and providing a well-balanced investment to the potential development. The policies set up within the framework of "The 2020 Strategy for the Rural Development" could be summarized as follows:

(1) Water related policies

- to increase agricultural production to meet the internal food demands as well as foreign marketing demands.
- to rehabilitate the natural potential development especially in view of water resources development.
- to improve services related to life style and living standard, in particular, health, potable water, electrification and transportation.

(2) Other policies

- to update and improve the education and professional training of local people.
- to increase employment opportunity and revenues for the people in the rural areas.
- to create and diversify jobs in the rural areas.

This chapter reviews Government policies that are embodied in the Five Year National Development Plans as well as Integrated Master Plans that are related to the water resources and rural developments in line with the Government's long term strategies.

4.2 Hydraulic Sector Plan

4.2.1 Integrated Master Plans

Long term Government policy until the target year of 2020 with regard to water resources development is stated in the Integrated Master Plans for water resources in respective river basin, or set of river basins, as follows:

- Integrated Master Plan for Moulouya River basin that was approved by 5th session of CSES in 1990;
- Integrated Master Plan for Sebou, Bouregreg and Oum Er Rbia River basins that was approved by 6th session of CSES in 1992;

- Integrated Master Plan for Northern Morocco basins that was approved by 5th session of CSES in 1993;
- Integrated Master Plans for Tensift River, Souss-Massa River basins and Guir, Ziz, Rheriss and Draa River Basins are in final stage for their study.

Establishing these plans mainly aims to evaluate water demand from different sectors such as potable and industrial water, irrigation and hydropower generation, and to determine optimal integrated scheme of the water resources development.

Allocation of water resources is fixed in the plans to cover demand of different sectors up to 2020 as shown in the table below. Such demand is to be met by local water resources or transfer from resources within or outside of the river basin.

Allocation of Water Resources (Mm^3/year)

River Basin	Potable Water		Irrigation		Maintenance Flow	
	1990	2020	1990	2020	1990	2020
Northern Morocco	110	305	385	925	-	-
Moulouya	75	160	1,170	1,525	-	-
Sebou	230	663	1,550	3,398	-	60
Bouregreg	386	1,270	164	440	-	30
Oum Er Rbia	300	425	1,750	2,230	-	60
Tensift	150	355	1,850	2,740	-	-
Souss-Mass	50	155	915	870	-	-
Guir, Ziz, Rheriss and Draa	23	55	1,326	1,445	-	-
Total	1,324	3,388	9,110	13,573	-	150

Source: Synthese des Plans Directeurs d'Amenagement Integre des Eaux des Differents Bassins du Royaume

4.2.2 Five Year National Development Plan

Major programs of the hydraulic sector, which are listed in the Five Year National Development Plan for 2000/2004, are as follows:

(1) Surface water resources development

The program deals with the implementation of nine large-scale water resources developments, 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. The minimum target of the implementation of the surface water resources development is set as follows:

- Construction of five large-scale dams (Ait Hammou in Agadir, Raouz in Tetouan, AEP of Rabat-Casablanca in Rabat, Wirgane in Marrakech and Safi canal in Safi) and three medium-scale dams (Ait Mzal in Chtouka, Igouzoulane in Essaouira and Adarouch in Ifrane) for drinking water supply;

- Construction of three large scale dams (Dchar El Oued – Ait Messaoud in Beni Mellal, Sidi Said in Khenifra and Ouljet Soltane in Khemisset) and 2 medium scale dams (Chakoukan in Taroudant and Taskourt in Chichaoua) for the reinforcement of irrigation water for the existing areas and to rehabilitate the Zidania canal in Beni Mellal under operation;
- Construction of eight small-scale dams for the areas where the groundwater is insufficient.

An optional program includes the following projects:

- Construction of two large scale dams (Zerrar in Essaouira and Emsa in Tetouan) and one medium scale dams (Bousfoul in Taounate) for drinking water supply;
- Construction of four large scale dams (Assayad in Guelmim, Imizer in Haouz, Mechraa Lahjar in Sidi Kacem and Ifassiyene in Al Hoceima) and five medium scale dams (Timkit in Errachidia, Ain Kwachia in Ben Slimane, Touizgui Remz in Guelmim, N'Fifikh in Ben Slimane, Boulaouane in Chichaoua) for irrigation water;
- Construction of one large scale dam (Mdez–Ain Timedrine in Sefrou) for power generation.

(2) Flood control program

Six projects for the flood control as well as the implementation of waterways for connecting rivers are planned in partnership with local communes.

(3) Program of drinking water supply for rural areas

About 830 million DH is to be invested annually to increase access to potable water from 38% to 62% in rural areas by the end of the Five Year Plan.

The share of the Government is 250 million DH, and the remaining part will be shouldered by the national solidarity tax, in partnership with communes, rural populations and grants.

4.3 Water Supply Plan

ONEP Strategy for potable water supply in the coming five years is summarized as follows:

- Satisfying potable water demand in urban or rural centers that ONEP currently intervenes, with minimal cost as practicable as possible;
- Improvement of accessibility to potable water for low-income populations, providing networks and stand pipes with character of welfare work;

- Proper maintenance of facilities for production and distribution of potable water, so that efficiency of ONEP's activity might be improved;
- Maintenance of quality level of produced water and service for consumers;
- Participation in 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
- Improvement of quality of polluted water, with close cooperation with local government.

Investment program of next five years (1999-2003) by ONEP amounts to 8.12 billion DH. This program schedules provision of facilities for supplying additional 6.8 m^3/s of which 65% is from surface water and 35% from groundwater resources.

4.4 Flood Control

4.4.1 Flood and Sediment Disasters

Flood and sediment disasters in the Study area are mainly caused by flooding and bank erosion. Damages due to debris/mud flows like in the Ourika River were not reported at any candidate dam sites. In addition, characteristics of flood runoff and inappropriate land use can also significantly aggravate the flood and sediment disasters. Since river has little flow most of the time, people are apt to live near the river and even on the riverbed, cultivating lands and constructing irrigation facilities in traditional manners. The flash flood that occurs once in a long while brings about serious damages to these defenceless settlements, facilities and farmlands and occasionally causing loss of lives. Many of the existing dams in Morocco are suffering from sedimentation problems. El Kallabi, Al Wahda, El Kansera and Sidi Driss dams in the Study area are those facing severe sedimentation problems.

4.4.2 Previous Works and Studies

DGH is the main authority responsible for flood control and prevention of sediment disasters of the country. DGH conducts investigation, planning, design and construction for flood and sediment control. The undertakings of DGH cover various types of works such as channel normalization, cut-off channel, intercepting canal, riverbed consolidation, revetment, earth dike, and flood control dam.

Most of these works are implemented in collaboration with the local communes and the MOE, mostly based on the request of the local communes. Therefore, the works are locally oriented and of small scale.

4.4.3 Study on National Protection Plan against Floods

DGH has a program to conduct "Study on National Protection Plan against Floods" under the financial assistance of the IBRD (World Bank). Implementation of this program was basically agreed with the IBRD and the procedures to commence the study is now at the final stage. However, the time schedule for the implementation of the study is not known yet. The study is rather institutional.

The Study aims at defining flood types, preparing synthesized materials of the flood risk zones, analyzing the current situation of the institutional framework, and proposals for its improvement, as well as the formulation of an action plan against floods. The study includes three missions, namely,

- Qualification of the problems caused by flood and control measures of land use in the flood prone areas (Mission 1),
- Diagnosis of existing institutional framework and proposal of improvements and modification to be introduced, as well as, the regulation related to the flood hazards (Mission 2),
- Elaboration of an action plan for the higher and moderate risk zones Mission 3).

4.5 Agricultural Development Plan

4.5.1 Irrigation Development

The action plan concerning the rural development and irrigation in Five Year National Development Plan consists of the following two major components:

Adjustment of the irrigation potential, mainly by reducing the existing gap between the irrigated areas dominated by dams and those without regulation of water; and improvement of the performance of irrigation sector through the following;

- Rehabilitation and modernization of out-of-dated facilities for the upgrading of production tools;
- Adequacy of measures for operation and maintenance for equitable water distribution in order to ensure sustainability of investments;
- Water savings at the level of agricultural lands; and
- Adoption of a system for giving incentives to private farmers.

(1) Projects related to the adjustment of the irrigation potential

National Irrigation Program (PNI)

It deals with the following:

- Completion of the first phase of the PNI which deals with 32,900 ha involving the ORMVA of the Doukkala and Haouz schemes;
- Achievement of the second phase of the PNI through the extension of irrigation to an area of 66,810 ha located in the ORMVA of the Gharb, Doukkala and Loukkos schemes as well as in the DPA of Fes and Rabat-Sale schemes.

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

Within the framework of the PNI

These rehabilitation programs deal with the following:

- Completion of the on-going projects pertaining to the PNI First Phase and involving 9,950 ha of the GH (ORMVA of Doukkala and Moulouya) and 33,850 ha of the PMH in the northern provinces;
- Achievement of a new rehabilitation program dealing with an area of 108,200 ha, including 24,000 ha of GH in the Souss-Massa area and 84,200 ha of the PMH scattered all over the national territory. This program falls within the framework of the implementation of the PNI Second Phase.

Outside the framework of the PNI

- Achievement of the punctual rehabilitation program in the areas managed by the ORMVA, provided for in the Program of Large Irrigation Improvement (PAGI) of which completion is scheduled for 2000-2001;
- Commencement of another punctual rehabilitation program in the areas of GH and distributed areas of PMH;
- Implementation of an integrated rehabilitation program involving an area of 20,810 ha of the PHM and dealing with the areas of Tafilalet and Figuig, as well as the areas of the spreading flood water.

(3) Maintenance of the hydro-agricultural facilities

This action program seeks to ensure adequate maintenance of the hydro-agricultural facilities in the large perimeters over an area of 590,000 ha. It deals with pumping stations, irrigation networks, drainage, sewage systems, etc.

4.5.2 Development of Production Techniques

The proposed common action plan for the development of the agricultural producing procedures deal with the following main factors:

- The implementation of regional projects for the intensification of agricultural produces with a contractual framework with farmers, consisting mainly in the handling of soil analysis, close counseling and supervision, and training of farmers' children;
- The maintenance of inputs selling points, the organization of the trade of fertilizers and continuation of actions and studies aiming at the formulation of fertilizers;
- The preparation of Moroccan standards for agricultural equipment and the promotion of young promoters for the creation of services companies in this field;
- The nodulation of the system of loan granting for the funding for cultivation and the specific support of the State;
- The promotion of agricultural insurance with the State's support;
- The elaboration of a master plan for a warehouse of crops at the local level; and
- The promotion of partnership between producers and industrials.

4.5.3 Agricultural Extension and Supporting Services

The Five Year Plan document "The Document Project de Plan de Development Economique et Social: Periode 2000-2004, Commission, Development Agricole et Rural" December 1998, has outlined the following programs for the development of Agricultural Extension and Supporting Services.

- Implementation of a national committee for agricultural extension and regional committees to implement
- Diversification of extension methods (closer approach in favorable areas and development of research)
- Consultation and dialogue with the rural population and popularization of female participation
- Promotion of human resources working in the sector of extension through training and career plans
- Functional liaisons between the service of extension and agricultural research and farmers' organizations
- Strengthening of technology transfer programs
- Setting up of a follow-up and evaluation system for extension programs
- Integration of training, research and extension

4.6 Water Law (95-10)

Water Law (95-10), which was approved by the Government of Morocco in September, 1995, constitutes a legal basis for policy making with regard to water resources development in Morocco in the future. In this law, CSES was assigned to formulate general guidelines of national policy in terms of water and climate. The CSES examines and formulates 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.

Members of the CSES compose of the government, basin agencies, ONEP, ONE and ORMVA, elected consumers, provincial or prefecture assemblies, and scientific experts. It is stated in the law that the administration for each river basin or a set of river basins is charged for establishing an integrated master plan for water resources development. Such plan is required to define the following items:

- Territorial limit of the river basin;
- Quantitative and qualitative evaluation and development of water resources and demand in river basin;
- Sharing plan of water among the various sectors in the basin. This plan will eventually specify a surplus of water quantities that can be subject to a transfer towards other basins; and
- General scheme of construction in river basin so as to insure conservation of water resources and their suitability to the needs.

The integrated master plan for water resources development is established for a period of 20 years, and subject to review every five years. This plan is approved by a decree following the recommendation by CSES. According to the law, the administration is also charged to establish a national water plan on the basis of results and conclusions of the integrated master plan for water resources in each basin.

Water Law (95-10) also specifies the establishment of a basin agency in each river basin or a set of river basins. It is a public agency, endowed with individual legal entity and financial autonomy. Such basin agency is in charge of the followings:

- Elaboration of an integrated master plan for water resources development relevant to its action zone;

- Making sure that the integrated master plan for water resources development is implemented inside its action zone;
- Giving permission and concession to use hydraulic domain scheduled in the integrated master plan for water resources development in its action zone
- Provision of financial support and service, notably technical assistance, to both public and private bodies that make request, either to prevent the pollution of water resources or to equip or use the public hydraulic domain.

In 1996, a decree was issued to announce establishment of the first basin agency in Oum Er Rbia river basin.

4.7 Government Agencies Related to Water

The Study Team evaluated and reviewed existing government agencies related to water resources. The list of their activities is shown in Table 4.7.1 and corresponding abbreviations are listed in Table 4.7.2. The following agencies have higher and direct responsibilities related to water resources development in Morocco.

(1) Superior Council of Water and Climate (CSES)

To coordinate the interventions of ministerial departments, Morocco established the Superior Council of Water and Climate in 1981 with the following missions:

- Formulation of the general orientations of the water policy
- Examination of integrated master plans of hydraulic basins
- Study of projects of the territory and their impact on water resources
- Study of draft laws related to water legislation

The Council includes all ministerial departments, the elected members and experts interested in water problems. It constitutes a framework of reflection and dialog for the main national option to define means and long term planning, affectation and management of water resources.

(2) Ministry of Equipment (MOE)

MOE organization is shown in Figure 4.7.1. In general, the MOE assignments are as follows:

- Inventory, mobilization and planning of surface and groundwater resources
- Construction and management of main hydraulic equipment
- Forecasting and control of floods
- Execution of a part of the PAGER

(3) Ministry of Agriculture, Rural Development and Maritime Fisheries (MOA)

MOA organization is shown in Figure 4.7.2. In general, MOA is responsible for:

- Development and maintenance of irrigation water perimeters (GHS and PMH)
- Stabilization of water for the plant and animal production (DPV and DPA)
- Management and distribution of the irrigation water (ORMVA and DPA)
- Organization and framing of farmers (AUEA)

(4) Ministry of the Interior (MOI)

In general, MOI is responsible for:

- Development of disfavored zones by stabilize water resources utilization
- DRSC : administration of public utilities services
- DGCL : water and purification administration framed supported by the local collectivities according to the law of September 30th , 1976
- Production and distribution of potable water

(5) Ministry of Water and Forests (MCEF)

In general, MCEF is responsible for:

- Conservation and forest resources development, cynegetics and fish breeding ensured by the administration of the forest resources conservation (DCRF).
- Development of basins and the soil conservation assigned to the administration of forest development (DDF).

(6) Ministry of Public Health (MSP)

In general, Ministry of Public Health is responsible for:

- Control of the quality of drinking water nationally in urban areas and rural areas
- Control of the surveillance by producers and distributors of potable water
- Control, in collaboration with the ONEP, of all studies of potable water adduction
- Involvement in the information and education of the populations in order to protect them from disease risks
- Diffusion of a simple hygienic system of wells, decontamination and conservation of water indoor.

(7) Ministry of the Habitat and Development of the Territory: Secretariat of the Environment (SECE)

This ministry in general aims at the following activities:

- Establishing an inventory of the qualitative problems of potable water
- Promoting all actions to contribute to the struggler against the specialized commissions of the CNE concerned with problems of drinking water

(8) The National Office Drinking Water (ONEP)

ONEP Organization is shown in Figure 4.7.3. In general, the ONEP office is responsible for:

- Planning of drinking water supply to the territory:
- Management of drinking water distributions in communes where the service cannot be ensured by the communes themselves
- Technical assistance in terms of control of quality of the water for feeding purposes
- Control, in association with relevant authorities, of the pollution of water
- Technical assistance to individuals requiring it for studies of drinking water
- Study, in association with the Ministry of Public Health, of all technical files of adduction buildings and drinking water

(9) The National Office of Electricity (ONE)

One of the assignments of this office is the management of hydropower production and to ensure its distribution.

4.8 Environmental Policy

4.8.1 Environmental Impact Assessment (EIA)

The Ministry of Environment (Secretary of State) is a relatively new governmental body in Morocco, established in 1994. There is an environmental impact study unit within the ministry. To strengthen the environmental conservation in Morocco, National Council of Environment (NCE) that consists of several ministries as permanent members has been formulated to provide technical assistance to the ministry. The member ministries are:

- Ministry of Interior,
- Ministry of Energy and Mining,
- Ministry of Equipment,
- Ministry of Agriculture, Rural Development and Fishing,

- Ministry of Commerce, Industry and Craft,
- Delegate Ministry of Fishing,
- Ministry of Tourism,
- Ministry of Health.

NCE acts as a main body in the process of EIA, and it is responsible:

- To approve the guidelines of EIA that is proposed by the governmental authority in charge of environmental conservation,
- To examine EIA reports and provide advice,
- To propose amendments to the legal and institutional frame work of EIA,
- To update the list of projects that requires an EIA.

Although EIA guidelines have been prepared by the ministry (draft law for the protection of environment[1]), those guidelines have not been approved by the Moroccan Government yet. Therefore, there is no legal status on the EIA guidelines or an official environmental permit for a development project by the ministry is not required in Morocco at present time. In the guidelines, development projects are classified into two major categories where an EIA is compulsory for the projects in List 1, and an EIA is not mandatory for the projects listed in List 2. Dam project is in List 1 so that an EIA will be required in Morocco once the guidelines are approved. The Ministry of Environment recommends that structure and general contents of an EIA report be in the following format:

Chapter 1: EIA synthesis

- Goals and objectives of the study
- Precise and concise statement on the basis of the study

Chapter 2: Institutional references for the establishment of an EIA study

- Moroccan laws, decrees and regulations on environmental protection in association with the EIA
- International regulations and conventions on environmental protection

Chapter 3: Project description and its location

- Detailed and concise description of the project (project activities)
- Objectives and location of the project site(s)

[1] Ministry of Environment (1995) Proposal to establish a procedure for environmental impact assessments in Morocco

Chapter 4: Justification of the project

- Technical basis of the project
- General perception in the area of development (e.g. dam construction)

Chapter 5: Temporal environmental impacts

- Environmental impacts with different stages on the project (e.g. impacts during construction and operation stages)

Chapter 6: Perimeter of the study

- Identification of environmental factors that will likely be affected by the project (e.g. water, air, submerged ecosystems and etc.)

Chapter 7: Description and analysis of the state of environment

- Analytical methods of environmental impacts
- Physical, biological and social aspects of the impacts should be analyzed.

4.8.2 International Conventions in Relation to Environmental Conservation of Morocco

Morocco has signed and/or ratified several international conventions in relation to environmental conservation. These conventions are important when an EIA is conducted. They are listed as follows:

- The African Convention for the Conservation of Nature (1968)
- Washington Convention (CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973)
- World Heritage Convention (Convention Concerning the Protection of the World Cultural and Natural Heritage, UNESCO, 1975)
- Ramsar Convention (Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1980)
- The Rio Convention (Signed in 1992, Ratified in 1995)

CHAPTER 5 DEVELOPMENT OF PROJECTS

5.1 Introduction

Since the 1960's, large-scale dam projects have been implemented in accordance with the governmental policy of the hydraulic sector. This policy aimed at increasing agricultural production to meet the food demands and improving living standard, potable water supply and electrification, and flood protections of towns/cities and important economic areas. The implemented projects have achieved a certain success in such areas.

However, a large part of the rural areas is suffering from severe drought, where both surface and subsurface water resources are insufficient. People living in such areas are not blessed with the public services. Compounding this, some of the areas are subject to inundation due to floods. As a result the gap in living standards between urban and rural areas is getting wider. The lack of job has caused people to flow into the cities, especially in the drought years. In order to decrease this inequity, a program for constructions of medium-scale dams was launched. In 1994, MOE formulated a national plan of medium-scale dam, in association MOA and the Ministry of Interior (MOI). MOE is the main execution agency to construct medium-scale dams. It implemented six medium-scale dams, namely Joumoua, Enjil, S.El Hamra, Sahla, Bouhouda, and Imi El Kheng. Implementation of another three dams was on going namely Chakoukane, Bablouta and Bousfoul as of the end of 1999. Construction of these dams is directly managed by MOE.

MOE is conducting survey and studies for many possible sites for the planning of the medium-scale dams. To establish long term strategy for sustainable water resources, it nominated 53 sites in the framework of the national program of the medium-scale dam development. The list of candidates is shown in Table 5.2.1 and their locations are shown in Figure 5.2.1. Out of them, 25 sites were selected and given high priority and JICA was requested to carry out further study for Basic and Feasibility Studies.

5.2 Proposed Medium-Scale Dams

5.2.1 Medium-Scale Dams

(1) Definition

There is no definitive standard for the size of a medium-scale dam. Approximate conditions in view of physical aspects definited by DGH are as follows:

- Scale of catchment basin is in the order of 10 km^2
- Volume of annual average inflow is in the order of 1 million m^3 to 10 million m^3
- Dam height is generally more than 30 meters.

If any of the physical aspects of the dam are greater than these, then the dam is classified as a large-scale dam. Previously, direct work and management was MOE's responsibility. However, recently MOE has changed its policy so that tender for the construction work is given to qualified contractor(s). This is to raise the technology and capability of domestic private sectors in the field of dam construction.

5.2.2 Dams Applied for OECF-Loan

In 1997, the Moroccan Government requested an OECF loan for the implementation of four (4) medium-scale dams, i.e. N'Fifikh, Boukarkour, Amezmiz, and Timkit. But the loan agreement did not get concluded. OECF might have concluded that the studies for the proposed dam were not detailed enough for acceptance. Evaluation of natural and social environments, explanation of the master plan for the water development, evaluation of the economic viability, etc. are to be made in detail.

5.2.3 Twenty-Five (25) Dams selected for the Study

As described in 5.2.1 above, the 53 sites that were nominated as priority dams were studied at different levels. The provincial government aggressively performed the geological survey and dam design after the admission of the ministry council. Two sites, i.e., Sidi El Mokhfi and Sarhro, were studied in the master plans of the water resources by JICA. Remaining sites were studied in the recent national master plan of the water resource in the basins of major rivers and nominated in the Five-Year Plan (2000-2004). CSES authorized these plans as the Government basic policy for the hydraulic sector.

Based on the annual budgetary allocation, DGH aggressively conducted the geological investigation and the studies on the dams commencing from the promising sites. It completed such investigation and studies for more than 50% of the 53 sites at the level of pre-detailed design (APD; avant projet detaillé in French). Out of the projects whose APD have more or less been completed, the highly prioritized 25 sites were short-listed for further detailed studies (Table 5.2.1).

The Study on the development of the downstream areas of the proposed dam sites thus selected was conducted in parallel. The preliminary studies on irrigation development were conducted for 13 sites as seen in Table 5.2.1.

5.2.4 Significance of the Projects in the National Development Plan

In Morocco, there are approximately 8.7 million ha of arable land of which 1.6 million ha are potentially irrigable (1.3 million ha of perennial irrigation and 300,000 ha of seasonal irrigation), water resources availability being the limiting factor. As of now, irrigation accounts for 88% of the water use compared to 8% for domestic use and 4% for industry. There are large-scale (GH) and small and medium-scale (PMH) irrigation systems. The latter projects range from 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 improve PMH through rehabilitation of some 330,000 ha and hence some 180,000 ha are to be developed. According to the action plan concerning the rural development and irrigation in the Five Year National Development Plan (2000 - 2004), new irrigation development of 33,850 ha are proposed to be conducted under PMH. As well, an integrated rehabilitation program involving an area of 84,200 ha of PMH is scheduled to be implemented. Thus, total area to be developed under PMH projects is 118,050 ha.

Implementation of the proposed 25 medium-scale dams plays an important role in the development of domestic water and agriculture, control of flood and sedimentation, and recharging of groundwater in the rural areas. Taking irrigable lands alone for instance, 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.

It is also important to note that the Government regards the development of PMH as a means of alleviating rural poverty through the creation of agricultural production and activities that generate income and employment. The technical assistance rendered by JICA to the development of these medium-scale dams is of great significance in this regard.

5.3 Basic Development Strategy

This section deals with the basic development concept in order to evaluate, with the common and simplified standards, the master plan on medium-scale dam projects identified and formulated by the Government of Morocco. Based on the natural and socio-economic conditions and the Government policies related to water resources development, the basic strategy proposed by the Study Team is discussed hereinafter with respect to zoning of the Study area as well as the plans for dam development, rural water supply development, agricultural development, flood and sediment control and restoration of groundwater.

5.3.1 Zoning of the Study Area

The territory of Morocco is vast and complicated in view of natural and socio-economic conditions. In the formulation of the master plan for rural development in such country, it is a common practice to establish strategic backgrounds common to certain areas in terms of geography and ecology as well as administrative aspects. In fact it is possible to typify by zone parameters such as climate, water resources in terms of surface and subsurface, flood and sedimentation, land tenure and cropping, water supply for farming and inhabitants, etc.

Likewise, development plans for water resources, rural water supply, agriculture, and control of flood and sedimentation are prepared based on the standards and criteria, which are commonly applicable for each zone thus demarcated for the formulation of the master plan presented in this Report. Characteristics of respective zones and zone-wise development plans are discussed in the subsequent paragraphs.

Water Law (95-10), that is a legal basis for water resources development in Morocco, clearly stipulates necessity of 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 POA 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 is divided into five zones for the convenience of the Study (Phase I), as the demarcation of zones made by MOE and MOA is consistent with each other.

Scheduled boundary of action zone that is to be controlled by respective agency is as shown in Figure 5.3.1. Zoning of the Study area is planned basically in accordance with such boundaries of water resources management by agencies, with slight modifications as mentioned below based on consideration with regard to numbers of nominated projects in respective basin, and similarity of natural and socio-economic conditions:

- Action zones of agencies for Loukkos River and Sebou River basins are combined, and regarded as Zone I.
- Action zone of agency for Bou Regreg River and Casablanca Coastal basins is regarded as Zone II.

- Action zones of agencies for Oum Er Rbia River and Tensift River basins are combined, and regarded as Zone III.
- Action zone of agency for Souss-Massa River and middle reach of Draa River basins are combined, and regarded as Zone IV.
- Guir, Ziz, Rheriss and Draa River basins, except middle reach of Draa River basin, are regarded as Zone V.

Zoning of the Study area is accordingly set as shown in Figure 5.3.1. Based on the government policy, integrated master plan at each basin as well as current issues in Morocco, water resources development strategy in future at each zone might be established as follows:

(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 are 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 are areas that have not benefitted from the existing large dams in downstream. In those areas farmers who gave up farming are increasing due to long lasted drought, and such farmers are migrating into Fes or other cities, bringing social problems. Agricultural water needs to be supplied so as to prevent such problems.

(2) Zone II

- This zone in general does not have enough groundwater resources due to its geological structure. Salt damage is caused due to excess exploitation of groundwater near the Atlantic Ocean. Due to long lasted drought, farmers who gave up the farming are migrating 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 flooding 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 require mitigation.

(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, severe drop of groundwater level (1.6 m per annum) occurs at the vast farmland along the Sous River, especially near Taroudant. Groundwater needs to be conserved in this area.
- Damages at 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 stabily supplied.

(5) Zone V

- Due to long lasted water shortage, desertification is progressed in this zone. Securing potable water is becoming difficult and depopulation is progressed there. Most migrant workers to Rabat, Casablanca and European nations 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 in the area.

5.3.2 Dam Development Plan

The Government of Morocco has exploited water resources by 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 not had their water supply condition improved, 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 exist 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

In due consideration of these conditions and water resources development strategy in future at each zone described in Section 5.3.1 of this report, the medium-scale dam should be selected in the respective zones.

Selection of dam type is to be made carefully in view of technical and economical aspects. It is commonly recognized that any alterations should be done as the study on dam type progresses. Basically, gravity type dam is proposed in many cases because most of the sites are located in the mountainous areas, where hard rocks, which can bear high stress without much excavation, exist. It is also important to consider the location of the spillway to be placed as fairly large floods occur.

For example, in the case of Tadighoust (No. 11) dam, a fill type dam seems to be preferable for a proposed dam height of 45 m in view of the topography and geology of the dam site, which is as wide as 200 m with deep river deposit of 20 m, and considering a large flood with a design discharge of 10,000 m^3/s. However, a gravity dam may be preferable, because the spillway can be located on the dam body. For small and medium-scale dams, roller compacted concrete (RCC) method has become predominant recently in Morocco. This seems to be preferable as the materials for concrete are easily obtained from the riverbed. This method is also acceptable if the height of dam does not exceed 70m and careful management of quality is made. However, it is important to note that natural sand and gravel often contain low quality and dusty materials, which may be a cause of uneven quality of concrete. Under the high stress with such materials may arise an issue of partial concentration of stress and strain, which causes a deficit in the dam body. To avoid this kind of problem, it is suggested to maintain the quality of concrete by using a well equipped concrete plant and conducting frequent quality control tests. It is also necessary to analyze stress and strain in the dam and foundation in various aspects before the commencement of dam construction. As limestone is one of the dominant rocks in Morocco, dams constructed on such rock may experience leakage through the foundation, though this is inevitable. To cope with this, grouting work is commonly practiced. It should be noted that appropriate selection of the dam axis, which connect less permeable layer with curtain of water stop, is much more important. In some cases, limestone contains various kinds sedimentary rocks, which have much smaller permeability.

5.3.3 Rural Water Supply Development

The Government of Morocco has been intensively implementing spring and groundwater development under PAGER. This is because surface water development requires provision of water treatment and distribution facilities that is rather expensive and brings, in general, less economical viability in the rural area that generally has dispersed and small populations. However, if groundwater resource is not sufficient enough to be developed, mobilization of reservoir water from medium or small-scale dams, or transmission from another area's source become the possible, and sometimes unavoidable, solutions.

Construction of a small-scale dam is an effective water resource development to supply domestic water for rural populations, especially in the mountainous area. However, it is difficult for this option to be the major alternative for supplying potable water for the following reasons:

- Population that is covered by small-scale dam is generally small; therefore per capita investment cost of water supply facilities including water treatment plant becomes high.
- Storage capacity of small-scale dam is too small to regulate river discharge fluctuating by season for serving potable water constantly throughout a year.

Therefore, as basic strategy, potable water supply system by surface water will be planned to cover urban area with a relatively large water demand and to be a component of a multi purpose project based on construction of medium or large scale dams. The 25 dam development projects proposed by MOE contains two projects, Tiouzaguine Dam (No.12) and Adarouch Dam (No.14), for purpose of potable water supply to urban or regional centers. The former is expected to supply water to Gourrama in Errachidia province, meanwhile the latter contribute to the existing Kansera Dam that supplies potable water to Khemisset and Tiflet in Khemisset province. In this study, demand of potable water supply in the target year of 2020 for the above two (2) projects are referred to the estimation by ONEP.

Meanwhile, there are other project sites where the groundwater is severely scarce, or almost none like in some mountain areas of Rif or Atlas. In such rural areas, even thought there are no major regional centers that have substantial population, water supply to rural inhabitants is considered still necessary to be elaborated. At this moment, possibility of alternatives such as transferring water from another source or utilizing water of the proposed medium scale dam are studied by the relevant authorities.

For such projects, this study suggests 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 target year of 2020 is obtained by multiplying unit water demand of 20 lit/man/day with projected population which is assumed to increase at an annual rate of 0.7 %.

5.3.4 Agricultural Development

a) Basic Concept of Agriculture Development Plan

On the basis of the National Development Strategy of Agriculture during 2000-2004, the Government of Morocco identified the development and stabilization of agricultural sector as the most urgent task for rural development.

The main targets of agricultural development are:

1) Securing of necessary food (national food security),
2) Dissolution against alleviation of poverty and mitigation of rural differentials, and
3) Harmonizing and encouragement with other development sectors.

The present conditions of agriculture sector are however, recognized as

1) Low and unstable productivity,
2) Low motivation of farmers,
3) Shortage of required human resources, while 80 % of total family in rural area is in agricultural sector.

In addition, irrigation projects have been developed, which achieved five to nine times higher income than without project.

This shows that there is a high potential for increasing agricultural production by introducing irrigation facilities with appropriate management and operation.

Considering these national conditions and governmental strategy, the development strategy of agricultural plan in each zone has been formulated.

General strategies and approaches of agricultural development are as follows:

<u>Technical Aspect</u>

- To increase the yield of present crops
- To introduce fodder cultivation for livestock
- To introduce adaptable cash crops considering with local agro-climate

- To respect cropping pattern of present cultivation
- To recommend new cropping system as future development

Economic and Social Aspect

- To consider transportation and distance condition from marketing area for selection of crops
- To activate farmer's cooperatives
- To respect the present water low and water rights by farmers
- To accelerate participatory step of farmers to the development
- To consider the importance of water supply for livestock and their migration
- To consider afforestation at appropriate areas for sustainable land use
- To respect existence of nomad and pay attention to their life conditions
- To pay attention to the conservation of natural and social environments

b) Basic Development Strategy in Each Zone

In the process of crop selection and formulation of cropping pattern for the respective zones, the physical conditions of the areas, the general crop selection criteria, and the current politics are carefully considered under the following concepts and conditions:

- Adaptability of the crop to soil and agro-climate conditions of the area and its ability to perform optimally under irrigation
- Expected level of technology and the experience of the farmers
- Practicality 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
- Generation of the maximum benefits to the farmers, to the region and country.

Based on the considerations mentioned above, recommended cropping patterns for the Study is conveniently formulated.

(1) Zone I

Present Farming Conditions

This zone is situated at the Fes-Boulemane and Taza-Al Hoceima- Taounate regions. Rain-fed cultivation (very low irrigation ratio) is practiced owing to relatively high precipitation. The project sites in Taza-Al Hoceima- Taounate region are mostly located at mountainous areas, where the cultivated areas are situated at the sloped areas and narrow riverbeds. Cereals (soft wheat and hard wheat) and fruits (olive) are the major crops in this zone.

It seems that the cultivating technique is rather low in view of the mechanization and irrigating farming. The project sites in Adarouch and Azghar are located at gentle and wide slope areas. Cropping system is similar with other sites in Zone I and has rather larger cereal areas (barley & hard wheat).

Crop Selection and Formulation of Cropping Pattern

- To increase yield of cereals and fruits
- To increase area of potato and vegetable cultivation
- To increase fodder production (Azghar and Adaroush areas)

(2) Zone II

Present Farming Conditions

This zone is favorably located near the large consumption area such as Rabat and Casablanca. However, many unemployed people settled in these areas since drought of 1996, and hence many cities are suffering from the inflow of people. This indicates that there is an urgent need for rural development for the generation of employment opportunity. Since the groundwater resources are limited due to shallow aquifer, and over exploitation, intrusion of the seawater is observed in these areas. Vegetable cultivation prevails in this zone in green houses as well as in the field. N'Fifikh and Ain Kwachiya located near Rabat and Casablanca have high potential for vegetable cultivation for cash crops with surface water development. Boukarkour and Sidi Omar are typical cultivation area for cereals with rain fed condition. Main crops in this area are cereals (soft wheat and hard wheat), vegetable (potato, squash) and fruits (olive and grapes).

Crop Selection and Formulation of Cropping Pattern

- To introduce vegetables cultivation (cabbage, mint, squash) for high cash income
- To increase yield of cereals
- To introduce green house for vegetable cultivation

(3) Zone III

Present Farming Conditions

This zone is located near Marrakech and Beni Mellal, where irrigation facilities are equipped by ORMVA (Haouz). Farmers have relatively high technique for irrigated farming and the cooperatives are well organized. The area has a high irrigation ratio. However these areas irrigated by flooding water does not seem to be irrigated effectively.

It is also noted that the soil condition of this area is not necessarily favorable due to existence of gravels. The occupancy of cereal cultivation is high. The major crops in this area are cereals (barley), vegetable (potato and watermelon), and fruits (Almond, grapes).

Crop Selection and Formulation of Cropping Pattern

- To increase yield of almond production
- To increase yield of cereals
- To transfer cultivation from barley to wheat
- To increase sugar beet in Beni Mellal area

(4) Zone IV

Present Farming Conditions

This zone is located at the Taroudannt and Ouarzazate where irrigation facilitites are well equipped by ORMVA (Souss-Massa and Ouarzazate). The major crops are cereals (soft wheat and barley), vegetable (potato, sweet melon) and fruits (Olive and almond).

Crop Selection and Formulation of Cropping Pattern

- To increase yield of cereals
- To increase yield of fruits
- To transfer cultivation from barley to wheat
- To increase vegetable area (Potato, tomato)

(5) Zone V

Present Farming Conditions

This zone lies on the Er Rachidia area. Traditional oasis cultivation is practiced in and around the area where the water resources were developed from ancient times. All the project sites are located in such oasis area. The irrigation water is lead to small plot farms by open and underground canals (called Khanat). Traditional water law has been applied for management of water.

Major crops are cereals (hard wheat and soft wheat), fruits (dates), vegetables (onion, carrot) and fodder. This zone has large number of livestock and named also has carried livestock breeding (mainly goat).

Crop Selection and Formulation of Cropping Pattern

- To increase yield of cereals
- To increase cultivation of vegetables that can be stored for a long time and easily transported (onion, carrot)
- To increase fodder for animal breeding
- To modify traditional cultivation system, wherever necessary

Detail results of proposed cropping pattern are shown in Figure 5.3.2.

5.3.5 Irrigation and Water Demand

In order to grasp the existing water demand, estimate of consumptive use was based on the potential evapotranspiration worked out by the methods of Radiation, Blanney-Criddle, etc.

Recently, MOA has been re-estimating the water demand using the modified Penman method for the proper management of irrigation water. In fact, according to the guideline prepared by FAO (Irrigation and Drainage Paper No.56 Crop Evapotranspiration, 1998), it is suggested that the modified Penman method be used since it offers the best results with minimum error of plus or minus 10% in summer, and up to 20% under low evaporative conditions. However, the Radiation method, in extreme conditions, involves a possible error up to 20% in summer, and the Blaney-Criddle method should only be applied for a period of one month or longer; in humid, windy, mid-latitude winter conditions.

A higher level of dependable rainfall (say 4 out of 5 years) needs to be selected during the periods that crops are germinating or are most sensitive to water stress, and yields are severely affected. Only a portion of heavy and intensive rains can enter and store in the root zone with effectiveness that is consequently low. It is recommended that daily rainfall that is less than 5 mm/day is to be regarded as non-effective (FAO Irrigation & Drainage Paper No. 25, Effective Rainfall, 1975).

Estimate of the future water demand is 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 (ET_0) by the modified Penman method.

The effect was estimated of the crop characteristics on crop water requirement, which is given by the crop coefficient (kc) which represents the relationship between potential (ET_0) and crop evapotranspiration (ETcrop) and can be concluded as ETcrop = kc* ET_0.

Detail results of proposed irrigation water demand are shown in Tables 5.3.1 and 5.3.2.

5.3.6 Flood and Sediment Control

(1) Roles of Dams in Flood Mitigation

Dam reservoir generally functions as flood and sediment control facility for 1) reduction of flood peaks, 2) stabilization of river channel, and 3) trapping sediment. These functions are naturally provided with any dams not withstanding the project purposes, though the extent of effects may depend on the conditions.

(2) Principles for Flood and Sediment Control

The flood and sediment control study will be made in line with the following.

- Flood mitigation function should be incorporated in planning dams as much as possible, to make the project multipurpose and economical. Since floods do not occur so often in the Study area, facilities exclusive for flood mitigation would not be economically viable in general.
- In order to mitigate flooding, measures other than dam should also be discussed. These measures may include bank protection works and flood plain management.
- As to 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 from the object to be protected, etc.

5.3.7 Recharging of Groundwater

In recent years, Morocco has suffered from severe drought throughout the country, though the water demand is increasing year by year as it develops economically. The deficit of surface water has been made up with pumping large amount of groundwater. Such overexploitation has resulted in lowering the groundwater table significantly. Nowadays it has dropped to such level that is causing social instability in some rural areas. Groundwater urgently needs to be recharged and/or conserved.

One of the most effective counter measures is recharging water by reservoir. This stored water is released to the river so as to penetrate it into 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.

Since the dams proposed in Taroudant aim to recharge groundwater using limited amount of reservoir water to the vast Oued Souss basin, it is difficult to forecast the effectiveness of the reservoirs at present unless the information on the groundwater flow regime of the basin such as boundary, capacity, condition of substrata, etc. is sufficient. It is also suggested to carry out long-term observations of consumptive use, water supply, variation of groundwater table, etc. to analyze the flow regime of the basin accurately. The dams proposed in Tafilalet aim to supply irrigation water and recharge groundwater into alluvial deposit during the transportation of irrigation water through riverbeds. The water is to be utilized in the downstream areas as potable and irrigation water. The flow regime of this basin is more or less foreseeable in view of geology and topography. The groundwater thus recharged may concentrate in a certain area where valley, river and oases are formed. Most of the recharged water can be utilized effectively. In other regions, water stored in dams will be recharged in rock formations, in which cracks and voids of fissures exist. In such case, it is very difficult to foresee the flow regime of the groundwater.

5.4 Water Balance Study

In this study, it is examined whether the extended irrigable area and the projected population to be served with potable water exceed the capacity of respective dam storage or not. Its method is as described as below:

(1) Projects to be studied

All the proposed 25 dam sites were studied except 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, that are categorized as Group D in Chapter 6 due to technical or social environmental limitations.

Also, No.24 Amount Abdelmoumen is also not included in this study, because the dam is planned only for sediment control for the existing downstream dam.

(2) Inflow Data

Hydrological potential for water resources is studied by the use of discharge records available at the respective gauging stations for recent 10 to 20 years.

(3) Water Requirement

Water requirement for 1) irrigation and 2) potable water supply are considered in this study, meanwhile maintenance flow to downstream reach is neglected.

Water demand for irrigation is estimated at: 1) 745 mm/year for Zone I, 2) 825 mm/year for Zone II, III 946 mm/year for IV and 5 1,041 mm/year for Zone V, respectively as detailed in 5.3.5.

Water demand for potable water is estimate at: 1) 0.2 mil m^3/year for No.12 Tiouzaguine and 2) five million m^3/year for No.14 Adarouch, respectively, based on ONEP estimation. Meanwhile water demand for domestic water is included in the water demand for irrigation.

Evaporation loss from reservoir is neglected in this study.

(4) Dam Scale and Reservoir Storage Capacity

Dam scale of respective project is basically fixed as proposed by MOE and alternative scale for optimization is not considered in this study. For No.5 Upper N'Fifkh, the Study Team tentatively fixes the dam scale, as it is not yet proposed by MOE. 50-year sedimentation is taken into account for estimating net reservoir capacity in this study. It is noted that reservoir will be filled up by sedimentation before the life time of the dam (50 years) for the four projects of 1) No.1 Neckor, 2) Tizimellal, 3) No.3 Ait Baddou and 4) No.22 N'ouzntz.

For all dams, flood control capacity is not planned. Flood reduction effect is considered only due to surcharge volume in this study stage.

(5) Operation Rule

Operation of reservoir is simplified in this study as follows:

1) Initial water volume in the reservoir is set at half of the net reservoir volume.
2) As far as water is available, 100% of water demand is extracted from reservoir
3) In case that the reservoir becomes empty, water demand is met within the inflow volume.
4) No responsible discharge to downstream or maintenance flow is considered.

(6) Development Criteria

A guarantee level of 90% (1/10) in frequency is applied in case that potable water supply scheme is related, meanwhile 80% (1/5) is applied to irrigation water supply scheme only. Frequency to satisfy 100% of water demand is counted for respective project. If the frequency is found not to satisfy the required guarantee level above, the irrigation area is decreased. Meanwhile if such frequency is found to be enough higher than the required guarantee level, irrigable area is expanded considering the restrictive conditions at each site. Scale of respective dam is fixed as originally planned by MOE and therefore optimization of the dam scale and the extent of beneficiaries are not made in this study.

5.5 Result of the Study

Development scale of dam, irrigation area and potable water supply for each project that are fixed through the above study, are presented in Supporting Report VII.

CHAPTER 6 EVALUATION AND PRIORITIZATION OF THE RESPECTIVE PROJECTS

6.1 Projects Evaluation

Before prioritizing the 25 dam projects, five items of social aspects, technical feasibility, natural environmental impact, social environmental impact and economic viability of each project were evaluated. A score was given for each of these five evaluation items and the final evaluation is comprehensively made on the basis of the cumulative scores obtained by the project. Detailed description of the five items evaluated for each project as well as method and result of evaluation are given in Supporting Report VIII.

6.1.1 Social Aspects

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) effect on stabilization of social condition, etc. Each project was given a ranking out of three for social aspects as presented in Table 6.1.1. The dam site Nos. 4, 5, 9, 10, 17 and 25 were given an A rank that is considered to be good in social aspect, while, Nos. 2, 3, 12 and 22 are rank C that is considered to be rather poor.

6.1.2 Technical Feasibility

Type and height of the dams proposed by DGH were examined in view of technical feasibility, especially 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 spillways. Likewise, technical feasibility was evaluated for irrigation development plans in view of the location of the beneficiary area, water supply method, topographical and soil conditions, etc. An appraisal of each project was made in view of technical feasibility and ranked as presented in Table 6.1.2. The dam site Nos. 5, 7, 8, 9, 10, 15 and 17 are rank A that is considered to be good in technical feasibility, with no maturity problem, of which judgment is in existing plans and/or studies.

6.1.3 Natural Environmental Impact

The basic approach of this study was to conduct an environmental investigation according to the JICA guidelines for environmental considerations, because an EIA system has not been fully established and authorized in Morocco yet. The results are shown in NE1 of Volume VII Data Book.

The level of negative impacts on natural environment for each proposed dam site was calculated and classified into three ranks as presented in Table 6.1.3. From natural environmental point of view, dam sites ranked A and B are recommended for a further study in Phase II to examine feasibility of construction. The two dam sites No. 19 and 21 ranked C are likely to cause more serious impact than the impact level predicted with the rest of the proposed sites.

6.1.4 Social Environmental Impact

Social environmental was investigated by visiting all the 25 dam sites (one additional site of Lower N'Fifikh was also investigated) as shown in SE1 of Volume VII Data Book. Information was collected using a guideline and checklist prepared beforehand. The checklist consists of matrix, intervention and social elements. The results of ranking evaluated by the negative social impacts are shown in Table 6.1.4. This ranking is rather relative because different parameters receive the same weight no matter how their qualitative social values are different. But the impact on gender and generation is considered in all the sites. The sites No. 1, 3, and 5, rated H, are not ranked, because their points exceed the limit of the worst, rank C. From the social viewpoint, these sites must seek a different development program.

6.1.5 Economic Viability

Before conducting the economic analysis, the proposed projects were screened from the other four evaluation items. Only the projects that satisfy all these aspects without serious defect were subjected to economic analysis. These projects were No.6, 19, 21, 17, 4, 5, 15, 7, 8, 9, and No. 10. The economic viability of the projects was examined by cost-benefit analysis. The analysis was conducted by a cash flow using economic prices. The projects were evaluated from the economic viewpoints using three types of indicators, i.e. economic internal of return (EIRR), benefit cost ratio (B/C), and net present value (NPV). By using a discounting procedure, benefits and costs of the projects that arise at different points in time can be compared in terms of present values. EIRR is the rate that meets the totals of the benefits and costs come out from the project during the project life. B/C is the ratio of total benefits and costs during the project life. NPV is the difference between the present worth of the benefit stream less the present worth of the cost stream. The results of the economic analyses are summarized in Table 6.1.5.

6.2 Projects Prioritization

6.2.1 Strategy of Rural Development

Due to disturbance of cultivated lands and reduction of farm products caused by severe drought and exceptional floods, the household economy in the rural society is getting seriously deteriorated.

Due to this, the annual growth rate of the rural population has been slowed down to 0.7% since 1982, while the urban population has increased with a quite high growth rate of 4.5%.

Meanwhile, the domestic water supply for the rural society depends mainly on surface water of rivers flowing nearby and shallow groundwater including spring water. There has been a seasonal shortage in surface water and a shortage in groundwater year-by-year. The Government policy strongly emphasizes that the said constraints and problems should be solved to achieve integrated rural development effectively and to attain the stable agricultural production, sustainable water supply conditions and increasing opportunity to get jobs after the completion of the projects. It is strongly suggested that any endeavor should be taken for the local people so as not to abandon farming, which results in instability of social conditions due to population outflow.

6.2.2 Criteria on Prioritization

(1) Methodology of Ranking of the Projects

Figure 6.2.1 shows the general flow of selecting priority projects for a feasibility study. Three study levels of Zone Level, River Basin Level, and Dam site Level, formulate the strategy of rural development as follows:

a) Zone Level

Natural and socio-economic conditions of Morocco are complicated for different zones throughout the territory. It is therefore proposed to establish zone-wise development strategy in view of topography and geology, climate and hydrology, natural and social environments as well as socio-economy of the respective zones. The country is administratively divided into 16 regions that are further divided into 71 provinces as prefecture. In accordance with the long term government policy, the Study area was divided into five (5) zones in view of regional level administration as well as similarity in natural and socio-economic aspects, as described in 5.3.1.

b) River Basin Level

In accordance with the policy of river basin development, the Study area was mainly divided into eight basins namely, Northern Morocco, Sebou, Bou Regreg, Oum Er Rbia, Tensift, Sous-Masa, Guir-Ziz-Rheriss Draa, and Moulouya. These river basins were sub-divided into the specific basin boundaries to assess the water resources potential for the dam development through the water balance study for the respective dam sites. If the dam development projects did not seem to be justifiable from the viewpoints of any aspects, they were discarded from the priority projects and classified into Group D (refer to paragraph d below).

c) Dam Site Level

The proposed projects were reviewed by the Study Team in view of social, technical, environmental and economical aspects through formulation of water resources development plans to serve the potable water, irrigation and livestock water, and investigation of flood mitigation and IEE. If any significant problems in technical or environmental aspects were identified in the implementation of the dam developments, they were discarded from the priority projects and classified into Group D.

d) Grouping

Based on the evaluation results, the proposed dam development projects were classified into four groups as follows:

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

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

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

Group D: Alternative development plan is to be elaborated.

(2) Evaluation Factors

a) Classification into Group D

Identification was carried out for the dam projects that have serious problems in respect of necessity of the dam, technical matters such as dam foundation, or natural or social environmental aspects. The identified projects were classified as Group D; then discarded from further classification.

b) Classification into Group C

Identification was carried out for the dam projects that fail to attain required economic viability assumed by the Study Team; that is, 5% of economic internal rate of return (EIRR). The identified projects were classified as Group C; then discarded from further classification. Meanwhile, in case that insufficient maturity was recognized 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, such project was also classified as Group C.

c) Classification into Group B and A

Identification of four (4) dam projects was carried out as the highest priority projects. Evaluation factors for this classification consist of: 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, scoring system of which weighing method (shown on Table 6.2.1) was introduced considering the character of each zone.

Four projects that obtain the highest total scores were classified as Group A, and the others classified as Group B.

6.2.3 Results of the Prioritization

Results of prioritization study are listed in Table 6.2.1 and summarized as follows:

- The four projects of: 1) No.5 Upper N'Fifikh, 2) No.9 Taskourt, 3) No.10 Timkit, and 4) No.17 Azghar were categorized for Group A and are highly recommended to be realized after the commencement of the their Feasibility Study. These 4 projects are considered as 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.

- 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 were categorized for Group B. These projects are recommended to be realized succeeding the construction of Group A projects as they are also attractive projects without significant problem socially, technically, economically and natural/social environmental.

- The Study Team placed 10 projects in Group C based on obtained information. Therefore, planning of these projects should be reviewed in detail for the reasons stated below. However, there is still a high possibility for these projects to be attractive projects like those of Groups A and B subject to the results of review.

    1) No.11 Tadighoust

    Currently, water diversion project of the Gheris to Ziz River is under construction at the downstream of No.11 Tadighoust therefore, planning of this project should be reviewed.

    2) No.12 Tiouzaguine

    Kaddoussa dam project (large dam) is now proposed at the downstream of No.12 Tiouzaguine and according to opinion of regional office of the Ministry of Agriculture; priority of the implementation of Kaddoussa dam is higher than No.12. Therefore, for the No.12 Tiouzaguine, the planning should be reviewed and the implementation schedule should be carefully studied in relation to the implementation of Kaddoussa dam.

3) No.13 Kheng Grou

Currently, construction of irrigation facilities without dam are under way at the downstream of No.13 Kheng Grou with less demand to urgent requirement implementation of the dam itself. Therefore, for the No.13 Kheng Grou, the planning should be reviewed and the implementation schedule should be carefully studied.

4) No.14 Adarouch

One of the main purposes of this project is to supply drinking water to the existing El-Kansera dam located in the downstream of No.14 as well as irrigation water supply. However, the Study Team concluded that the Project planning is not definitely decided so far in relation to planning of the proposed Ouljet Es Soltane dam (big dam) which is located on Beht river between No. 14 and the existing El-Kansera dam, and has purpose of drinking water supply as well. Therefore, planning of No.14 should be reviewed as soon as possible. The Study Team believes that No.14 is a very promising project having urgent implementation requirement.

5) No.16 Tiouine

This dam has big potential for water resources development but present water demand downstream of this dam by irrigation and water supply is not so much. So implementation schedule of this dam should be postponed.

6) No.18 Bourkarkour

In order to intake water for irrigation and water supply, pumping up of about 150 to 200 m height is necessary, so the economic viability of this project is very marginal. Planning of this project should be reviewed.

7) No.20 Sidi Abbou

Dam axis by the existing dam planning is heavily covered with limestone and there will be great possibility of uncontrolled water leakage from the reservoir body. Therefore, further study of alternative dam axis including dam type should be made. The Study Team proposes that the dam axis should be moved to upstream by about 100 m and the dam type should be earth-fill type. No.20 is also a very promising project having urgent implementation requirement.

8) No.23 Igui N'ouaqa

Effect of water conservation in the downstream area by this project is not quantitatively clear so far. Therefore, further detail study will be required to evaluate this project.

9) No.24 Amont Abdelmoumen

This project is proposed to compensate the lack of storage capacity of the existing Abdel Moumen dam. Due to some unclear reasons, the dam cannot raise up the water level until high water level. However, the detail is not clear so far to the Study Team. Therefore, the Study Team cannot evaluate No.24 Amont Abdelmoumen at the moment.

10) No.25 Sidi Abdellah

The same as No.23 Igui N'ouaqa.

- The 1 (one) project of 1) No.6 Tazarane is also categorized for Group C with low economic viability. Therefore, it will be rather difficult to implement it by soft loan from foreign countries.

- The 5 (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. These projects in view of the project necessity, technical or social environmental aspects as follows:

1) No.1 Neckor

Serious resettlement problem may occur by implementation of this project.

2) No.2 Tizimellal

Main purpose of this project is mitigation of intrusion of sediment from the Rif mountain area into the existing Al Wahda dam. However, the effect is very doubtful due to the small basin catchment area of 170 km^2 comparing to that of Al Wahda dam of 6,200 km^2. Besides, this project does not have irrigation water supply purpose.

3) No.3 Ait Baddou

The same as No. 1 Neckor.

4) No.5 Lower N'fifikh

The same as No. 1 Neckor.

5) No.22 N'ouantz

In the Study Team's opinion, the reservoir of this project will be full of sediment within 40 years so this project can not be accepted.