

THE HASHEMITE KINGDOM OF JORDAN
MINISTRY OF MUNICIPAL AND RURAL AFFAIRS
AND THE ENVIRONMENT

THE STUDY ON INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE KARAK-TAFILA DEVELOPMENT REGION

VOLUME 2 MAIN REPORT
PART 1
MASTER PLAN STUDY

March 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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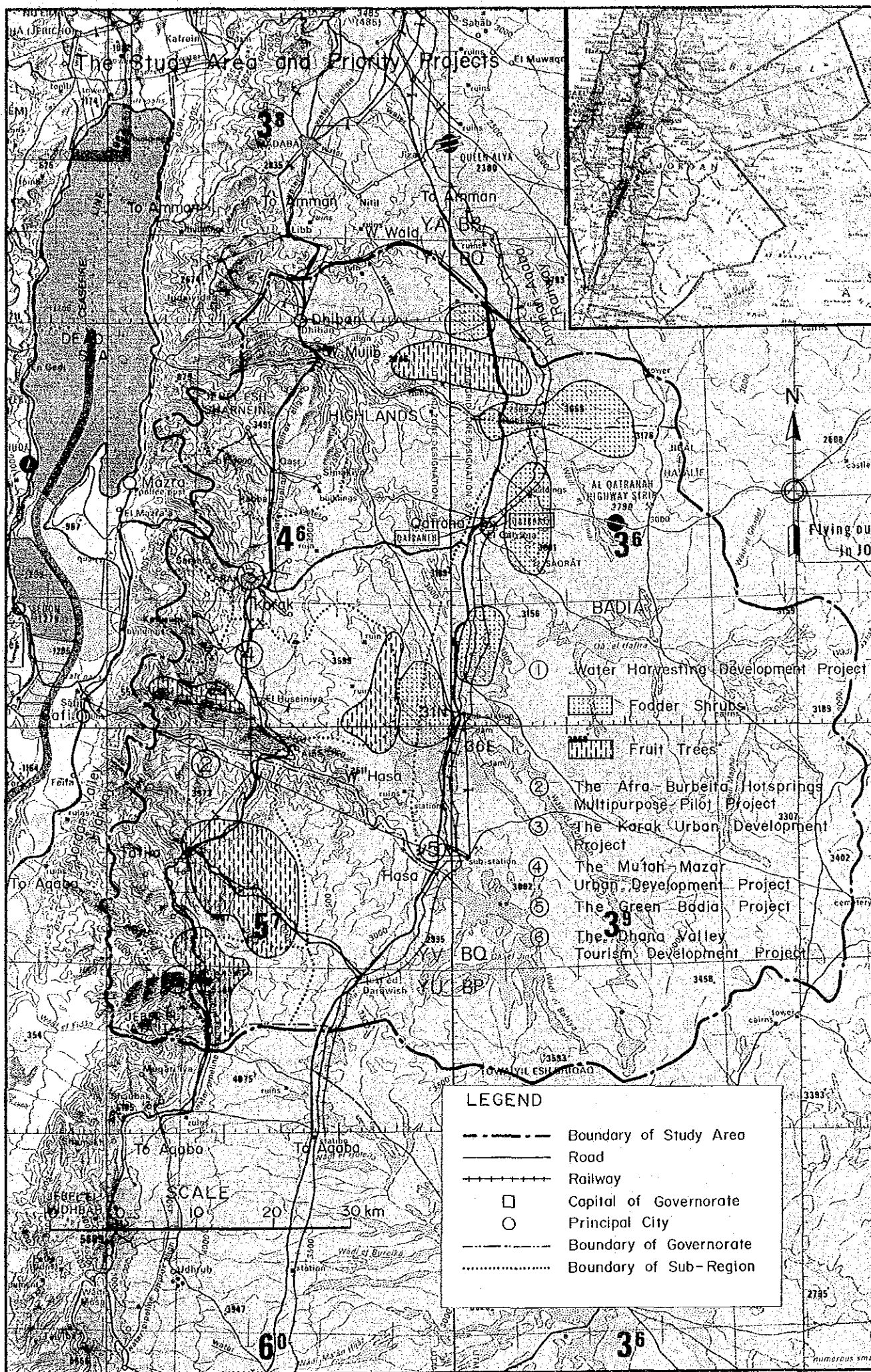
FINAL REPORT

LIST OF VOLUMES

- Volume 1: Executive Summary
- Volume 2: Main Report - Part 1 Master Plan Study
- Volume 3: Main Report - Part 2 Preparatory Studies of Priority Projects
- Volume 4: Supporting Reports

- ANNEX-A Water
- ANNEX-B Agriculture
- ANNEX-C Mineral Resources
- ANNEX-D Small and Medium Scale Industries
- ANNEX-E Tourism
- ANNEX-F Transportation and Communications
- ANNEX-G Human Resources
- ANNEX-H Housing and Urban Planning
- ANNEX-I Solar and Wind Energy Utilization
- ANNEX-J Aquaculture

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THE STUDY ON
INTEGRATED DEVELOPMENT MASTER PLAN
FOR THE KARAK - TAFILA DEVELOPMENT REGION

FINAL REPORT

MAIN REPORT PART 1: MASTER PLAN STUDY

TABLE OF CONTENTS

LIST OF VOLUMES

	<u>PAGE</u>
1. INTRODUCTION	1
1.1 Background of the Study	1
1.2 The Study	2
1.3 Organization of this Report	3
2. PRESENT CONDITIONS AND REGION'S POSITION	5
2.1 Natural Conditions	5
2.1.1 Climate	5
2.1.2 Topography	6
2.1.3 Soil	7
2.1.4 Vegetation and Wildlife	8
2.2 Socio-economy and Finance	8
2.2.1 Population	8
2.2.2 Employment	9
2.2.3 National Economy	9
2.2.4 Economy and Finance in the Study Area	10
2.2.5 Socio-economy by Sub-region	11
2.3 Productive Sectors	11
2.3.1 Agriculture	11
2.3.2 Mineral Resources	14
2.3.3 Small and Medium Scale Industries	14
2.3.4 Tourism	16
2.4 Physical Infrastructure	17
2.4.1 Water	17
2.4.2 Transportation	18
2.4.3 Telecommunications	19
2.4.4 Energy	20
2.5 Social Infrastructure	23
2.5.1 Education	23
2.5.2 Health	24
2.5.3 Housing	24

3.	DEVELOPMENT OBJECTIVES AND SCENARIOS	25
3.1	National Development Policy	25
3.2	Regional Development Objectives	26
3.3	Alternative Development Scenarios	27
4.	DEVELOPMENT FRAMEWORKS	29
4.1	Socioeconomic Frameworks	29
4.1.1	Introduction	29
4.1.2	Methodology and Procedure	30
4.1.3	Alternative Socioeconomic Frameworks	31
4.2	Spatial Framework	33
4.2.1	Landuse	33
4.2.2	Spatial Structure	35
4.2.3	Strategic Urbanization	37
4.3	Water Allocation Plans	38
4.4	Selected Framework	41
5.	SECTORAL DEVELOPMENT PLAN	43
5.1	Productive Sectors	43
5.1.1	Agriculture	43
5.1.2	Mineral Resources	45
5.1.3	Small and Medium Scale Industries	46
5.1.4	Tourism	48
5.2	Physical Infrastructure	50
5.2.1	Water	50
5.2.2	Transportation	52
5.2.3	Communications	53
5.2.4	Energy	54
5.3	Social Infrastructure	56
5.3.1	Education	56
5.3.2	Health	58
5.3.3	Housing and Urban Planning	58
6.	MASTER PLAN	61
6.1	Present Conditions and Climate for Development	61
6.2	Development Concepts	63
6.2.1	Development Objectives	63
6.2.2	Development Frameworks	64
6.2.3	Development Concepts	64
6.2.4	Overall Development Strategy	66
6.2.5	Sectoral Development Strategy	67

6.3	Master Plan	73
6.3.1	Rural Development Plan	73
6.3.2	Urban Development Plan	81
6.3.3	Green Badia Plan	84
7.	IMPACTS AND REQUIREMENTS OF MASTER PLAN	90
7.1	Impacts of Master Plan on National Socio-economy	90
7.2	Requirements for Implementation	92
7.2.1	Investment	92
7.2.2	Conditions for Industrial Location	94
7.2.3	Labour Force	95
7.2.4	Institutional and Incentive Measures	96
7.2.5	Requirements for Sector Development	96
8.	CONCLUSIONS AND RECOMMENDATIONS	100
	References	104
	Tables	105
	Figures	

LIST OF TABLES

	PAGE
Table 1	RECORDS OF COUNCILS, COMMITTEES AND WORKSHOPS 105
Table 2	REGION'S PRESENT POSITION IN JORDAN 108
Table 3	SOCIO-ECONOMY BY SUB-REGION 110
Table 4	INDUSTRIAL ORIGIN OF TARGETED GDP IN JORDAN 111
Table 5	FUTURE IMAGE OF THE STUDY AREA (2005) 111
Table 6	SOCIOECONOMIC FRAMEWORKS 113
Table 7	PROJECTED POPULATION (SCENARIO 1) 114
Table 8	PROJECTED POPULATION (SCENARIO 2) 114
Table 9	PROJECTED POPULATION (SCENARIO 3) 115
Table 10	PRESENT LANDUSE AND FUTURE PLAN 115
Table 11	WATER ALLOCATION PLANS FOR 2005 116
Table 12	STRATEGIC INDUSTRIAL PROJECTS 117
Table 13	PROSPECTIVE TOURISM PROJECTS 120
Table 14	LIST OF MASTER PLAN PROJECTS 121
Table 15	PLANNED INVESTMENT DISTRIBUTION IN KARAK GOVERNORATE ... 123
Table 16	PLANNED INVESTMENT DISTRIBUTION IN TAFILA GOVERNORATE .. 124

LIST OF FIGURES

Fig. 1	Existing and Planned Road Networks
Fig. 2	Distribution of Existing Villages in the Study Area
Fig. 3	Present and Projected Spatial Structures
Fig. 4	Present Landuse Map
Fig. 5	Proposed Future Landuse Map
Fig. 6	Distribution of Existing and Proposed Industries
Fig. 7	Proposed Regional Tourism Network
Fig. 8	Development Sub-areas

ABBREVIATIONS

(1) International/Foreign Organizations

JICA	Japan International Cooperation Agency
UNRWA	United Nations Relief and Works Agency
USAID	United States Agency for International Development
WHO	World Health Organization

(2) Jordanian Governmental Organizations

MOA	Ministry of Agriculture
MOC	Ministry of Communications
MOE	Ministry of Education
MEMR	Ministry of Energy and Mineral Resources
MOHE	Ministry of Higher Education
MOIT	Ministry of Industry and Trade
MOL	Ministry of Labour
MOP	Ministry of Planning
MPW	Ministry of Public Works
MMRAE	Ministry of Municipal and Rural Affairs and the Environment
MOT	Ministry of Transport
MCTA	Ministry of Culture, Tourism and Antiquities
CBJ	Central Bank of Jordan
CVDB	Cities and Villages Development Bank
DOS	Department of Statistics
IDB	Industrial Development Bank
JEA	Jordan Electricity Authority
JIEC	Jordan Industrial Estate Corporation
JNGC	Jordan National Geographic Centre
JVA	Jordan Valley Authority
NPC	National Planning Council
NRA	Natural Resources Authority
RSS	Royal Scientific Society
WAJ	Water Authority of Jordan

(3) Other Public Organizations

ACC	Agricultural Credit Corporation
ALIA	Royal Jordanian Airline
APC	Arab Potash Company
ARC	Aqaba Railway Corporation
HC	Housing Corporation
HJR	Hejaz Jordan Railway
IDECO	Irbid District Electricity Company
JCFC	Jordan Cement Factories Company
JCO	Jordan Cooperative Organization
JETT	Jordan Express Tourist Transport
JPMC	Jordan Phosphate Mines Company
TCC	Telecommunications Corporation
UDD	Urban Development Department of MMRAE

(4) Technical Terms

AMSL	above mean sea level
SS	suspended solids
TDS	total dissolved solids
EC	electric conductivity

(5) Economic Terms

JD	Jordanian Dinars
GNP	Gross National Product
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
ICOR	Incremental Capital Output Ratio

(6) Measurement

mm	millimetre	cm ²	square centimetre
cm	centimetre	m ²	square metre
m	metre	ha	hectare
km	kilometre	km ²	square kilometre
cm ³	cubic centimetre	mg	milligramme
l, lit	liter	g	gramme
m ³	cubic metre	kg	kilogramme
MCM	million cubic metre	ton	metric ton
bbl	barrel	t.o.e.	tons of oil equivalent
s, sec	second	°	degree
min	minute	'	minute
h, hr	hour	"	second
y, yr	year	°C	degree Celsius
V	Volt	m ³ /s	cubic metre per second
A	Ampere	lcd	liter per capita per day
W	Watt		
kW	kiloWatt	kWh	kiloWatt-hour
MW	megaWatt	MWh	megaWatt-hour
GW	gigaWatt	GWh	gigaWatt-hour
10 ³	thousand	10 ⁶	million
ppm	parts per million	ppt	parts per thousand
φ	diameter in mm		

(7) Exchange rate

US\$ 1.00 = JD 0.34 (the prevailing rate in mid 1987)

1. INTRODUCTION

1.1 Background of the Study

The Government of the Hashemite Kingdom of Jordan (the Government of Jordan) recognizes integrated regional development as an important tool in development strategy. The basis of this approach is to integrate each region into a self-sustained development unit by providing residents with social services and basic infrastructures to meet their socioeconomic needs.

In accordance with the strategy above, integrated development plans have now been prepared for each region on the East Bank of the Jordan through international technical cooperation. In August 1982, the Government of Jordan requested the Government of Japan to implement an integrated regional master plan study for the Karak-Tafila Development Region (the Study).

In response to this request, a contact mission was dispatched to Jordan to clarify the background and specifics of the request and to discuss with the Jordanian side (Ministry of Municipal and Rural Affairs and the Environment, MMRAE) the possibility and the scope of cooperation in March 1985 by the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of technical cooperation of the Government of Japan.

In December 1985, JICA dispatched another mission to Jordan to discuss in more details and in more specific terms the scope of this technical cooperation. The official Scope of Work was concluded between Jordanian and Japanese sides and signed by respective representatives on December 9, 1985.

1.2 The Study

The Study was undertaken in the following six steps:

- Step 1: Analysis of the present situation for development
- Step 2: Identification of the development potentials
- Step 3: Preparation of overall development frameworks
- Step 4: Preparation of an integrated development master plan
- Step 5: Identification of possible priority projects
- Step 6: Preparatory studies of high priority projects

The Study aimed to formulate an integrated development master plan for the Karak-Tafila Development Region for a purpose of reducing socio-economic disparities between the region and the rest of the Kingdom by means of socioeconomic development of the region.

The Study Area, 8,100 km² in total area, is located in the Highlands to the south of Greater Amman, and covers Karak Governorate excluding Safi Sub-region, Tafila Governorate, and a southern part of Amman Governorate. The Safi Sub-region in the Southern Ghor was excluded from the Study Area since it is designated as part of the development area of Jordan Valley Authority (JVA). On the other hand, part of Amman Governorate to the south of the main river course of Wadi Wala was included in the Study Area, because it was not covered in the master plan prepared for Amman-Balqa Region in 1979. Master plan studies for Irbid and the South Regions were done in 1979 and 1983 respectively, and only the Study Area was left for planning.

The Study was undertaken by the study team appointed by the Japan International Cooperation Agency (the Study Team) with cooperation from MMRAE, the Ministry of Planning (MOP), and other ministries and agencies concerned of the Government of Jordan (the Government).

Study schedule: The Study was undertaken in three stages: the first stage covered Steps 1, 2 and part of Step 3; the second stage covered the remaining part of Step 3, and Steps 4 and 5; and the third stage covered Step 6. The first stage of the Study was started in the end of July 1986, and the findings and study results were presented in the

Progress Report submitted in November 1986. The second stage of the Study was commenced in mid-December 1986 and continued through March 1987, to prepare the Interim Report. The third stage was commenced on July 8, 1987 and was continued to November 4, 1987 in presentation of the Draft Final Report on the Study. This Final Report has been prepared taking the final comments of the Jordanian side into consideration.

Regional Development Councils and Sector Committees: Each governorate in Jordan has its own Regional Development Council for planning and monitoring of regional development, which was formed for preparation of the Third Five-Year Plan covering a period from 1986 to 1990. Each Council is composed of the governor, mayors of municipalities, and the representatives of villages and government offices in respective regions.

In parallel to the Councils above, seven Sector Committees were formed by the prime minister on December 13, 1986 to review the Study and provide appropriate guidelines to the Study Team. Each Sector Committee was comprised of representatives of the ministries and agencies concerned. The Sector Committees covered (A) water, (B) agriculture, (C) labour force, (D) education and higher education, (E) industry, mining and tourism, (F) transportation, communications and energy, and (G) housing and urban planning.

Workshops with Jordanian counterparts: The Study maintained close collaboration throughout with counterparts from MMRAE and MOP, through daily work and workshops held almost every two weeks, for transfer of planning technology and coordination (see Table 1).

1.3 Organization of this Report

This Report consists of four volumes: Volume 1 - Executive Summary; Volume 2 - Main Report Part 1 - Master Plan Study; Volume 3 - Main Report - Part 2 - Preparatory Studies of Priority Projects; and Volume 4 - Supporting Reports. Detailed results of sector studies are presented as Annexes A to J in Volume 4.

The remaining part of this Volume 2 is organized in the following manner. In Chapter 2, the present situation for development in the Study Area is summarized by sectors for better understanding of the region.

Chapter 3 sets up development objectives and discusses overall development strategy. Chapter 4 examines socioeconomic frameworks, a landuse plan and alternative water allocation plans, and proposes a spatial structure of the region.

With the overall development framework established above, Chapter 5 studies sectoral development plans to attain the respective development targets. Chapter 6 integrates the sectoral plans into the Master Plan for the Karak-Tafila Development Region.

Chapter 7 examines impacts of and requirements for the implementation of the Master Plan. Conclusions and recommendations of the Study Team are given in Chapter 8.

Those readers who want to see only the Master Plan may directly skip to Chapter 6.

2. PRESENT CONDITIONS AND REGION'S SITUATION

This chapter presents present conditions and situation for development in the Study Area.

2.1 Natural Conditions

2.1.1 Climate

The Study Area is characterized by a semiarid climate with mean rainfall of 150-350 mm/yr in the western Highlands and an arid climate with mean rainfall of less than 50 mm/yr in southeastern desert areas. Rainfall generally decreases from northwest toward southeast. Moist air mass inflow from the Mediterranean Sea is a source of rain in the Kingdom, but usually dries up after giving rain in the western Highlands.

In winter a cold southwesterly to westerly wind prevails, and frequent frost and occasional snowfall are observed in the Highlands. The maximum snow depth of 40 cm ever recorded was at Al Rabba meteorological station. In spring, though it is short, the khamsin from the Sahara occasionally reaches the Kingdom causing high temperature and surface winds often accompanied with thunderstorms and hail in the Highlands. A northwesterly wind prevails in summer. Mean temperature at Wadi Wala meteorological station (EL 450 m AMSL) varies between 10.1°C in January and 23.8°C in August, and the extreme maximum of 43.5°C and minimum of -5°C were ever observed.

The rainy season in the Study Area normally starts in November (ranging from October to January) and lasts for 3 to 7 months. Most of the rainfall is concentrated in the 4 months from December to March. Mean monthly rainfall at Karak exceeds 70 mm in these 4 rainy months. A maximum 24-hour rainfall of 120 mm was observed at Wadi Wala station. The mean pan evaporation is as high as 3,600 mm/yr at Al Hasa meteorological station. The daily pan evaporation amounts to 13 to 14 mm in the months from May to August which are low relative humidity months

(around 40 per cent at Wadi Wala station). In rainy months from December to February mean relative humidity often exceeds 60 per cent.

The mean rainfall over the Study Area is 153 mm/yr equivalent to 1,242 MCM/yr. The Mujib basin receives 62 per cent of this, Hasa 23 per cent, and others 15 per cent respectively.

Mean wind speed is high at around 14 km/hr at Rabba station, and at 10 km/hr at Wadi Wala station respectively.

Sunshine is abundant in the Study Area. Daily sunshine hours range from 6 to 9 hours in winter and exceed 11 hours in summer. The mean solar radiation rate at Al Rabba meteorological station is 490 cal/cm²/day.

2.1.2 Topography

The Study Area is located in the central part of the eastern Highlands of Jordan. The Rift Escarpment in the Jordan Valley, the Wadi Araba Graben, forms the natural western boundary of the Study Area. Maximum elevations along the crest of the Escarpment are 1,640 m at the south of Tafila, 1,250 m near Karak and 1,060 m to the north of Rabba. The Escarpment is breached by a number of wadis running westward. The largest wadis are Wadi Mujib (6,590 km² in drainage area) and Wadi Hasa (2,520 km²). Erosion in these valleys has been rejuvenated by successive lowerings of the base level of the Dead Sea and the Wadi Araba Graben. As a result, deep gorges have been cut in the sedimentary rocks which underlie the Highlands. These gorges extend eastward far into the central plateau.

To the east of the Escarpment, there is a gradual decline in elevation though hilly lands extend eastward almost to the Amman-Hejaz Railway. Eastward from the railway to the eastern border of the Study Area is a gently dissected plateau. The elevation ranges from about 1,000 m in the foothills of the southwestern Highlands to less than 810 m in topographic depressions which form the mudflats of Hafira and Jinz.

A graben occurs in the Highlands between Karak and Abiad, running from NW to SE.

2.1.3 Soil

The red Mediterranean soils develop in the Highlands with annual rainfall of more than 350 mm. The parent rocks are limestone, basalt and sandstone. The soil profile has A, B and C horizons. The A and B horizons can not be clearly differentiated by colour. Clay content of B horizon is larger than in A horizon. The soils are the best in Jordan having comparatively higher fertility, and cover about 910 km², 11 per cent of the Study Area.

The yellow Mediterranean soils occur in areas with annual rainfall of 250 to 350 mm, covering the narrow zone between the cultivated Highlands and the steppe regions. The soil profile has A, B and C horizons, but difference between B and C horizons is obscure. The soils have hard consistency. The dominant present landuse of the soils is grazing. The soils cover about 550 km², 7 per cent of the Study Area.

The yellow soils is the typical steppe soils with the annual rainfall of 100 to 200 mm. Profile development is weak having C horizon and very thin A horizon. The soils are hard and their permeability is poor. The soils cover about 1,770 km², 22 per cent of the Study Area.

The gray desert soils occur in areas with annual rainfall of less than 100 mm. The soils are shallow in depth and their surface is covered by flint and basalt gravels. They have little agricultural potential except wadi beds. The soils cover about 4,800 km², 59 per cent of the Study Area.

The saline soils are found in wadi beds with poor drainage. Agricultural utilization of the soils is difficult without leaching of salts. The soils cover about 70 km², 1 per cent of the Study Area.

2.1.4 Vegetation and Wildlife

The natural vegetation in the Study Area may be roughly sub-divided into three main zones (Long, 1957).

Forest zone: This type of vegetation was formerly present in areas where the mean annual rainfall exceeds 300 mm. However, due to human actions, surviving vegetation in this zone is degraded and areas of true forest are now extremely limited.

Steppe zone occurs in areas having a mean annual rainfall of 150 to 300 mm. Under natural conditions it would develop a fairly complete cover of perennial shrubs and grasses. However, due to ploughing and over-grazing the vegetation in this zone is degraded.

Desert zone is developed in areas with less than 150 mm of mean annual rainfall. The vegetation consists mainly of perennial shrubs, which are concentrated along wadis, and annuals which grow after winter rains. The vegetation cover is incomplete under natural conditions, and extensive areas of chert strewn desert occur being devoid of plant growth.

In the Study Area, there are three wildlife reserves; Mujib Wildlife Reserve (2,400 ha in total land area), Abu Rukbah Wildlife Reserve (41,000 ha), and Dhana Wildlife Reserve (5,100 ha).

2.2 Socio-economy and Finance

2.2.1 Population

MOP estimated population and its growth rate for the period 1979-1985. According to this estimation, the total population of Jordan amounted to 2.7 million in 1985. 84 per cent of the population was concentrated in northern Jordan in Amman and Irbid Governorates. The average annual growth rate was 3.7 per cent in the whole Kingdom whereas those of Karak and Tafila Governorates were 2.9 and 2.7 per cent respectively (see Table 2 for region's present position in Jordan). There was migration from the Study Area towards the Amman Region.

Population in the Study Area was estimated at around 143,000 in 1985, comprising 96,000 in Karak Governorate (except Safi Sub-region), 37,000 of Tafila Governorate, and 9,000 in the area belonging to Madaba Sub-region of Amman Governorate.

There were 180 settlements in the Study Area in the National Village Survey of 1984. Of these, 120 settlements (67 per cent) had small population of 500 or less, and shared 14 per cent of the total population. On the other hand, nine municipalities with populations of 3,000 or more accounted for nearly 40 per cent of the population (see Figs. 2 and 3 for village distribution and present spatial structure). The Karak and Tafila Municipalities are the capital cities of these governorates and are required for further agglomeration to provide a higher level of urban services as regional centres.

2.2.2 Employment

According to the Third Five-Year Plan, the number of Jordanian workers was estimated at 502,000 in 1985. The share of the services sector was predominant at 70 per cent. An influx of foreign labour occurred in the later half of the 1970's. The number of foreign labourers increased from 41,000 in 1979 to 143,000 in 1985. The Plan expects 97,300 new job opportunities for the economic sectors in Jordan.

In 1985, employment in the Study Area was estimated at around 29,000 which was 5.7 per cent of national employment. Public service and other service sectors accounted for 61 per cent of the total employment in the Study Area, followed by 17 per cent in the agricultural sector, and 10 per cent in the mining sector.

2.2.3 National Economy

In spite of limited natural resources and some interruptions due to instability in the Middle East, the economy of Jordan had grown rapidly until 1980 around. Gross National Product (GNP) rose at 15 per cent annually in real terms from 1975 to 1980. Since the early eighties, however, the annual growth rate has fallen to 4.2 per cent (1981-1985).

In 1985, GNP at market price amounted to JD 1,856 million, Gross Domestic Product (GDP) at market price JD 1,581 million, and GDP at factor cost JD 1,359 million respectively at current prices. The domestic economy was dominated by the services sector, which accounted for 63.5 per cent of GDP at factor cost in 1985. The remaining 36.5 per cent was the contribution of directly productive sectors.

2.2.4 Economy and finance in the Study Area

The Gross Regional Domestic Product (GRDP) of the Study Area was estimated at JD 98 million in 1985, which accounted for 7.2 per cent of the whole Kingdom (Table 2). The average per capita GRDP in Jordan was JD 509 whereas that of the Study Area was JD 687 in 1985. However, the per capita GRDP of the Study Area, which excluded a mining sector's contribution, was only JD 381. Among the productive sectors, GRDP of the mining sector accounted for 47 per cent of total GRDP in the Study Area followed by the agriculture sector having 10 per cent. The manufacturing industry accounted for only 0.7 per cent. The total share of the productive sectors including the mining sector was 63 per cent, which was much higher than the nationwide value of 36.5 per cent. Service sectors other than government services accounted for 15 per cent.

Per capita household income was estimated at JD 495 in the old Karak Governorate, which was 77 per cent of the national average (JD 641) and only 69 per cent of that of Amman Governorate (JD 719) in 1980. This lower household income in the Study Area forms a remarkable contrast to the per capita GRDP in the Study Area which is higher than the national average. This is considered to be mainly because of the sluggish growth in the manufacturing and major service sectors, slow development of Highlands agriculture, and low income effects of the mining sector.

As for local government (municipalities) finance, revenues of the old Karak Governorate in 1984 amounted to JD 2 million, equivalent to per capita revenue of JD 21. Total expenditures amounted to JD 2.2 million in 1984. The share of municipality's own revenue remained only

about 10 per cent of the total revenue.

Investment distributions planned in the Third Five-Year Plans of Karak and Tafila Governorates are presented in Tables 15 and 16.

2.2.5 Socio-economy by Sub-region

In order to formulate the regional development plan under the Third Five-Year Plan, MOP set up sub-regions inside the governorates. According to this classification, the Study Area has nine sub-regions comprising five from Karak, three from Tafila and one from Amman Governorates. Characteristics of each sub-region are shown in Table 3.

Among nine sub-regions, Karak and Tafila Sub-regions are outstanding in terms of administrative, industrial and commercial activities as well as population. Mazar Sub-region, which includes Mazar and Mu'tah Municipalities, features flat agricultural land, high density of population, and Mu'tah University. Other sub-regions such as Qasr, Ayy, Bseira and Madaba are characterized as agricultural area. Badia and Hasa Sub-regions are located along the Desert Highway and feature phosphate mining.

2.3 Productive Sectors

2.3.1 Agriculture

The agriculture sector produced 8.2 per cent of the GDP of Jordan, and accounted for 17.1 per cent of the commodity exports in 1985. However, 85 percent of the agricultural export were contributed by the irrigated agriculture in the Jordan Valley.

Landuse: The Study Area having total area of 8,100 km² is classified into four types of landuse; (1) Highlands (1,750 km²), (2) grazing land (1,040 km²), (3) sloping wadis (640 km²), and (4) desert (4,670 km²). Most of the cultivated lands are situated in the Highlands. The arable land in the Study Area is 124,700 ha, which is 15.4 per cent of the total Study Area. Of these, 29,000 ha is annually used for rainfed crop production. The rainfed farmlands are cultivated for cereal crops;

16,000 ha for wheat, 6,000 ha for barley, and 7,000 ha for lentils, chick-peas, etc. These planted areas varied from 11,400 ha in 1984 to 44,100 ha in 1978, being affected by yearly fluctuations of rainfall.

Land tenure: The average family size of a farm household is 8.1 (Ref. 14). The rural population in the Study Area, which is defined as those who are living in villages with populations of less than 5,000, is 106,000 (Ref. 3). The number of farm household is estimated to be 13,000. 99 per cent of farm holders in the Study Area manage their land by themselves (Ref. 14). About 20 percent of farmland is cultivated by tenant farmers under the sharecropping system. Most of the farmers are, therefore, owner farmers, and 16 per cent of the farmers are owner-cum-tenant farmers. The average cultivated area is 4.8 ha per farm household, and the planted area is 2.2 ha per farm household.

Crop production: The average unit yield of cereal crops in the Study Area was 0.62 t/ha in the period from 1981 to 1985. The average cereal production during the same period was 15,000 t/yr. Among the cereals, wheat production in the Study Area (10,700 t/yr in 1981-1985) accounted for 8.9 per cent of the nationwide production (120,000 t/yr).

Irrigated agriculture: Irrigated land in the Study Area is limited to 3,200 ha comprising 2,300 ha of fruit tree plantation and 900 ha of vegetable cultivation (Ref. 14). More than 2,000 ha are irrigated with spring water, and 500 ha by deep wells. Some are fed from base flow of wadis by pumping for 50 to 100 m in head. Most of the fields in the Study Area are not provided with farm drains. Water logging damage for crops is seldom reported because of a deep groundwater table. On the other hand, fields are susceptible to soil erosion by storm water. Improvement of drainage facilities is required for land conservation. The Qatrana and Sultani dams were constructed in 1962 for irrigation of forage land, livestock watering and groundwater recharge. But the irrigation systems are not presently used.

Livestock production: The most important livestock in the Study Area are sheep and goats. 185,000 sheep and 158,000 goats were raised

in the Study Area in 1984 on the natural grazing land, barley and on the waste of other crops. The total number of sheep and goats in the Study Area was 25 per cent of the Kingdom total. The average holding number was 14 sheep and 12 goats per farm household. The total number of chicken farms in the Study Area was 77 in 1983 with 3 million chickens, comprising 64 broiler farms and 13 egg laying farms.

Judging from the present situation of Highlands agriculture in the Study Area, the following form the principal constraints for agricultural development:

(1) Meager rainfall: land favoured with a mean annual rainfall of 250 mm or more is limited to 1,070 km² or only 13 per cent of the Study Area. An area of 124,700 ha is estimated to be arable from viewpoints of land slope and soil conditions. Semidesert land with a mean annual rainfall of less than 100 mm spreads over 3,742 km², or 46 per cent of the Study Area. The medium rainfall area of 100-200 mm/yr extends over 2,303 km². Due to the high pumping head required to use flood flow in deep valleys for Highlands agriculture, its economical development can not be expected.

(2) Land erosion by wind and rainstorm has been incurred as the result of past over-grazing in the marginal rainfall area. Cultivation not along contour lines but along the slope direction in the hilly area, shortage of afforestation, shortage of terraced farmlands, and lack of check dams also aggravate it.

(3) Vertical fragmentation of land tenure along the slope direction has resulted from equitable inheritance among heirs. It makes the contour cultivation and efficient use of farming machinery difficult.

(4) Out-migration trend: The low agricultural production as a result of the constraints above causes a low income and employment in the agricultural sector, reducing economic vitality in the rural areas.

2.3.2 Mineral Resources

Mineral exports in 1986 were estimated at JD 96.2 million, comprising JD 64.8 million of rock phosphate and JD 31.4 of potash. Jordan is the third largest phosphate exporter in the world. Domestic phosphate production amounted to 6.25 million tons, all of which came from El Hassa Mines in Tafila Governorate and from El Abiad Mines in Karak Governorate. Of this production, 5.2 million tons were exported and 0.9 million tons were delivered to the fertilizer complex in Aqaba.

The Rashadiya cement works in Tafila Governorate came into production in 1984 but due to a decrease in foreign demand of cement, the factory was running at less than 30 per cent of its designed capacity of 2 million t/yr. Nevertheless the annual production of Rashadiya works is expected to reach a level of 1.1 million tons in 1989. Gypsum is being supplied in proportion to cement production from a mine at Jabal Muleyh in Tafila Governorate.

Since the Study Area is situated between Amman and Aqaba, not surprisingly construction and upgrading of roads in the Study Area are being actively undertaken. Many buildings and houses are also being constructed. Production of natural sand in the Study Area stood at 300,000 m³ in 1986, having increased from 180,000 m³ in 1985.

Around 4,000 persons including contractors are estimated to be engaged in mining, quarrying and cement production in the Study Area.

2.3.3 Small and Medium Scale Industries

There are 212 industrial establishments in the old Karak Governorate including above mining and quarrying sectors. Of these, 182 establishments (85.8 per cent) have less than five employees. The establishments in the Study Area are mainly distributed in Karak Sub-region (44.7 per cent), Mazar Sub-region (23.7 per cent), and Tafila Sub-region (16.2 per cent). Distribution of these establishments in the Study Area is shown in Fig. 6. Furthermore, 41.7 per cent of the total establishments are concentrated in Karak Municipality.

The main industries relate to fabricated metal products (except machinery), construction, wearing apparel, carpentry and wood-working, and non-metallic mineral products. They are mainly construction related products to meet the local needs.

The out-migration of the population, limited local demand for industrial products, and inactivity of manufacturing industries form a vicious circle.

Many local enterprises depend on only a few employees and simple equipment without large capital investment. Since it is quite easy to start this kind of enterprise, there would seem to be an excess number of local manufacturers, which in turn reduces their share in the limited market. The comparatively low level of technology, productivity and production capacity of the local enterprises makes it difficult to compete with enterprises from Amman. Many of the local manufacturers are unable to find opportunities to participate in large scale projects such as construction of large public buildings.

In addition to low productivity and low wage levels, unemployment is a serious issue. This is related to the non-Jordanian work force in the labour market.

At present some industries in Old Karak are reported to cause noise problems. So the Municipality is constructing a new industrial zone to the south of New Karak to relocate these establishments. Some will suffer financial problems from the relocation.

In general, shortage of funds often occurs for such causes as delays in payment. Available financial services such as Industrial Development Bank (IDB), however, are not fully understood by local entrepreneurs. Similarly, vocational training facilities are not utilized efficiently.

Some kinds of raw materials, spareparts and big machines are not available in the Study Area thus necessitating heavy dependence on Amman

by the local industries. Provision of these commodities is needed as well as improvement of infrastructures.

2.3.4 Tourism

Tourism in Jordan: Jordan has abundant tourism resources owing to its geographical location at the crossroads of ancient civilizations from Asia, Europe and Africa. These tourism resources may be categorized to three groups: archaeological resources, historical/religious resources, and natural resources.

Since the loss of direct control of West Bank of the Jordan River in 1967, tourism in Jordan has been obliged to rearrange its tourism network within the resources of the East Bank. The success of this rearrangement has resulted in the generation of a remarkable share in GDP (11 per cent in 1985), foreign exchange incomes (16.6 per cent in 1985), and opportunities for employment (1.3 per cent in 1985).

Arrivals to Jordan in 1985 were about 1.9 million persons apart from pilgrims but including foreign workers mainly from Egypt, Syria and Lebanon. Their nationalities were Arabs (82.0 per cent), Non Arabs in the Middle East (7.0 per cent), Europeans (5.8 per cent), Americans (3.2 per cent), and others (2.0 per cent).

Regional situation: Tourism in the Study Area is not playing an important role in the national tourism network at present. Old Karak used to be considered as a place for luncheon by most tourists and tourism agencies on their way to Petra and Aqaba. Tourists would have their lunch in the rest house and visit the Castle of Karak for a limited time before continuing their trip towards their main destination. This tourism style does not contribute to the local economy except in food and beverage supply.

The existing constraints on the regional tourism development are:
(1) The tourism resources are not well presented; (2) Required tourist facilities, attractions and town beautification are not well developed; (3) The tourism market is not open enough to the private sector. To

activate the tourism industry, it is essential to open the market to free competition by the private sector; (4) Insufficient statistics prevent a reasonable response to demands of the market and establishment of a total development strategy; and (5) Consensus of the local inhabitants has not been established to accept foreign tourists who may have different cultures.

2.4 Physical Infrastructure

2.4.1 Water

Most of the water supplied for regional consumption is groundwater and spring water. Due to the high altitude of about 800 m AMSL or more in most part of the Study Area, utilization of base flow and flood flow in deep wadis is limited to areas along wadi beds with a low elevation of some 400 m AMSL or less.

Municipal water: There are two principal water networks for municipal water supply in the Study Area; the Karak water network, and Tafila water network. The annual water supplied by the two networks in 1985 was estimated at 3.5 MCM. Of these, 0.7 MCM was supplied from Ain Sara Spring in Wadi Karak, 0.8 MCM from Chuweir well field, 0.9 MCM from Sultani well field, and 1.1 MCM from Nijil well field in Shaubak, Ma'an respectively. The per capita municipal water demand including distribution losses was estimated at 100 lcd (liter per capita per day) in Karak and Tafila Municipalities in 1985, and 55 lcd for villages with population less than 3,000.

Irrigation water: Sources of irrigation water supplied in the Study Area are springs, deep wells, and surface flow of wadis.

Of 169 major springs in the Study Area, about 140 are used for small scale irrigation around each spring. Most of the springs are concentrated on the western slopes of the Highlands facing the Dead Sea between Wadi Karak and Wadi Feifa with some springs in the Wadi Mujib basin. The spring-irrigation water is estimated at around 7.5 MCM/yr irrigating farmlands in wadi slopes of more than 2,000 ha.

There are 118 deep wells in the Study Area. Of these, 25 in the Mujib basin and several in the Hasa basin are used for local irrigated agriculture. Annual water used is estimated at around 3 MCM for farmlands of about 500 ha.

Irrigated agriculture using the base flow is limited to deep wadis like Burbeita in Wadi Hasa. The flood water of Wadi Qatrana is stored by the Qatrana Dam which has a storage capacity of 1.85 MCM, and is used for livestock watering. The Sultani Dam which had an initial storage capacity of 1.2 MCM, has been almost filled with sediments and slimes. The present capacity as surveyed by WAJ was 0.33 MCM in 1987.

Mining and large scale industrial water: At present 10 MCM/yr of groundwater are extracted for the two phosphate mines in the Study Area. Of this 6.1 MCM/yr is discharged with about 1.5 million t/yr of suspended solids as slimes. Because of the accumulated high chloride concentration through recycling of the phosphate washing water, a constant supply of fresh water and discharge of the slimes are required. At present the slimes are left for natural evaporation and infiltration.

The cement factory at Rashadiya has 2 deep wells. Groundwater abstraction in 1985/1986 was estimated at less than 0.6 MCM/yr. There is no specific discharge of wastewater except from the quarters where 603 employees and their families are living.

Water transfer: Groundwater from the Mujib basin is transmitted to Greater Amman at about 15 MCM/yr. However, 1.1 MCM/yr of groundwater are supplied to the Tafila water network from Ma'an Governorate.

The base flow of Wadi Hasa and adjacent small wadis is supplied to the Southern Ghor Irrigation Project, Stage I at about 39.3 MCM/yr to irrigate 4,060 ha of farmlands.

2.4.2 Transportation

Road transportation: Of the total length of national roads in the Study Area (760 km), 700 km is paved. The road system consists of three

trunk routes running in parallel from south to north, which connect the Aqaba seaport and the capital city Amman (Fig. 1). These are, from east, the Desert Highway, the King's Highway and Route-65. The Desert Highway has four lanes in the section between Qatrana and Ma'an. The King's Highway with two lanes has a safety problem with stones falling from steep wadi slopes during rainstorms. The northern part of the Route-65 is still under construction for about 32 km between Ghor Haditha and Zara. These three trunk routes are connected to each other by several lateral roads.

The traffic capacity of the Desert Highway is 29,000 vehicles per day in its four-lanes section, and 12,600 in the two-lanes section. The lateral road connecting Karak and Qatrana has a capacity of 12,800 and other secondary roads 9,000 (Ref. 15).

The traffic volume in Karak City has had an average growth rate of 5.4 per cent per annum in the past 5 years, while in Tafila City it has remained at the same level. The traffic volume on the primary and secondary roads in 1985 was in the range of 800 to 8,200 vehicles per day, being well within their capacities.

Railway transportation: The total length of the railway in Jordan extends to 609 km, being operated by the Hejaz Jordan Railway (HJR) and Aqaba Railway Corporation (ARC). The rolling stock in 1985 consisted of 37 locomotives, 8 passenger carriages, 508 freight cars, and 48 other cars. The railway is mostly used for freight traffic. ARC, which was established in 1975 to transport phosphates from El Hassa and El Abiad Mines to Aqaba port, operated eight trains a day for transporting phosphates of 3.2 million t/yr in 1984.

2.4.3 Telecommunications

There are two automatic exchanges, one each in Karak and Tafila. Each has an exchange capacity of 2,000 lines. In addition, there are 62 manual exchanges with a total of 8,200 operating lines. The telephone demand is widely scattered in the Study Area and on a small scale ranging from 20 to 2,000 lines. The number of telephone subscribers in

Karak Governorate was 5,900 in 1985, having grown at 8.4 per cent per annum in the past 5 years. The Telecommunications Corporation estimates that future telephone subscribers will reach 30,700 by the year 2000, assuming a rate of 0.87 lines per household. To meet these growing demands, establishment of one trunk exchange, 22 digital remote switching units and four remote line multiplexers are planned.

2.4.4 Energy

Fuel: Jordan is dependent on imported oil to meet its energy requirements. About 50,000 bbl a day of crude oil are imported from Saudi Arabia and Iraq. The cost of imported energy in 1985 stood at US\$ 603 million.

The total energy consumption in 1985 was 2.82 million tons of oil equivalent (t.o.e.), indicating the lowest annual growth rate of 2.1 per cent in the last 20 years. This low growth rate was due to a slowdown in economic growth and also saving in energy consumption through the conservation programmes and measures taken by the Ministry of Energy and Mineral Resources (MEMR).

ENERGY SUPPLY IN JORDAN

(million t.o.e.)				
Year	Crude oil	Fuel oil	LPG	Total
1981	2.16	-	-	2.16
1982	2.57	-	-	2.57
1983	2.54	-	-	2.54
1984	2.62	0.14	0.01	2.76
1985	2.48	0.39	0.01	2.89

Source : MEMR

Of the total energy consumption of 2.82 million t.o.e., the transport sector consumed 1.16 million t.o.e., or 41 per cent of the total. 79 per cent of the transport sector energy consumption came from road transportation and the remaining 21 per cent came from air transportation. This was followed by the electricity sector with 0.70 million t.o.e. or 25 per cent of the total, the industrial sector with 0.45 million t.o.e. or 16 per cent, the domestic sector with 0.34 million

t.o.e. or 12 per cent and all other sectors with 0.17 million t.o.e. or 6 per cent.

Saudi crude oil is imported through the two pipelines of 8 and 12 inches in diameter which run over a distance of 42 km from a pumping station of Trans-Arabian Pipeline Company to the Zarqa refinery of Jordan Petroleum Refinery Company. Import of crude oil and related products from Iraq was commenced in 1984, and both crude oil and products are transported to Jordan by road tankers. Domestic production of petroleum was started in 1984 at a pilot level, and crude oil produced is being trucked to the Zarqa refinery.

The Zarqa refinery has a capacity of 13,300 t/day of crude oil and is provided with cracking units. The Jordan Petroleum Refinery Company is also responsible for distribution of its products in the Kingdom.

Distributed amounts of fuels in the old Karak Governorate are given as follows (Ref. 5):

Year	(1,000 litres)		
	Benzine	Kerosene	Diesel Oil
1981	13,396	10,991	94,159
1982	12,002	12,225	89,291
1983	11,084	10,776	66,051
1984	11,646	9,288	62,967
1985	13,275	8,296	70,299

The annual per capita consumption of fuels in the old Karak Governorate was estimated to have been 85 litres of benzine, 53 litres of kerosene and 450 litres of diesel oil in 1985.

Electricity: Since commissioning of the 132 kV National Grid in 1983, the Interconnected System has covered the whole Kingdom from Irbid to Aqaba. The 132 kV transmission system extends for 1,284 km. In 1986, another transmission line of 400 kV was constructed between Aqaba and Amman. The national electrification ratio showed a rapid improvement from 32.0 per cent in 1970 to 92.8 per cent in 1985.

In 1985, a total of 2,495 GWh of electricity was generated, of which 2,102 GWh (84.2 per cent) was generated by the Jordan Electricity Authority (JEA) and the balance by the private sector. The Hussein Thermal Power Station (HTPS), with a total installed capacity of 395 MW, generated 1,916 GWh in 1985, or 76.8 per cent of the national total. In 1985, 20.5 GWh of energy was exported.

The system peak load in 1985 was 475 MW including the peak load exported (69 MW), while the system installed capacity was 602 MW. The Aqaba Thermal Power Station (ATPS) having two units of 130 MW thermal generators was put into operation in 1986. Electricity losses in the Interconnected System were 14.0 per cent in 1985.

The standard electricity tariff is 31 fils/kWh for the first block up to 160 kWh/month, and 52 fils/month for over 160 kWh/month. The commercial consumer's tariff is 46 fils/kWh, and the small industrial consumer's tariff is 32 fils/kWh for the first block up to 2,500 kWh/month and 22.5 fils/kWh for over 2,500 kWh/month. The tariff for water pumping and agriculture is 23 fils/kWh. The hotel's tariff is also 23 fils/kWh.

In the Study Area, electricity is supplied by 132 kV and 33 kV transmission lines which are connected to the Interconnected System at the Qatrana Substation. In addition, there is a power plant in Karak City which has one gas turbine (18 MW) and three diesel generators (3 x 1.5 MW). Also El Hassa mines have a diesel power plant with an installed capacity of 12 MW. The number of consumers in the Study Area was 23,000 in 1985, which grew at 22.6 per cent per annum from 1980 (8,300).

The electricity consumption, excluding industrial use, in the Study Area including the Shaubak area was 54.7 GWh in 1985, or 4.4 per cent of the national consumption (1,248 GWh/yr). The industrial use was 120 GWh, or 13.3 per cent of the national (903 GWh/yr). The total consumption in the area was 8.1 per cent of the national (2,151 GWh/yr).

The total number of connected consumers at the end of 1985 amounted to 401,000, representing 93 per cent of the total population in the Kingdom. By the end of the year the total number of electrified villages was 574, inhabited by 985,000 people, or 91 per cent of the total rural population.

The electrical energy consumption of major industrial companies in the Study Area was as follows:

Year	(GWh)	
	Phosphate Mines	South Cement Works
1981	58	-
1982	70	-
1983	77	1
1984	83	50
1985	81	72

2.5 Social Infrastructure

2.5.1 Education

The public education system comprises three levels; elementary (grades 1 to 6), preparatory (grades 7 to 9), and secondary (grades 10 to 12) schools. Enrollment of students in the Study Area in 1985/1986 was 34,900 in elementary schools, 12,300 in preparatory schools, and 6,400 in secondary schools. The school enrollment rate of the population is 30 per cent being at the national level. The national target is to provide all children with education up to the preparatory school level.

There are 2,046 teachers in Karak Governorate, and 730 in Tafila. Many of these lack formal qualification and require further training.

There are three higher education institutes in the Study Area; the Community College in Karak, Mu'tah University, and Polytechnic Institute in Tafila. These aim to produce school teachers, public administrators, engineers and so forth. The Third Five-Year Plan has allocated 18 per cent of the national educational expenditures (general and higher edu-

cation) to the Study Area, a large part of which will go to the ongoing Mu'tah University Project.

2.5.2 Health

The infant mortality rate in Jordan was 60 per 1,000 in 1984. Life expectancy for males is 67 years and for females 71 years.

In the Study Area there are 28 health centres, 53 rural clinics, 20 mother and child care centres, seven dental clinics, three public hospitals (170 beds), one private hospital (58 beds), and several other health facilities.

The total number of health staff in the Study Area is 452 including physicians, dentists, pharmacists, nurses and midwives. The number of physicians per 10,000 population is 7.9, or two thirds of the national level of 11.9. The health services in the Study Area are understaffed compared to the national level.

2.5.3 Housing

Housing has been developed during the past three decades through many housing projects. Between 1951 and 1985, housing units in Jordan increased from about 37,000 to 456,000, at an average growth rate of 7.6 per cent per annum.

The censuses of 1961 and 1979 also show significant quality improvements in building materials. The establishment of several housing cooperatives and specialized housing funds contributed to this development.

Most of the housing projects implemented in the Study Area have been for employment-related housing such as for the Phosphate Mine Company, the South Cement Company and Mu'tah University.

3. DEVELOPMENT OBJECTIVES AND SCENARIOS

3.1 National Development Policy

This section sets forth the national policy for regional development presented in the Third Five-Year Plan (Numerical development targets are shown in Table 4). The development policies reflect viewpoints not only at the national level but also at the governorate level through the newly organized body called Regional Development Council headed by the governor.

Policies of commodity-producing and associated services sectors: The principal points from the standpoint of regional development are as follows: (1) to promote research and development in private and public institutions and to utilize science and technology; (2) to upgrade the productivity of industrial, public and mixed sector institutions.

Investment policy: To realize balanced regional development and an equitable distribution of social services, the Plan accords attention to regional distribution of investments in the light of available agricultural, mineral and human resources as well as the population size and growth rate in each governorate.

Services development policies: The following two policies are emphasized for regional development in particular: (1) The development of human skills and qualifications to meet demand by domestic and Arab markets for highly skilled and specialized labour; (2) Enhancing efforts to attract foreign tourists to Jordan, through cooperation between hotels and tourist companies in order to develop an overall pattern of programmed tourism.

Employment, wage and population policies: The Plan places great emphasis on employment and wage policies because of a projected increase in unemployment of Jordanian manpower as a result of recession in the Gulf countries and the increased output of the educational system. Also, the Plan aims to adjust regional distribution of the population by

a strategic investment in infrastructure so as to encourage people to reside in less densely populated governorates, particularly in South Jordan including the Study Area.

Policies to reduce regional disparities: The Plan places special emphasis on rectifying regional disparities and mitigating the disproportionate levels of development of cities and villages, by reducing the concentration of economic activity in and the consequent demographic gravitation to Greater Amman. The Plan encourages (1) private sector investment in housing works outside the capital by granting a 50 per cent tax exemption on income from rents, compared to a 30 per cent exemption in the capital, and (2) investment in new industrial estates in the governorates of Balqa, Irbid and Aqaba. For achieving a more equitable distribution of social, health and educational services among the various regions, the Plan provides wage incentives to employees of public production enterprises located in certain regions, particularly in the southern governorates, to settle there.

Environment protection policies: Environment protection and pollution prevention are becoming important issues in the development of the various production sectors. The Plan aims to limit adverse effects of pollution on the environment and public health, taking economic and social priorities into account.

3.2 Regional Development Objectives

Taking into consideration the long-term objectives and policies stated in the Third Five-Year Plan and the development issues found in the Study, the following are set up as development objectives for the Study Area:

- (1) to increase the employment opportunities and income of broad segments of population in order to reverse the current trend of out-migration
- (2) to rectify inter-regional disparity in real GRDP and to achieve the national average of per capita GRDP by 2005
- (3) to achieve a balanced geographical distribution of population and economic activities within the Study Area

- (4) to achieve a stabilized economic base and to correct the dual structure of productivity existing between large and small enterprises
- (5) to provide public services in equitable, effective and efficient manners

3.3 Alternative Development Scenarios

The Development Scenarios are narrative descriptions of the socio-economic and spatial frameworks of the Master Plan. Three alternatives were conceived with future images taking account of resource potentials, development constraints, issues and objectives. The future image of the Study Area differs from the national Master Plan only in its emphasis on particular economic sectors, its spatial setting and roles in the national economy.

The growth scenarios of Greater Amman region were also taken into account as its *pull force* will significantly influence the socio-economy in the Study Area even if increased efforts are made to reduce the *push force*. At present agriculture and mining are the basic economic sectors of the Study Area. These are classified as primary industry since their production activities fully depend on natural resources. However the future outlook of the current basic sectors is not always promising in terms of employment.

Efforts to improve labour productivity in the agricultural sector will reduce the labour requirement. The existing major mining activities of phosphate and cement will not expand new employment opportunities as their production systems are fully established.

Development of oil shale will make a large impact on the Study Area as well as the Kingdom in two dimensions; creation of employment and import substitution of energy. However, technical and economic viability of the oil shale project is not clear at this time of the Study. The determinant is the future behavior of the world oil markets.

Judging from these situations, one employment option for long-term development must be the introduction of manufacturing and construction industries. There are several industrial development potentials such as a trend towards urbanization in the King's Highway Corridor, skilled manpower development at Mu'tah and Tafila, the availability of vast government lands in the Badia, dual accessibility to Queen Alia International Airport (QAIA) and to Aqaba Seaport, and so forth. The construction industry will grow as the population grows and the development progresses.

Scenario 1 images the Study Area with moderately-developed manufacturing industries so that the labour surplus from the agricultural sector can be partially absorbed by manufacturing and service sectors. It is assumed that the trend of out-migration will continue in spite of attainment of the targeted per capita GRDP.

Scenario 2 images the Study Area with a little higher industrialization and urbanization than in Scenario 1 at such primary population centres as Karak, Tafila and Mu'tah-Mazar Municipalities. Though these primary centres cannot act as a group of counter magnets to Greater Amman, the higher agglomeration will supply higher levels of urban services. The Study Area will have improved urban amenities while retaining a pastoral environment.

Scenario 3 images the Study Area with the most industrialization and urbanization among the three scenarios. Particularly socioeconomic activities in the Badia along the Desert Highway will increase their weight, which will lead to forming an overall balanced spatial structure of the region.

For comparison and evaluation, the relevant factors and future images are set out in Table 5.

4. DEVELOPMENT FRAMEWORKS

4.1 Socioeconomic Frameworks

4.1.1 Introduction

This section sets out the socioeconomic development frameworks of the Study Area for the target year 2005, based on the development objectives and scenarios discussed in the preceding chapter. The frameworks provide quantitative images of the alternative development scenarios for the Study Area, to evaluate the viability of each scenario, and to formulate appropriate strategies to achieve the goals set up. The frameworks comprise projections of population, employment (labour force requirements) and GRDP within the scope of the long-term objectives in socioeconomic development.

Limitations on the availability of data make it difficult to document accurate figures for the base year 1985. At the regional level, data on sectoral employment were found only for the year of 1979, while information on GRDP was scarce. In terms of population, data from National Village Survey by MOP were available and disaggregated into small areal units. Therefore, several assumptions were set up for the figures of the base year (1985) as follows: (1) Population is based on the National Village Survey; (2) GRDP of mining and manufacturing sectors is based on the Industrial Survey in 1984/1985; (3) GRDP of agricultural sector is derived from the Team's estimation based on the agricultural Census in 1983; (4) GRDP of other sectors is derived from the prorated gross production by governorates according to the number in employment in each economic activity in the Census of 1979; (5) Employment in the mining and manufacturing sectors is based on the Industrial Survey in 1984/1985; (6) Employment in other sectors is derived from the adjusted numbers in employment given in the Census of 1979 to which was applied the growth rate in employment in each economic activity in accordance with the national trend between 1979-1985.

4.1.2 Methodology and Procedure

This sub-section sets out the methodology and procedure for the projections:

Population: Population projections were made by trend projections based on the MOP projections with adjustment for three population scenarios; passive, mild and positive policies. Corresponding to each development scenario, annual population growth rates were set up. The average population growth rate in the period 1986-2005 will be 2.2 per cent per annum for Scenario 1, 2.8 per cent per annum for Scenario 2, and 3.2 per cent per annum for Scenario 3. Results of the projections for three scenarios are given in Tables 7 to 9.

In Scenario 1, the MOP projection was adopted and extended to 2005. This trend shows a passive population policy. It is assumed that the out-migration would still continue, even though the Study Area would develop. For Scenario 2, a mild population policy was adopted. This policy assumes that out-migration would stop by around 1995, and the Study Area could have the same growth rate as of the whole Kingdom from the mid-1990s onward. Scenario 3 assumed a positive population policy. It was assumed that the population would increase at a higher rate, and would nearly double in association with net in-migration.

GRDP: The per capita GRDP in the Study Area including the mining sector's contribution does not represent the actual income level because of the production of the mining sector independent from the regional socioeconomic activities. Accordingly, the per capita GRDP including the mining sector's contribution cannot be used as a scale to measure the disparity between this area and others.

As to basic concepts for projection of GRDP at factor cost, the following points were emphasized: (1) The goals shown in the Third Five-Year Plan were taken as a given condition; (2) A per capita GRDP was set as the common target for each development scenario; (3) The targeted per capita GRDP was the per capita GDP projected for the whole Kingdom in 2005; (4) The targeted per capita GRDP is to be attained by sectors

other than the mining sector so as to increase the actual income level in the Study Area.

With these assumptions, the GRDP excluding the mining sector's contribution in each scenario was calculated by multiplying the targeted per capita GRDP by the projected population. To get the total GRDP, the projected mining sector's contribution was added. The growth rate in each economic sector was projected with reference to that envisaged in the Third Five-Year Plan (see Table 4) as well as to actual growth in the former plan. The results may be summarized as follows:

Projected Growth Rate in 1986 - 2005			
Sector	Scenario 1	Scenario 2	Scenario 3
Agriculture	4.2] 3.9	4.2] 4.6	4.2] 5.0
Industry	3.8	4.6	5.2
Services	4.1	4.2	4.3
Total	4.0	4.4	4.8

Employment (required labour force): Numbers of required labour in agriculture, mining and manufacturing sectors were estimated by the analysis of the current situation of the Study Area through field survey, review of existing reports and interviews. Employment in other sectors was calculated by labour productivity, which is defined as the value-added per person employed. The growth rate by sector draws heavily on research by the World Bank (Ref. 13).

4.1.3 Alternative Socioeconomic Frameworks

Based on the methodology and procedure described in the previous sub-section, socioeconomic frameworks for each scenario were projected as shown in Table 6.

Scenario 1: A passive population policy is assumed in this scenario. The population in the Study Area in 2005 would be 220,000 and in relation to the whole of Jordan 4.4 per cent as compared with 5.3 per cent in 1985. The average annual growth rate between 1985 and 2005 would be 2.2 per cent.

As for GRDP, the targeted per capita GRDP excluding the mining sector's contribution will be JD 720 in 2005 as compared with the present level of JD 381 in 1985. For each development scenario, this same figure is taken as the common target. GRDP excluding the mining sector's contribution amounts to JD 153 million, and the total GRDP is estimated at JD 214 million. Annual growth rate of the total GRDP between 1985 and 2005 would be 4.0 per cent.

In terms of GRDP of the economic sectors, the agricultural sector amounts to JD 21 million at an annual growth rate of 4.2 per cent. The industrial sector, which comprises mining, manufacturing, construction and utility (water, gas and electricity), is estimated at JD 112 million with an annual growth rate of 3.8 per cent. Its share in 2005 will be about 52 per cent of the total production in the Study Area. As for the services sector, which is made up of trade, transportation, communications, financial services, public services and other services, their production will amount to JD 81 million at an annual growth rate of 4.1 per cent.

The total number in employment (the required labour force) will be about 56,000 as compared with 29,000 in 1985. This Scenario 1 would create 27,000 new job opportunities.

Scenario 2 adopts a mild population policy, and will have a 248,000 population in 2005. This figure would account for 4.9 per cent of the population in the whole of Jordan in 2005. Population growth rate over the 20 years would be 2.8 per cent per annum.

The GRDP in 2005 would be JD 234 million or JD 173 million excluding the mining sector's contribution. The growth rate of the total GRDP over the 20 years would be 4.4 per cent. By economic sectors, production of the industrial sector would be JD 130 million, or about 56 per cent of the total GRDP. The production of the agricultural and services sectors would be JD 21 million and JD 82 million respectively.

In this Scenario 2, the total number in employment will be about 59,000 and new job opportunities about 30,000.

Scenario 3 adopts a positive population policy with an annual average growth rate of 3.2 per cent. The total population in 2005 would be about 270,000.

The GRDP excluding the mining sector's contribution would be JD 190 million, or a total GRDP of JD 250 million at an annual growth rate of 4.8 per cent. The industrial sector's contribution would be JD 145 million, or 58 per cent of the total GRDP. The agricultural and service sectors are estimated at about JD 21 million and JD 84 million respectively.

The total number in employment will be about 62,000. Consequently, this Scenario 3 would create 33,000 new job opportunities.

It may be seen that each scenario will require development of the industrial sector, and manufacturing industry in particular. Future economic growth of the Study Area moreover will have to rely on development of labour-intensive small and medium scale manufacturing, because of the limited agricultural potential, and completion of large resource-based mining projects (except oil shales), although the share of manufacturing sector in 1985 was only 0.7 per cent of the GRDP.

In accordance with the Third Five-Year Plan, the rapid growth of commodity producing sectors is emphasized to enhance the stability of economic activity. The above-mentioned frameworks coincide with the Plan's concepts.

4.2 Spatial Framework

4.2.1 Landuse

Present landuse in the Study Area was identified from two data sources; the aerial photographs taken in September 1984 at a scale of 1:25,000, and the National Village Survey made in 1984. Photographic

interpretation was conducted by the Study Team with an expert from MMRAE, and the results were superimposed on topographic maps prepared in 1959 at a scale of 1:50,000. Final results were transcribed onto 1:250,000 maps by the grid method (Fig. 4).

The unit grid square is 1.0 km x 1.0 km. The predominant landuse in each square was identified from the photographs and drawn on the map. Minor elements of landuse were not necessarily shown on the map. Areas of irrigated vegetables, fruit trees and forest were taken from the figures of the National Village Survey. Present landuse is summarized in Table 10.

Future agricultural landuse plan: A land slope map and an isohyetal map of the Study Area were also prepared for the agricultural land classification based on topographic maps at 1:50,000 and the National Water Master Plan (Ref. 16). These maps are presented in Annex-B.

The land and water inventory surveys of the region revealed that there was much room for increasing agricultural production. The aerial photographs show that 100,200 ha have signs of cultivation of field crops and 500 ha of vegetables, while the agricultural statistics show only 29,000 ha of cultivation for crop production. The balance is thought to have been left fallow due to lack of proper cultivation methods, irrigation facilities and/or meager and erratic rainfall.

The Study Team proposes the following agricultural land classification criteria taking tractor trafficability, crop water requirements and water supply into consideration:

PROPOSED AGRICULTURAL LAND CLASSIFICATION CRITERIA

Present	Land	Annual Rainfall (mm)			
Land Use	Slope(%)	350-300	300-200	200-100	100-0
Field crops/	0- 8	Field crops	Field crops	Fruit trees	Grazing
Fallow	8-25	Fruit trees	Fruit trees	Fruit trees	Grazing
	25-	Forest	Forest	Grazing	Grazing
Vegetables	-	Vegetables	Vegetables	Vegetables	Vegetables
Fruit trees	-	Fruit trees	Fruit trees	Fruit trees	Fruit trees
Forest	-	Forest	Forest	Forest	Forest
Built-up area	-	Built-up	Built-up	Built-up	Built-up
		area	area	area	area
Others	0-25	Grazing	Grazing	Grazing	Grazing
	25-	Forest	Forest	Grazing	Grazing

Based on the criteria above with some allowances for built-up areas and for irrigable areas, the future landuse plan is proposed as shown in Table 10 and Fig. 5.

4.2.2 Spatial Structure

Present population distribution: As described in Section 2.2, the present population of the Study Area is predominantly rural with some two thirds of the total population. The rural population is classified as those who are residing in rural dwellings of less than 5,000 population, in accordance with the definition by the Department of Statistics (DOS).

As the regional economy is mostly based on rainfed agriculture, the distribution pattern of settlements in the Study Area practically follows the isohyetal pattern. The western Highlands along the King's Highway are situated in the middle of the closed isohyet, forming the north-south socioeconomic axis in the Study Area. Nearly 95 per cent of the total population is found in this area, while in the Badia along the Desert Highway there are only two major settlements; Qatrana and Hasa. The total population of the Badia is about 7,200.

Karak and Tafila Municipalities are the capital cities of respective governorates. Each capital city has about 15,000 population. This population size is outstanding in the Study Area, compared with such secondary towns as Ayy, Mazar, Moab (newly combined town), each having a population of around 5,000.

Road network: The King's Highway (Route-49) mainly functions as an intra-regional arterial road, supporting the socio-economy in the Study Area (See Fig. 1 for the road network).

The Desert Highway constitutes part of Route-15, which starts at the Syrian border and runs as a principal trunk road through Amman to Ma'an. From Ma'an it turns southeast to the Saudi border. The Highway runs almost parallel to the King's Highway, being 20 to 30 km to the east. The Study Area is approximately divided into a west half and an east half by the Desert Highway. The main function of the Highway is the international and inter-regional transport.

The Desert Highway is connected with another north-south trunk road, the Aqaba-Suweimeh Road (Route-65), by an east-west road (Route-80) extending from Qatrana to Safi via Karak. Route-65, running along the Ghor, will link Aqaba directly to North Shuna upon completion of its remaining part between Ghor Haditha and Zara, which is under construction.

In addition, there are three east-west secondary roads; Dhiban-Siwaqa, Mazar-Abiad, Tafila-Jurf Ed Darawish, each of which connects the King's Highway with the Desert Highway. In the Third Five-Year Plan, two more east-west roads are planned; one connecting Rashadiya located on the King's Highway with the Desert Highway for transportation of cement from Rashadiya to Aqaba, and the other connecting Tafila with Route-65 in the Ghor for agricultural and tourism development.

With these existing and planned roads, the Study Area will be covered with a ladder-shaped road network as shown in Fig. 1, and will be an important cross road area in the Kingdom for international and

inter-regional transport.

4.2.3 Strategic Urbanization

According to MOP estimates, Karak Municipality had an average population growth rate of 3.2 per cent per annum from 1979 to 1985, and Tafilah at 3.0 per cent. The Study Area, as a whole, achieved a growth rate of 2.8 per cent in the same period. Mu'tah is estimated to have had a high growth during the period chiefly due to establishment of Mu'tah University. This suggests that the intra- and inter-regional migration from rural areas to major urban centres is continuing.

However neither cities nor towns in the Study Area have reached such a stage that self-sustainable growth in commercial and manufacturing industry could occur.

To counter the migration trend, a selective urban agglomeration policy is required. The policy will need to provide a cohesion by creating urban-rural networks. The area between Karak and Mazar along the King's Highway was selected as a strategic area for such targeted urbanization, though it includes some of the best rainfed agricultural land. Accordingly one development issue will be trade-off between conservation of good agricultural land and the requirement for urban land.

Other strategic urban areas are Tafilah City and towns in the Badia. When Tafilah is directly connected with the Ghor by the planned road, its role will be enhanced. Tafilah has, however, a topographical limitation for large expansion. On the other hand, such towns in the Badia as Hasa and Qatrana have enough land for expansion.

An urban hierarchy system is proposed with four strategic urban centres and nine secondary urban centres for efficient provision of urban services to the people in the Study Area.

The land required for urban development is preliminarily estimated as shown below for each development scenario:

URBAN LAND REQUIREMENT

	(ha)		
	1985	2005	Increment
Scenario 1	1,900	2,600	700
Scenario 2	1,900	3,100	1,200
Scenario 3	1,900	3,600	1,700

4.3 Water Allocation Plans

The Study Area does not include the north bank of Wadi Wala and the Southern Ghor lower than 500 m AMSL. However, for planning of possible water allocation in the Study Area, it is necessary to take into account runoff from the north bank of Wadi Wala and groundwater resources in the Southern Ghor as well as water demands in these areas. Accordingly, the water allocation study was made for the expanded area, herein named the Mujib-Hasa basin.

Water resources development potential in the Mujib-Hasa basin was estimated at a master plan level, and is presented in Annex-A. The development potential is assessed at about 184.9 MCM/yr, consisting of base flow of 78.9 MCM/yr, flood flow of 33.2 MCM/yr, and groundwater of 72.8 MCM/yr.

Water demand: Water uses in Jordan are classified in three categories; (1) municipal demand including commercial and small industrial demands, (2) industrial demand, and (3) irrigation demand. In this Study, however, a fourth group of environment use is proposed. As one of the countermeasures required for achieving rehabilitation of the Badia, improvement of the environment with greenery is needed. For creating an attractive environment for human settlement and wildlife conservation, this environmental water will be required.

The water demand is projected for the years 1995 and 2005, and is presented in Annex-A. The total water demand in the year 2005 would be 203.4 MCM/yr, consisting of a municipal demand of 49.1 MCM/yr, an irrigation and livestock demand of 103.2 MCM/yr, an industrial demand of 47.5 MCM/yr, and an environmental demand of 3.6 MCM/yr. The demand may

also be grouped by region: the regional demand of 59.3 MCM/yr; the existing irrigation demand of the north bank of Wadi Wala (21.0 MCM/yr); the irrigation and industrial demand of the Southern Ghor (87.1 MCM/yr); and the assumed municipal demand of Greater Amman (36.0 MCM/yr). The projected demand exceeds the potential by 18.5 MCM/yr.

Water allocation policy: Comments by the Water Sector Committee on the Progress Report presented the water allocation policy as summarized below:

(1) In view of projected severe shortage of water in the Mujib-Hasa basin by the year 2005, water allocation is to be made with the following priority ranking:

- Domestic water supply from the Study Area to meet national priorities
- The Highlands agriculture projects
- The Southern Ghors irrigation projects

(2) Careful consideration is to be given to the following projects:

- The Highlands agriculture projects in the Study Area
- The Southern Ghors irrigation project, Stage II to irrigate 3,780 ha

Quantity allocation plan: Within the water allocation policy described above, four preliminary alternative water allocation plans have been prepared: Case 1--Highlands oriented; Case 2--Amman oriented; Case 3--Ghor oriented; and Case 4--Dead Sea Chemical Complex (Stage II of the Potash Project) oriented scenarios. These four cases are presented in Table 11.

The latest estimate of the water requirement of the Dead Sea Chemical Complex amounting to 14 MCM/yr could not be fully met except in Case 4. Also the water demand of the Highlands agriculture projects as presented in the Progress Report (24 to 37 MCM/yr) could not be supplied.

New extensive water users would have to bear the projected water deficit of 18.5 MCM/yr in 2005 as shown below for each case of water allocation:

WATER DEFICIT IN 2005

Water Use	(MCM/yr)			
	Case 1 Highland	Case 2 Amman	Case 3 Ghor	Case 4 Potash
1. Municipal of Amman	7.0	-	12.0	19.0
2. S. Ghors Stage II	-	7.0	-	-
3. Dead Sea Chemical Comp.	11.75	11.75	7.0	-
Total	18.75	18.75	19.0	19.0

Case 1 would satisfy all the demands except for Greater Amman and the Dead Sea Chemical Complex. Greater Amman would have, however, 14 MCM/yr of additional allocation on top of the present supply (15 MCM/yr). The Dead Sea Chemical Complex would be allocated only 2.25 MCM/yr, which is the original estimate of Arab Potash Company (APC).

Case 2 would provide an extreme water allocation to Greater Amman and, therefore, would have an adverse effect to the Southern Ghors Irrigation Project - Stage II.

In Case 3, the water requirement of Southern Ghors Irrigation Project would be fully met, but that of the Dead Sea Chemical Complex would be only half met. Greater Amman would have 9 MCM/yr of additional allocation as compared to now.

Case 4 is the reverse of Case 2; all the water demands other than the municipal demand of Greater Amman would be satisfied, but Greater Amman would have only 2 MCM/yr of additional water allocation on top of the present supply (15 MCM/yr).

If Greater Amman could manage its municipal water supply without significant additional supply from the Study Area (for example by early construction of Al Wahdah Dam planned on Yarmouk River), Case 4 would be the most preferable from the viewpoint of regional development as well

as national water allocation.

However, implementation of such a large scale project may take time and smaller scale projects would be needed to meet the growing demand in Greater Amman in the short-term. In the present circumstances, therefore, Case 1 may represent one of the most realistic and practical allocations.

Since the Dead Sea Chemical Complex was planned without reference to these water allocation studies, plans for the Complex need to be re-examined keeping in mind the need for a balance of water supply and demand.

Allocation plan by source of water: A preliminary water allocation plan by source of water was prepared only for Case 1 of the Alternative Water Allocation Plans to ensure that the above quantitative water allocation plans were practically possible.

In general, groundwater resources have been allocated to municipal and industrial water supply which needs high stability and dependability, while flood flow sources have been mainly allocated to new irrigation projects in the Highlands. Results are presented in Annex-A, showing that Case 1 of the Alternative Water Allocation Plans is practically possible.

4.4 Selected Framework

In selecting an appropriate socioeconomic framework for the Study Area, it is a prerequisite that the framework should be coordinated with the policy of regional development. The regional development objectives stated in the Third Five-Year Plan are referred to in Section 3.2. Within these objectives, the themes which should be directly reflected in the framework are:

- (1) to rectify the inter-regional disparity in real GRDP and to achieve a national average of per capita GRDP by 2005
- (2) to reverse the current trend of out-migration from the region

Another consideration is necessarily on the geographical location of the Study Area: juxtaposition to Amman. Although detailed analysis on this topic is beyond the scope of the Study, the future conditions of Amman, especially population policy, are important when considering the future of the Study Area, because Amman still attracts people from rural areas.

According to the Study on Greater Amman Development Plan (draft), two population scenarios are under consideration. One is a zero net migration scenario and the other is a net in-migration scenario over the period 1985-2005. The first scenario is based on the assumption of zero net migration because of the sustained efforts to stimulate the rural areas and to develop growth centres outside Greater Amman. The second scenario is based on the assumption that a large number of Jordanians will return to their home country as a result of the economic recession in the Gulf countries. In-migration of this scenario is not from the rural area but from foreign countries. Therefore, the basic concept of both the scenarios is consistent with the basic idea of the population policy for the Study Area; increasing the role of the Study Area as a counter-magnet to Greater Amman.

From the prerequisites mentioned above, the scenario is obliged to have such conditions in the target year of 2005 as:

- (1) to achieve the projected national average of per capita GRDP, namely JD 720
- (2) to retain the Study Area's share of population at or above the level of basic year; above 5.3 per cent

To fulfill these conditions, the selection of socioeconomic framework of Scenario 3 is obligatory.

5. SECTORAL DEVELOPMENT PLAN

5.1 Productive Sectors

5.1.1 Agriculture

(1) Objectives: Taking the agricultural constraints and objectives of the Third Five-Year Plan for agriculture into account, objectives of agricultural development may be stated as follows:

- (A) to increase agricultural products and productivity by making full use of such natural resources as rainfall and soils, to improve living standards of farmers so that they can continue to settle in their farms and villages
- (B) to increase food security by substituting domestic food produce for imported food
- (C) to create job opportunities in rural areas through intensification of farm production
- (D) to conserve basic agricultural resources; soil and water
- (E) to promote exports of agricultural produce and to reduce the trade deficit of the Kingdom

(2) Strategy: Strategies applicable in the agricultural development may be stated as follows:

- (A) Full utilization of under-utilized natural resources; water and soil
- (B) their Application and guidance of a principle; proper crops growing in proper land
- (C) Extension of Water Harvesting through microcatchments and contour furrowing for effective utilization of rainwater
- (D) Winter Irrigation with flood flow by construction of small dams and weirs in the Highlands

(3) Projects: Sixteen projects are recommended as listed in Table 14 (RDP-7 to 22). Of these, the following four projects are newly proposed by the Study Team while the rest are existing projects planned by the Government:

- (A) The Water Harvesting Development Project (RDP-18) is formulated for 45,200 ha for fruit tree growing, 22,200 ha for fodder shrubs growing, and some areas for field crops. This project has been studied as one of the priority projects and is detailed in Volume 3: Main Report - Part 2.
- (B) The Burbeita Aquaculture Project is formulated as part of RDP-25 using the base flow of Wadi Hasa at Burbeita. Red Tilapia and Giant Freshwater Prawn have been selected for culture for their demand in the Kingdom and technical soundness. With the fish plant proposed in Annex-J, 150 tons of Red Tilapia could be produced annually, and 8 tons of Giant Freshwater Prawns. This project will be financially feasible if a soft loan is provided (See Annex-J for details).
- (C) The Afra Greenhouse Horticulture Project is planned also as part of RDP-25. With heat energy supply from Afra hot springs, various kinds of flowers and fruits can be grown and supplied to consumers at a reasonable cost even in the winter season. Greenhouses with a total floor area of 4,500 m² are proposed (See Annex-B for details).
- (D) The Spring Irrigation Improvement Project (RDP-19) is proposed for rehabilitating existing irrigation systems and improving irrigation efficiency. There are 169 springs in the Study Area yielding about 9.4 MCM/yr of water in total (Refer to Section 7.4 of Annex-A for details).

In relation to the afforestation project planned by the Government, the following is proposed by the Study Team:

- (E) The afforestation project (RDP-23) is envisaged for 57,100 ha in the Study Area. Three species suitable for an arid climate, soil conservation, food and livestock feed are recommended; *Acacia tortilis*, *Albizia levek*, and *Prosopis pallida*. *Acacia tortilis* can withstand extremely arid and alkaline condition, grows fast and produces leaves and pods which are eaten by sheep, goats and wild-life. One tree of *Albizia levek* can produce one quarter of the annual feed required by a cow.

Profiles of the other projects are presented in Annex-B.

5.1.2 Mineral Resources

The lead in development of mining and large-scale industries has been taken by the Government and company boards of these industries. Contribution of these industries to the Study Area is rather indirect but they provide infrastructures and offer training and job opportunities. For the development of the Study Area, the following objectives should be taken into consideration:

- (1) to maintain the production level of the two phosphate mines in the Study Area as far as possible
- (2) to increase the rate of production of the cement factory at Rashadiya
- (3) to maintain production of building and construction materials
- (4) to investigate utilization of oil shale resources
- (5) to establish a research system to utilize unused indigenous resources for industrialization of the Study Area

Phosphate production from existing mines will increase gradually until a substantial production level has been achieved by a new mine which is under construction at Shidiya in Ma'an Governorate. After this it is probable that some of the work forces from the existing mines will be transferred but it is proposed that production levels should be maintained as far as possible.

Although the Rashadiya cement factory was with a view to export its products, the production level has been stagnant due to decline of foreign demand especially in the Gulf countries. Domestic demand for building and construction depends on the size of public investments. In implementation of the proposed Master Plan Projects, the domestic demand will increase to the extent that it will require expansion of production at the Rashadiya factory.

An extensive study on utilization of oil shale is being carried out for direct combustion to generate electric power and for retorting to recover shale oil. The viability of these projects largely depends on

government policy, but when implemented, the projects will create a large number of job opportunities to utilize the indigenous resources in the Study Area. Similarly, utilization research on unused minerals should be conducted with the cooperation of the exploration sector and the industrial sector.

5.1.3 Small and Medium Scale Industries

(1) Objectives of developing small and medium scale industries are (A) to create employment opportunities and income, and (B) to produce industrial products to meet local needs in quantity and quality on the one hand, and to promote export of manufactured products on the other.

(2) Targets of this sector's development are to create employment for 10,000 and to produce value-added of JD 63 million by the year 2005.

(3) Strategy for development of small and medium scale industries is set as follows:

- (A) improvement of industrial investment climate by provision of supporting facilities in coordination with urbanization strategies
- (B) coordination among related sectors and organization for technologies, manpower, finance and marketing
- (C) modernization of small scale industries
- (D) introduction of preferential incentives from the national and local authorities to attract both the local and international industrial investors
- (E) development of recommended types of manufacturing industry

(4) Projects

- (A) Projects under the Third Five-Year Plan: The Five-Year Plans of Karak and Tafila Governorates envisage industrial development projects such as industrial zone development, agro-industrial factories and facilities, promotion of handicraft, and construction related industries.
- (B) Projects for modernization of the existing small industries: In addition to these Five-Year Plan projects, improvement of existing establishments is needed. Actions to be taken will include pro-

viding intensive services in vocational training, joint work such as share of common space, joint purchase of materials and joint sales of products. More extensive public relations and services of the Industrial Development Bank (IDB), especially the Small Scale Industries and Handicraft Fund, are also recommended. In rural centres, housing and construction related industries are promising to meet the demand of increasing population. The following two projects are proposed:

- Industrial extension services
- Creation of industrial cooperatives

(C) Strategic industrial projects: The Five-Year Plan projects and improvement of existing small industries are not sufficient on their own to meet the increasing need for employment. The following strategic industrial development projects are therefore proposed to attract investment not only from the Study Area but also from Amman and foreign countries:

- (a) Mu'tah Industrial Estate
- (b) New Karak Industrial Zone
- (c) Karak Handicraft Centre
- (d) Outer Tafila Industrial Estate
- (e) Tafila Industrial Zone
- (f) Tafila Handicraft Centre
- (g) Hasa Industrial Estate

Profiles of the above projects are given in Table 12 and their location is shown in Fig. 6.

(5) Priority projects: Staged development is needed in implementing the proposed seven strategic industrial projects. The King's Highway Belt should be implemented at an early stage, and the Desert Highway Belt at a later stage after provision of infrastructure and rehabilitation of environment for human settlement.

Indications of priority for the above industrial projects are evaluated by a qualitative comparison.

The Mu'tah Industrial Estate and the Outer Tafila Industrial Estate are planned to be the advanced industrial estates. The Mu'tah Industrial Estate should have priority due to its location and the possibility of utilizing the potential of Mu'tah University.

Of the two handicraft centres, the Karak Handicraft Centre should have priority over the Tafila Handicraft Centre in view of the tourism potential of Old Karak and the necessity to restore the urban area in Old Karak.

It is concluded that the Mu'tah Industrial Estate and the Karak Handicraft Centre should be nominated as the priority projects of this sector in the short-term.

5.1.4 Tourism

(1) Objectives: Tourism development in the Study Area aims; (A) to create new employment opportunities through tourism development, (B) to promote domestic tourism, and (C) to increase foreign exchange income.

(2) Development strategy: The following tourism resources could be developed and improved:

Historical resources: Castles of Karak, Tafila and Hasa; Ruins in Rabba; Old Arab Villages in Aima, Sinifha, Nammata, Dhana, etc.

Religious resources : Muslim martyrs' tombs in Mu'tah, Mazar and Bsaira

Natural resources : Hot springs in Afra and Burbeita; Landscape at Wadi Mujib etc.; Forests in AL-Sala, Wadi Dhana, Lahda, Tafila Heights, Bsaira

To avoid the risk of overloading development and also to raise investment efficiency, the tourism development plan is prepared for the three stages: (A) short-term projects by 1990, (B) mid-term projects by 1995, and (C) long-term projects by 2005.

The short-term projects are planned to prepare the basis for the succeeding tourism development by initiating the necessary studies and

establishments of the Regional Tourism Centres in Karak and Tafila.

The mid-term development is planned to complete the establishment of the two Regional Tourism Centres, and to develop the surrounding tourism resources. The Regional Tourism Network will need the collaboration of local enterprises. The Centres and the travel agents in Amman will be connected by a computer network for the convenience of tourists coming from Amman.

The goal of the long-term development is to increase the role of Karak and Tafila to be tourism strongpoints of the Kingdom. The Regional Tourism Network centered on Karak and Tafila will be connected to the nationwide network. The regions will then have a suitable background for establishing international facilities.

(3) Targeted visitors: The number of visitors to Karak is projected on the basis of the statistics of present visitors and investment programmes as follows:

<u>Year</u>	<u>Overnight</u>	<u>One day visit</u>
1986	2,600	8,000
1990	12,000	16,000
1995	19,000	24,000
2005	40,000	48,000

(4) Development plan: For tourism development in the Study Area, 13 plans are formulated as presented in Table 13. Profiles of these projects are presented in Annex-E. With these projects, the regional tourism network would be reorganized as shown in Fig. 7.

(5) Priority of the projects: Priority of the tourism projects is evaluated in terms of (A) quality of resources, (B) present conditions, (C) accessibility and availability of utility, (D) social conditions, and (E) linkage with other sectors. Top priority will be given to rehabilitation of Karak Castle and restoration of Old Karak. The second priority project is the Hasa Oasis Park, followed by rehabilitation of Old Dhana and tourism development of the Dhana Valley.

5.2 Physical Infrastructure

5.2.1 Water

As revealed in Section 4.3, all the water resources need to be developed to meet the growing water demand. The development strategy and plan are examined and presented in Annex-A.

An outline of the prospective development plans is given below:

(1) Groundwater development plan in Hasa basin: One potential well field is proposed in Darawish area, having a new development potential of about 5.5 MCM/yr. To distribute the pumped water from the Darawish wellfield, construction of the following pipeline projects are proposed though they are subject to the final water allocation:

- (A) Darawish-Hasa Pipeline Project
- (B) Darawish-Tafila Pipeline Project

(2) Groundwater development plan in Wala and Mujib basins: Four new well fields are proposed in the Wala and Mujib basins by the JICA Mujib study (Ref. 17). They have a total potential of 27.9 MCM/yr, consisting of Rumeil (potential 7.0 MCM/yr), Siwaqa-Qatrana (9.6 MCM/yr), new Sultani (6.3 MCM/yr), and Lajjun (5.0 MCM/yr). Since the groundwater production in the proposed Rumeil well field will affect the base flow of Wadi Wala, it should be combined with the Wala Dam which is proposed also by the Mujib study.

To transmit the water from the proposed Lajjun well field to Karak, another pipeline project will be needed, namely the Lajjun-Karak Pipeline Project.

(3) Flood flow development plan in Wala and Mujib basin: Construction of five new dams and rehabilitation of two existing dams are proposed by the JICA Mujib study for flood flow development in the Wala and Mujib basin (See Annex-A for their outline).

(4) Hasa Dam is newly proposed by the Study Team. The site is located on the main stream of Wadi Hasa at about 10 km downstream from the railway bridge. The riverbed elevation at this site is about 780 m AMSL. The drainage area is 1,588 km². Expected mean yield is around 1.8 MCM/yr.

(5) Karak Highlands Dam Project: The upper Wadi Karak basin has a high rainfall of about 360 mm/yr on an average. Since it has a mountainous topography, a relatively high runoff coefficient is expected. The basin has a drainage area of 88 km² at Ain Sara, and 41 km² at the damsite near El Ifranji. The mean flood flow at this damsite would be about 1.1 MCM/yr.

Also in the upper Khabra basin of Wadi Mujib river system, which is adjacent to and in the east of the Karak basin, small dam and weir projects are conceivable for use of Highlands agriculture and groundwater recharge. The drainage area of the upper Khabra basin is 144 km² in total. An integrated development of these small dam schemes is proposed (see Chapter 2 of Volume 3: Main Report - Part 2 for details).

(6) East Tafila Highlands Dam Project: In the east of Tafila, there are many places suitable for small dams and weirs with drainage areas of 10 to 40 km² and hilly topography. Most of them are located in the Wadi el La'ban (115 km² in drainage area), Wadi Zabda (115 km²) and Wadi Ahmar (117 km²) basins with some in the adjacent basins. Total drainage area of the three sub-basins is 347 km². An integrated development of these small dam schemes is proposed (see Chapter 2 of Volume 3: Main Report - Part 2 for details).

(7) Slimes of phosphate mines: It is recommended that tailings dams be constructed for El Hassa and El Abiad Phosphate Mines for proper disposal of slimes, which amount to about 1.5 million t/yr as well as to recover wastewater contained in the slimes. Construction of ponds of 25 ha and 3.4 m deep for El Hassa, and of 15 ha and 3.7 m deep for El Abiad will be required almost every year. If these tailings dams are constructed, wastewater of about 3.3 MCM/yr could be recovered in total

although the water will have a high salinity (1,800-3,600 ppm in TDS). If all the required construction costs are imposed on the recovered water, the unit water cost will be about 140 fils/m³ for El Hassa, and 220 fils/m³ for El Abiad respectively. It is proposed that the waste-water be reused for rehabilitation of the environment and the proposed productive greens in the Badia after mixing with the flood water to be developed by the proposed Hasa Dam. The Study Team also proposes that this project be implemented as a joint work between the phosphate slimes disposal and the slimes reuse projects.

5.2.2 Transportation

(1) Road networks

- (A) Primary and secondary roads: According to the traffic volume projection made for the year 2005 on the basis of the current road network, the traffic volume of the roads except the Husseineyyeh-Abiad road will be within the respective capacities. In 2005, the traffic volume of the road between Mazar (Husseineyyeh) and Abiad is estimated to be at around 7,900 vehicles per day. The present width of this road is 5.0 m. It will be necessary to enlarge its width to 7.2 m by the year 2005.
- (B) Village roads: To have a good access to primary and secondary roads from each village, improvement and extension of village roads are necessary. It is recommended that such village roads as have a vehicle-lane width of less than 4.0 m be widened to the MPW standard size of 5.0 m.
- (C) Development of road safety facilities: It is recommended that installation and improvement works of the road safety facilities be expedited including road markings, pedestrian overpasses, side walks, guard fences, lighting, delineators, mirrors, traffic signals, retaining walls, parking lots, and street trees.

(2) Bus services system: To provide prompt and convenient bus services, improvements are required in the bus operational system. Functional division between the inter-regional and intra-regional transport is necessary by introducing large buses for the former and minibuses for the latter. The scheduled bus services need to be operated on a time-

table, with passengers only boarding at bus stops. Bus terminals would be established at the major population centres such as Karak and Tafila for the inter-regional transport as well as to connect with the intra-regional services there. The long distance bus services between Karak and Amman will need two routes; one via the Desert Highway and the other via the King's Highway. For those remote areas where demand for bus services is not large enough to operate scheduled services, a demand-bus system can be considered.

(3) Cargo transport system: Functional division is needed also in the cargo transport system between the inter-regional and intra-regional services. For the intra-regional services, small trucks will be used while the inter-regional services will use large trucks and the railway upon its improvement. A traffic terminal, which will include a truck terminal, a railway station, warehouses and wholesale markets, is proposed to be established at a node of the inter-regional and intra-regional transports along the Desert Highway.

5.2.3 Communications

(1) Telephone: A telephone network expansion project is being undertaken to cover the Study Area except the Dhiban area belonging to Amman Governorate, and is scheduled to be completed by the end of 1987. This project covers villages with population of 500 or more in 1985. The Dhiban area will be covered by another telephone project (refer to Annex-F for details). The rate of subscribers per household is projected to be 1.0 by the target year 2005.

On the basis of the above, the following projects are proposed:

- (A) Future expansion and new installation of the auto-exchanged network in villages to meet the increasing demand. The telephone demand has been estimated from the projected population. A reinforcement of telephone exchange capacity will be needed (see Annex-F for details).

Among the villages that are not covered by the ongoing telephone network projects, five villages will have a population more than 500 by the year 2005. Installation of the automatic telephone

- exchanges is proposed for these villages (see Annex-F for details).
- (B) It is proposed to provide villages, having populations less than 500 in 1985, with public telephone services.
 - (C) It is also proposed to establish an emergency telephone system along secondary roads.
- (2) Mail: It is proposed to promote a mail distribution system to each customer as a future system for the Kingdom.

5.2.4 Energy

The Ministry of Energy and Mineral Resources (MEMR) continues to meet the increasing demand for energy, and many efforts have been extended to develop and utilize potential indigenous sources of energy in the most appropriate and efficient manner. MEMR has been developing means to reduce energy consumption and has completed many studies involving energy conservation in the industrial as well as in the transport sectors.

The outlook of existing plans for energy supply and demand in the future may be summarized as follows as a basis for development planning:

- (1) Fuels: For supply of primary energy, MEMR intends to upgrade the capacity of the two existing pipelines to Zarqa Refinery and to establish a pipeline between Azraq and Aqaba to provide the refinery with crude oil from plural sources. Dual-fuel type generators will be added in the Aqaba Thermal Power Station to use coal as well as heavy oil.

The refinery will be connected to QAIA by pipeline, and to main distribution stations in Amman and Irbid as part of the national network for transport, storage and distribution of petroleum products (Ref. 1).

- (2) Electricity: The second stage of Aqaba Thermal Power Station Project will add two coal/fuel-oil driven system units of 130 MW each. Commissioning is expected during the second half of 1990 (Ref. 1). The total installed generation capacity in the Kingdom will be about 1,230 MW in 1991.

(3) Renewable energy: Jordan has initiated use of renewable energy to reduce dependency on imported fuel. In the field of water heating, manufacture of solar heaters was started in 1973 and the total number of installed heaters was estimated at about 66,000 in 1985, some 15 per cent of total households. The installation of heaters is targeted to reach a level of 50 per cent of total households by the year 1990.

The Royal Scientific Society (RSS) has executed many projects involving utilization of solar cells to supply electricity for wireless telephone stations along the Desert Highway, TV repeater stations, water pumps and for lighting the school and clinic in remote villages.

Field experiments for water pumping by wind energy are in progress at Jurf Ed Darawish and other places. Power generation experiments by windmill and photovoltaic (solar) battery are under preparation in North Jordan and at Jurf Ed Darawish respectively.

(4) Nuclear energy: Use of nuclear energy in Jordan is restricted to fields of medical treatment, physical research and environmental isotope study. It is not expected before the end of this century to utilize nuclear energy in power generation in the Kingdom (Ref. 18).

(5) Energy exploration: In conjunction with a study on utilization of oil shales in the El Lajjun area, recent exploration has identified the existence of large quantities of oil shale in Jurf Ed Darawish, Sultani, Attarat Um Ghudran, and Wadi El Maghar. Indications of oil shale have also been recorded in Siwaqa and Khan Ez Zabib (Source: NRA).

The Natural Resources Authority (NRA) discovered oil at Hamzeh in the Azraq region, late in 1983. Preliminary production was started following further findings in 1984 and some 21,000 barrels of crude oil were trucked in the first half of 1986.

Tar sand had been reported by NRA to occur in Wadi Isal on the eastern side of the Dead Sea (Ref. 19). Recently, several outcrops were found in Ed Dhira and Wadi Aheimir along faults running north-easterly

to the northeast of the Wadi Isal occurrences. A reconnaissance survey programme has been proposed by NRA to assess the case for a comprehensive investigation.

Investigation of geothermal energy is now in its third phase which involves drilling of two exploratory wells to a depth of about 1,500 m. The first well has been drilled in Zara on the eastern side of the Dead Sea (Refs. 1 and 18).

5.3 Social Infrastructure

5.3.1 Education

It was pointed out by the Education Sector Committee that the following problems had been faced in the Study Area, although there was no significant regional disparity in educational indicators compared with the national average:

- lack of qualified teachers particularly at the secondary school level
- inappropriate distribution of school buildings
- high percentage of unsuitable rented school buildings
- two-shift system in some schools
- poor educational facilities (playground, laboratories, etc.)
- difficulty in land acquisition for school buildings
- shortage of a well educated and vocationally-trained labour force

(1) Goals: The following goals are set in consideration of the current situation and its problems and the expected role of the sector in the regional development context:

- (A) Eradication of illiteracy
- (B) Retraining of under-qualified teachers
- (C) Achievement of higher enrollment rates in compulsory and secondary education
- (D) Better distribution of school buildings with improved facilities
- (E) Completion of Mu'tah University as the centre of technology and culture in the Study Area

(F) Supply of a well educated and trained labour force

(2) Strategies:

(A) Provision of adult school programmes at the village level

(B) Provision of retraining programmes for under-qualified teachers at summer course which would be provided by Mu'tah University

(C) Consolidation or reorganization of sparsely populated rural settlements into units which can provide better public services including education in conjunction with the proposed New Village Project

(D) Improvement and expansion of professional and vocational training

(E) Provision of a Techno-Highland Scholarship Fund from the secondary school level

(F) Provision of Techno-Highland Research Fund

(3) Expansion plans are proposed as follows:

(A) Utilization of Mu'tah University

Mu'tah University is positioned as nucleus of the proposed Mu'tah-Mazar urban centre for regional development. In order to utilize the University, its functions will need for: (a) assistance in the development of agro-industry with establishment of the faculty of agriculture, (b) supply of qualified labour force to the community, (c) provision of retraining programmes for under-qualified teachers in the Study Area.

(B) Encouragement of the private sector in educational activities is proposed as the private sector can complement the public education system in specific fields, in English courses for example. The Government or local government is proposed to take necessary institutional and incentive measures to promote the educational activities by the private sector.

(C) Appropriate distribution of educational facilities

It is necessary to review and examine the distribution of educational facilities in preparing a long-term plan in conjunction with the proposed New Village Project (RDP-1).

5.3.2 Health

(1) Goals: Considering the present situations and objectives of the Third Five-Year Plan for the health sector, the goals for the Study Area are set up as (A) making the health services generally available to all communities in the Study Area, and (B) upgrading the level of health services with modern equipment and female physicians and nurses who are required for mother and child cares especially in the rural areas.

(2) Strategies

- (A) Balanced distribution of medical and health facilities for the community health services
- (B) Improvement of the current health facilities and enhancement of health staff
- (C) Establishment of new medical hierarchical and information systems

(3) Expansion plans are proposed for improving the health services as follows:

- (A) Reorganization of the health facility hierarchy: In the long-term, it is proposed to construct a new general hospital in Mu'tah-Mazar area as the principal hospital in the Study Area. This hospital would be hierarchically placed at the top of the existing health care system, which consists of hospitals, comprehensive health centres, primary health centres and rural clinics. An advanced nursing school would be attached to this general hospital. All of these would be supported by a remote diagnosing information system.
- (B) Appropriate balance between public and private sectors: The present public and private institutions which offer health care would be reorganized to avoid duplications in the level of care, costs, insurance and medical facilities. To examine the matter, it is proposed to set up an ad hoc committee among the health-related authorities and institutions.

5.3.3 Housing and Urban Planning

(1) Goals: The housing demand of low and limited income groups has not been met in the past, and there exists a substantial shortage in this type of housing. Accordingly the goals of the housing sector are

directed towards low income housing as follows:

- (A) Supply of low cost housing with serviced land
- (B) Promotion of the housing-related industries to create new job opportunities

(2) Strategies

- (A) Increased investments in low income housing
- (B) Administrative and organizational arrangements
- (C) Provision of incentives for the private sector to invest in the housing industry
- (D) Encouragement to promotion of the building materials industries particularly those utilizing local raw materials
- (E) Development of a new housing system which meet the needs of low income groups, the introduction of semidetached and middle-rise houses to New Karak for example

(3) Housing demand: The annual new housing demand is estimated at 820 units in the first planning decade and 1,940 units in the second planning decade. According to this estimation, the number of household in the Study Area would become 45,800 by 2005. Annex-H goes into details.

(4) Urban development strategies: Karak, Mu'tah-Mazar and Tafila are the focal points for the targeted urbanization along the King's Highway Urban Corridor, while Hasa is selected as the strategic growth point in the Badia along the Desert Highway.

The main strategies for each urban centre would be as follows:

Karak

- (A) Redevelopment of Old Karak as the regional commercial and tourism centre
- (B) Restoration of Karak Castle as a tourist attraction
- (C) Relocation of administrative facilities to New Karak (Abu Hammoor) for convenience of citizens and tourists and making use of the vacated land as a plaza for tourists attractions and community activities

Mu'tah-Mazar

- (A) Introduction of an industrial estate to accommodate clean, light and technology-oriented types of industry
- (B) Introduction of a modern shopping complex
- (C) Introduction of a general hospital equipped with a remote medical diagnosing information system and attached with an advanced nursing school

Tafila

- (A) Development of transportation and tourism industries
- (B) Development of small scale industries (Handicraft industry related to the planned tourism development)
- (C) Beautification of the townscape including restoration of the castle and its environs

Hasa

- (A) Development of water resources
- (B) Afforestation and establishment of the proposed productive greenery
- (C) Development of an artificial oasis for human settlement
- (D) Development of recreational facilities
- (E) Development of an industrial estate
- (F) Development of new energy

6. MASTER PLAN

Master Plan of Techno-Highland Karak-Tafila

for harmonious life styles between:

- Rural peace and urban dynamics
- Traditional culture and modern technology
- Academy and business

6.1 Present Conditions and Climate for Development

Jordan's natural resources are not so abundant as to be the basis of its economy. Industrialization has been limited by the smallness of the domestic market and the distances by inland transportation from and to the Aqaba seaport. As a consequence efforts have been directed to manpower development, which has resulted in substantial contributions to GNP through the supply of educated and trained manpower, numbering around 339 thousand, to neighbouring oil producing countries. However, these Jordanian workers have been returning to the Kingdom due to the recent economic recession in the Gulf countries. Creation of job opportunities is therefore becoming an essential objective of socioeconomic development of the Kingdom (see Table 2 for region's present position).

Greater Amman has already achieved accelerated socioeconomic progress by elevating the levels of urban functions not only as the capital of the Kingdom but also as a regional centre of the Middle East. The University of Jordan has also become a recognized centre of excellence in the Middle East. As a result most of the population and economic activities which have concentrated in Greater Amman are benefiting from the high efficiency of the urban agglomeration. However, various undesirable effects of congestion have become apparent in recent years, which now show the need for decentralization and regional development.

The Study Area, of some 8,100 km², had a population of 143 thousand in 1985 which was 5.3 per cent of Jordan's total population. However, while the average rate of population growth in the Kingdom was 3.7 per cent per annum from 1979 to 1985 that of the Study Area was only 2.8 per cent, suggesting out-migration from the Study Area towards Greater Amman. About 95 percent of the population in the Study Area is concentrated in the western Highlands, and the rest in the eastern Badia. Of the 180 settlements in the Study Area, nine municipalities located along the King's Highway in the Highlands sustain nearly 40 per cent of the population (see Fig. 3).

The economy of the Study Area is characterized by traditional rainfed agriculture with grazing of sheep and goats and large scale phosphate mining and cement manufacture. GRDP represents 7.2 per cent of GDP which exceeds the 5.3 per cent population share as a result of the large scale mining activities in the Study Area. Accordingly, per capita GRDP is also high at JD 687 compared with the national level of JD 509. The mining sector produces half the GRDP, contributing to the foreign exchange earnings of the Kingdom, but its income effect on the regional economy is limited. If the contribution of the mining sector is excluded, the per capita GRDP falls to JD 381, which may represent the true situation of the regional economy.

The present number of people in employment is 29 thousand, 61 per cent being in the service sector including public services, followed by 17 per cent in the agricultural sector and 10 per cent in the mining sector (Table 2).

The Highlands, which enjoy relatively high rainfall, sustain a traditional rural life with rainfed agriculture and grazing of sheep and goats. The rainfed agriculture, however, suffers from meager and unstable rainfall and, therefore, needs re-examination for further development and improvement. While the Badia, which formerly supported Mediterranean oaks and grass, has been cleared by the operation of the Hejaz railway and over-grazing, and needs rehabilitation for future development.

The mineral resources of the Study Area are already being exploited with ample resources. However, future prospects for the two principal mineral products are not assured due to keen competition in the world market. Foreign market research and marketing are needed for potash and phosphates, and development of the domestic demand for cement.

The manufacturing industry could play a leading role in the future regional economy, overcoming such constraints as the limited size of the local market and the weaker urban background for industrialization than those in Greater Amman, Zarqa and Irbid. Industrialization of the Study Area needs, therefore, different approaches from those for these areas.

Tourism activities in the Study Area have good future prospects if advantage is taken of underdeveloped historical, religious and natural tourism resources as well as the region's geographic location at the centre in the national tourism network.

Meanwhile, the Study Area is famous for the traditional culture which identifies the people in the region. The people generally reach high standards in education for successful careers in business, academy and public administration not only in the Kingdom but also in neighbouring countries.

6.2 Development Concepts

6.2.1 Development Objectives

Development objectives for the Study Area are examined through analyses of present conditions and development constraints of the regional socio-economy, and with the overall aims of:

- (1) alleviation of the out-migration trend by increasing job opportunities and raising actual income levels
- (2) achievement of the national level of per capita GRDP excluding the mining sector's contribution
- (3) achievement of a balanced geographical distribution of socio-economy by environmental rehabilitation and socioeconomic development of the Badia

- (4) enhancement of economic activities by promotion of small and medium scale industries
- (5) provision of public services in an equitable, effective and efficient manner.

6.2.2 Development Frameworks

The development frameworks were examined in three alternative scenarios (see Table 6). Of the three, Scenario 3 was selected as being the only case which conforms to the decentralization policy of the Government. This Scenario has such targets in the year 2005 as to retain the region's share of population at 5.4 per cent which is above the level of the base year (5.3 per cent in 1985), and to attain the national level of per capita GRDP (projected at JD 720 in 2005), excluding the contribution of the mining sector. The target population in the year 2005 is then proposed to be 270 thousand, which is 1.89 times the present population of 143 thousand.

The future landuse plan in 2005 is proposed as shown in Table 10 and Fig. 5. Four alternatives plans were prepared to examine possible water allocation for the maximum benefit of regional development as well as for development of the Kingdom. Table 11 suggests that all the water requirements necessary for implementing the Master Plan will be secured provided that new development of irrigated agriculture with groundwater is severely limited.

6.2.3 Development Concepts

The main concept for achieving the development objectives and frameworks under present conditions would be realization of harmonious development between rural peace and urban dynamics, being fostered by the traditional culture and promoted by modern industrial technology.

Within the above concept, the Islamic and medieval culture and tradition of the Bedou would be conserved in the historical towns, rural areas and in the Badia, while modern and practical technologies would be introduced in the urban corridor along the King's Highway. Diversified urban activities and a peaceful rural environment will encourage the

development of a stable urban-cum-rural socio-economy.

Urban dynamics would be enhanced by promotion of the manufacturing industry, which could be fostered by an organic integration of the three principal functions of business, academy and urbanization, preserving the traditional culture and life styles. Promotion of the manufacturing industry would give impetus to urban development and attract qualified labour, including those who are likely to return from neighbouring countries. The services sector - especially tourism, transportation and communications - would complement the urban dynamics.

Efficient urbanization requires an urban hierarchy composed of strategic urban centres, secondary urban centres, and New Villages. The strategic urban centres would be developed as prime movers of the regional socio-economy. While the secondary urban centres would supply urban functions and services in the rural areas, each covering several New Villages. The New Villages would be established by integrating existing small villages scattered in the Highlands to upgrade the quality of public services and rural living standards.

The rural environment would be sustained by integrated rural development in the Highlands and by strategic rehabilitation and development of the Badia. Highlands agriculture would be improved in its productivity and stability by introduction of water harvesting. Traditional animal husbandry of sheep and goats would further be developed by promoting feed production in conjunction with Highlands agriculture. Grazing would be managed to prevent the lands being denuded. Rehabilitation of the Badia would commence with greenbelt and afforestation/re-afforestation works to improve the environment for human settlement and wildlife conservation. Badia development would then follow with tourism promotion, and promotion of small and medium scale industries.

This concept of balanced development of three sub-areas of the Study Area, urban, rural and the Badia we have called *Techno-Highland Karak-Tafila*.

6.2.4 Overall Development Strategy

(1) Resources for development: In addition to the region's quality labour force, the following natural resources are available for the development of *Techno-Highland Karak-Tafila*:

- water resources of about 184.9 MCM/yr in the Mujib-Hasa basin
- mineral resources such as phosphates, limestones, oil shale and so forth
- land resources such as 111,000 ha for agriculture, 3,600 ha for urban centres
- solar and wind energy including thermal energy of hot springs
- landscape and tourism resources

Furthermore, the following man-made resources are available:

- two capital cities: Karak and Tafila are functioning as primary centres of business, culture and public services, though the extent of the urban agglomeration is low
- Mu'tah University in Mu'tah and the Polytechnic Institute in Tafila
- the primary and secondary road network: when the planned two secondary roads, Tafila-Ghor and Rashadiya-Desert Highway routes, are completed (see Fig. 1) the Study Area will become an important crossroads for the north-south and the east-west inter-regional and international transport
- other infrastructures such as the power transmission system, telephone system, water supply system and so forth

(2) Development strategies: To utilize the above resources for regional development, the following overall strategies are proposed to achieve the development objectives and targets:

(A) Formation of a balanced socio-economic spatial structure in the Study Area by promoting growth of the strategic urban centres along the King's Highway and the Desert Highway:

(a) The King's Highway Urban Corridor: Designation of Karak, Tafila and Mu'tah-Mazar as strategic urban centres along the King's Highway for giving momentum to self-development. Karak mainly features tourism and administrative functions while

Mu'tah-Mazar features education, research and industrial functions. Thus these two urban centres will complement the urban functions of each other in developing the Corridor.

Tafila features a self-sustained urban centre as the regional centre of Tafila Governorate.

- (b) Growth point in the Badia: Designation of Hasa as a strategic urban centre of the Desert Highway Belt and development of it as a growth pole for future Badia development assisted by suitable investment policies
- (B) Introduction of new manufacturing industries, service activities and academic activities as the main economic base of the above strategic urban centres, and promotion of related private sector activities to form a balanced employment structure between public and private sectors
- (C) Designation of Ayy, Tayybeh, Faqqoo, Rabba, Moab, Bseira, Ain Al-Baida and Dhiban as secondary urban centres so that urban population agglomerations of over 5,000 may become about 60 per cent of the total
- (D) Development of the rural area being sustained by stabilized farm income at a higher level, so that the peaceful rural life would be preserved and out-migration from the rural area would be restrained. Study on techno-agriculture would be pursued by the academic sector, and its fruits could be applied to rural development in the Highlands.
- (E) Development of the Badia by promotion of tourism with an artificial oasis and by introduction of manufacturing industries

6.2.5 Sectoral Development Strategy

(1) Agriculture: The basic policy for agricultural development will be to fully utilize suitable uncultivated land with effective utilization of rainwater, and to promote animal husbandry of sheep, goats and camels. Due to the limited water resources economically available for Highlands agriculture, large scale development of irrigated agriculture is neither realistic nor practical. The relatively cool climate in the Highlands is advantageous to livestock farming. The animal husbandry would provide a nucleus for agricultural development, by making use of

by-products of field crops as well as fodder and shrubs to be planted under rainfed agriculture with some supplementary irrigation after transplanting.

In the long run, efforts should be directed towards improvement of grazing technology, development of suitable grass for grazing, development of a cultivating technology for prospective local crops such as *Chama* and *Jojoba* for an arid environment, new crops such as *guayale* (a kind of rubber) which can survive irrigation with salty water, technologies to counter desertification and so forth. Mu'tah University would play a principal role in the development of these technologies.

(2) Mining: Utmost efforts should be made to maintain, at least, the present level of phosphate production at El Hassa and El Abiad Mines by promotion of export marketing. Marketing efforts are even more required for improving the production level of cement. It is proposed in the short run that the Government guides the construction industries to use more cement, but in the longer run it will be necessary to develop new building products, prefabricated building units, facing panels, etc., again with the help of Mu'tah University.

Concerning oil shale development, its future prospects will depend on the world oil market and the development of technology (e.g. for gasification). However, it is important under any circumstances to develop a technology for recovering energy from this indigenous resource. Accordingly pilot plants of both the retort type and direct combustion type should be established by the year 2005.

(3) Manufacturing industry: Modernization of existing small scale enterprises should be promoted by guiding them to form industrial co-operatives and by enhancing their technology with Government assistance and advice from Mu'tah University. The utmost efforts are required to promote industrial investment in the strategic urban centres. As incentives for promoting private investment, industrial parks should be developed as an integral part of the urban development especially. Attractive fiscal and financial incentives should also be provided by

the Government.

An industrial estate should be established in the Mu'tah-Mazar urban centre especially near Mu'tah University, mainly for research and development-oriented industries. Industrial zones and estates should also be established in the New Karak and Tafila urban centres, mainly for commercial production of those products that would be developed in the Mu'tah Industrial Estate.

Another industrial estate should be established in the Hasa urban centre, mainly for distribution and processing industries taking advantage of convenience for transportation and groundwater. Export-oriented industries may be given priority for location in this estate. For this purpose an intermediate type between the coastal free zone in Aqaba and the inland type free zone in Zarqa may be studied. Products related to solar and wind energy utilization and to Bedou handicraft should be manufactured here.

(4) Tourism: Promotion of tourism and recreation has effects on various aspects of socio-economy such as foreign exchange earnings, employment and the regional image, which may help promote industrial investment by the private sector. Public investment would first be made for the relevant infrastructure, restoration and conservation of cultural assets, afforestation/re-afforestation and for other non-income-generating sectors like sports facilities, so as to induce investment of the private sector in income-generating projects.

Tourism projects linked with other sectors such as urban development, agricultural development and development of hot springs should be promoted with high priority to attain efficient investment. Restoration of Karak Castle and renovation of Old Karak should be given priority in conjunction with Karak urban development. Tourism development in the Badia should also be promoted as the principal productive sector of the overall Badia development.

(5) Water: A water shortage of 18.5 MCM/yr is projected in the overall Mujib-Hasa basin in the year 2005, with the projected demand of 203.4 MCM/yr and the potential water supply of 184.9 MCM/yr. Utmost efforts are required to develop the groundwater and surface flow potentials in the basin as much as possible. For effective flood flow development, not only large dams on main reaches of major wadis but also many small dams in the western Highlands and desert basins should be constructed. The many small dams in the Highlands will contribute to flood flow utilization in the Highlands, groundwater recharge and reduction of sediment transport.

In parallel with the above development of new water resources, utmost efforts should be given to (A) reduction or restriction of the growth rate of unit water consumption in all water uses, particularly in municipal use in large urban centres, (B) reuse of both municipal and industrial wastewater, and (C) the most beneficial use of fresh, brackish and saline water resources.

Water saving measures and circulatory use have been taken in large scale mining and industry like in production of phosphate, potash and cement. However, further efforts will be needed especially in phosphate and potash mining. In municipal water supply, water saving measures should be sought including flow reduction devices, reuse of treated wastewater for appropriate purposes and improvement of distribution losses. Reuse of wastewater should be given due roles as it can satisfy the quality requirements for certain water uses and both municipal and industrial wastewater will steadily increase in accordance with the population growth and socioeconomic development.

Brackish water can be utilized in the production of potash to reduce consumption of fresh water. Certain crops can survive with combined irrigation of fresh and brackish water. Integrated use of fresh, brackish and saline water resources should be sought for the socioeconomic development with the limited amount of water resources available.

(6) Transportation: The existing road network and the network planned under the Third Five-Year Plan should meet the projected traffic volume by the year 2005 except for minor improvement works. Village and agricultural roads should be improved as part of the integrated rural development. A bus and trucking terminal should be established near Qatrana to create more efficient services from the existing bus and truck transportation systems.

(7) Communications: Minor expansion of telecommunications facilities will be needed for the planned urban and rural development. The telephone system planned under the Third Five-Year Plan will meet future needs for data communication with computers, facsimiles and so forth. Additions to the network should be studied for modernization of rural life as agriculture, meteorological and market information systems and for a remote medical diagnosis information system.

(8) Energy: It is proposed to set up an Energy Institute within Mu'tah University to specialize in the development of oil shale, tar sand and soft energy such as solar and wind in close cooperation with RSS, NRA and other relevant institutions. For equipment and apparatus that will be developed by this institute, an opportunity for commercial production should be given to appropriate local industries located in the planned industrial parks.

(9) Education: A well educated and trained work force is prerequisite for the development of *Techno-Highland Karak-Tafila*. Competent human capital would be produced from a well prepared educational environment.

General education: The number of non-qualified teachers at secondary schools should be reduced by such measures as retraining programmes at Mu'tah University during vacation periods, and by provision of housing and extra allowances as incentives for teachers in rural and remote areas. Those schools inadequately located should be shifted and/or integrated in conjunction with the proposed New Village Project. The standard of school facilities should be upgraded.

Higher education: Mu'tah University started functioning in 1984 with faculties of military and police science, which should be developed to be the techno-centre of the Kingdom as well as of the Middle East in this field. Other faculties such as Arabic and English languages and literature, law, higher education and administration were established as a civilian wing of the University in 1986. The University should play a catalytic role in the Techno-Highland projects by way of training and educating people who will lead the regional development.

(10) Health: A general hospital, to function as the principal medical centre of the Techno-Highland, should be established in the Mu'tah-Mazar urban centre. Rural health care should be extended from local health centres, which should be located in the secondary urban centres, by mobile clinic services.

(11) Housing and urban planning: The housing supply for the low and limited income groups should be provided by the Housing Corporation and the Urban Development Department. Other housing should be financed by the Housing Bank, commercial and investment banks and relevant institutions. Housing areas should be selected to minimize alienation of productive farmland especially along the King's Highway Urban Corridor. Higher density urban landuse will be needed while retaining the favourable urban amenity. Housing for faculty members of Mu'tah University should preferably be built outside the campus to improve social links with surrounding communities.

The housing demand above should provide a large market for the construction related industries, which should be promoted in the Study Area as one of the leading sectors of the region's economy.

6.3 Master Plan

With the above overall and sector strategies within the development concepts, a Master Plan has been formulated for integrated regional development of the *Techno-Highland Karak-Tafila*. The Study Area is divided into the following three development sub-areas by their socio-economic characteristics and natural conditions (see Fig. 8):

No.	Sub-areas	Area in km ²	Population	
		2005	1985	2005
(1)	Rural development	3,874	86,000	140,000
(2)	Urban development	21	50,000	100,000
(3)	Badia development	4,205	7,000	30,000
Total		8,100	143,000	270,000

The urban development sub-area covers the King's Highway Urban Corridor, which consists of Karak, Mu'tah-Mazar and Tafila. It is surrounded by productive farmlands in the rural development sub-area, which covers the rest of the Highlands. The Badia development sub-area is located to the east of the rural development sub-area, and covers the semidesert along the Desert Highway.

Development plans for each of the sub-areas are set out below for examination and discussion by the agencies and people concerned.

6.3.1 Rural Development Plan

(1) Objectives

- (A) to raise living standards in the rural areas by increasing and stabilizing farm income, promoting rural vitality, and preserving the rural environment and traditional culture
- (B) to increase non-agricultural income by promoting cottage-industry and agro-industry in rural areas, and by increasing job opportunities for villagers in urban industries
- (C) to supply food for sustaining population increase and to supply raw materials to agro-industries
- (D) to provide villagers, urban residents and tourists with a peaceful and relaxing rural environment and landscape

(2) Development strategy: Animal husbandry, especially of sheep and goats, should be enhanced as a leading production sector in rural areas to increase farm income. Production of field crops including forage crops should be promoted to complement the animal husbandry. Vegetable and fruit production should also be promoted in those areas where water is available at an acceptable price.

The holding size of farmlands should be enlarged for mechanized farming by integrating farm plots and by promoting contract and/or co-operative farming.

Afforestation/reafforestation should be promoted to create a restful and relaxing rural environment as well as for soil and rainwater conservation.

Against this background, New Villages should be established and furnished with electricity, drinking water, clinic facilities, community halls and so forth, by consolidating scattered houses in order to realize a quality rural life comparable to that in urban centres.

Based on the strategies described above, 27 rural development projects are selected and proposed as listed in Table 14, and as briefly described below:

(3) Projects under the Rural Development Plan

(A) Social projects for improving the rural life

RDP-1--The New Village Project: The minimum unit of the New Village would comprise three sub-villages of 40 households each. Each New Village would be supplied with electricity and piped drinking water to each house. A school, a village office and a community hall would be provided for each New Village. Existing hamlets numbering 157 (data of MMRAE) would be consolidated into about 80 New Villages.

The basic idea of this Project is given in Section 4.4 of Annex-H. However, because of different historical, tribal and cultural traditions

between existing villages, it will be difficult to consolidate these villages into New Villages by fixed criteria. This project should be further studied in detail by a joint team of MMRAE, local governments and related villages.

RDP-2--The School Bus Project: Until completion of the New Village Project, school buses would be provided targeting those pupils who have to walk more than 3 km to their nearest school.

RDP-3--The Village Clinic Project: To complement the proposed New Village Project, a village clinic would be established in each New Village.

RDP-4--The Home Garden Project: To improve the nutrition of rural people as well as landscape, this project is proposed by promoting establishment of home gardens for fresh vegetables, flowers and fruit trees. Under this project, 500,000 fruit seedlings, vegetable seeds for 40 ha and 13,000 spades would be distributed to farm households. This project will require about 0.8 MCM of water annually for all the rural areas.

RDP-5--The Darawish-Tafila Pipeline Project: A water pipeline would be constructed to transmit municipal water of about 1.2 MCM/yr to Tafila City from the proposed Darawish well field.

RDP-6--The Lajjun-Karak Pipeline Project: A water pipeline would be constructed to transmit municipal water of about 4.4 MCM/yr to Karak City from the proposed Lajjun well field.

(B) Economic projects

RDP-7--The Lamb Fattening Centre Project (Five-Year Plan project): Under the Third Five-Year Plan, two lamb fattening centres will be constructed, one each at Karak and Tafila. This project would be continued and expanded to include three additional centres in the Study Area by the year 2005.

RDP-8--The Rangeland Reservation Project (Five-Year Plan project) would be continued and expanded to reserve a total of 15,000 ha of rangeland in the Study Area by the year 2005.

RDP-9--The Fodder Shrubs Planting Project (Five-Year Plan project) would be continued and expanded to plant fodder shrubs on 6,000 ha of land in the Study Area by the year 2005.

RDP-10--Introducing Forage Crops into the Farming Cycle Project (Five-Year Plan project) would be continued and expanded to 10,000 ha of land in the Study Area by the year 2005.

RDP-11--Introducing Legumes into the Farming Cycle Project (Five-Year Plan project): Under the Third Five-Year Plan, 600 ha of farmlands in the Study Area will be planted with legumes during the first 2 years. After evaluation of results, the project would be continued and expanded into 10,000 ha of farmlands in the Study Area.

The above three projects RDP-9, 10 and 11 are recommended for implementation in close coordination with the Water Harvesting Development Project (RDP-18) proposed below.

RDP-12--The Veterinary Clinics Project (Five-Year Plan project) would be expanded to establish four additional clinics in the Study Area by the year 2005.

RDP-13--Development of Farming in the Highlands Project (Five-Year Plan project) aims to diffuse modern cultivation techniques and animal husbandry methods by reinforcing functions of the planned extension centre at Rabba. Under the Third Five-Year Plan, extension services at the sub-region level have not yet been planned. This project would be continued and expanded to establish one extension office, which would be staffed by a few extension field workers, in each sub-region by the year 2005.

RDP-14--The Production of Certified Seeds Project (Five-Year Plan project) aims to supply certified seeds of the main field crops such as wheat, barley and vetch. Jordan Cooperative Organization (JCO) will select crops, and will provide seeds growers with stock seeds, which will be supplied from the stock seed farm of Ministry of Agriculture (MOA), to produce certified seeds.

RDP-15--The Mechanized Agricultural Services Project (Five-Year Plan project) would be expanded to construct three additional stations by the year 2005.

RDP-16--The Fruit Tree Seedlings Production Project (Five-Year Plan project) would be expanded to meet future increased requirements in the Study Area.

RDP-17--The Soil Conservation and Fruit Tree Planting Project (Five-Year Plan project) would be expanded to cover about 20,000 ha of land in the Study Area by joint operation with the proposed Water Harvesting Development Project by the year 2005.

RDP-18--The Water Harvesting Development Project: For agricultural development in the Highlands, this project aims to increase and stabilize the production of field crops, forage and fodder shrubs and fruit trees in the rainfed area, by constructing micro-catchments, contour furrows, check dams and recharge wells. The proposed project will cover areas with an annual rainfall of more than 100 mm (see Chapter 2 of Volume 3: Main Report - Part 2 for details).

RDP-19--The Spring Irrigation Improvement Project would rehabilitate the existing irrigation facilities and improve the irrigation method of 169 springs existing in the Study Area (see Section 7.4 of Annex-A for details).

RDP-20--The Cottage Industry Development Project would aim to increase non-agricultural income of rural people living in areas of low agricultural potential like Ayy, by developing such cottage industries

as semimanufactured leather goods and traditional homemade high value added products like *Jamid* (specially treated dry yoghurt), with a close linkage with manufacturers and traders in the urban centres. Means of transportation would be provided between the cottage industry areas and factory/trader zones in the related cities.

RDP-21--El Lajjun Oil Shale Retorting Project would be promoted by the Government to recover shale oil. This project would include construction of the proposed Khabra and/or Dabba Dam for supply of the required water.

RDP-22--The Unused Minerals Utilization Development Project would be proceeded to develop adequate utilization technology of unused minerals existing in the rural areas.

(C) Projects for environment conservation and tourism promotion

RDP-23--The Afforestation Project (Five-Year Plan project) would be continued and expanded to cover 74,900 ha in the Study Area by the year 2005.

RDP-24--The Greenbelt Project would aim to improve the image of the Highlands for tourism development and for realization of peaceful rural life, by planting trees along the main roads. About 110,000 seedlings would be planted in single line along both sides of the roads between Qatrana and Karak, Karak and Dhana through Tafila, Mazar and Abiad, and Tafila and Darawish. Such branch roads as Karak-Ayy-Mu'tah, Tafila-Aima, Tafila-Afra and Tafila-Sinifha-An Nammata would be provided with observation points, rest shelters and other facilities for tourists.

RDP-25--The Afra-Burbeita Hot-springs Multipurpose Pilot Project would aim to examine the possibility of multipurpose utilization of hot springs existing in Wadi Hasa. Utilizing hot springs gushing at Afra and Burbeita and the base flow of Wadi Hasa, a health resort with a Rest House and a Medical Rehabilitation Station, horticultural greenhouses (4,500 m²), improvement and expansion of the irrigated agriculture, and

fresh-water aquaculture would be constructed for development of a model New Village.

RDP-26--The Dhana Valley Tourism Development Project: Old Dhana village still has a row of old arab style stone houses (more than 130 years old), and located at a viewpoint called Small Canyon. This village would be shifted to a higher location under the proposed New Village Project, and the place vacated would be reserved for tourism development with shops and restaurants. A resort hotel would be constructed on the north bank of the Valley, which is presently used as a quarry for the Rashadiya cement company (see Chapter 7 of Volume 3: Main Report - Part 2 for details).

RDP-27--Environmental Assessment of El Lajjun Oil Shale Project should be made preceding the commencement of El Lajjun Oil Shale Project (RDP-21) to seek the optimum way of environmental conservation.

(4) Future image of the rural areas in the Highlands: Rural areas in the Highlands will, in future, surround the urban corridor of Karak, Mu'tah-Mazar and Tafila, and will be bounded to the east by the Badia along the Desert Highway, to the north by Greater Amman and to the west by the Jordan Valley. With a favourable climate and environment in the Highlands, the rural areas should be developed not only for animal husbandry supported by rainfed agriculture, but also for recreation or retirement in rural peace and traditional culture.

Rural living standards would also benefit from the proposed New Village Project. The farm household income would be increased and stabilized by the Animal Husbandry and the Water Harvesting Projects as well as by increasing job opportunities in the proposed cottage industry and urban industries on the side.

Farm sizes should be enlarged for mechanized cultivation and higher farm income, but the number of farm households would remain at the present level. Surplus labour in future should be absorbed in non-agricultural sectors.

Dhiban (Madaba) should be developed by the Water Harvesting Project as a centre for production of vegetables in the Study Area. Production of field crops including forage and shrubs should be increased by extending planting areas, and sheep raising should also be increased.

Qasr should become the largest centre for production of field crops in the Study Area. A large scale centre for lamb fattening should also be established in this area.

Karak should become a main production centre for livestock like Qasr and Mazar, as well as having the proposed large scale fattening centre. This area should also be developed as one of the main fruit production areas by promoting small scale irrigation under the Water Harvesting Development Project.

Ayy should be an area of intensive agriculture, as farm sizes are relatively small and the room for further expansion is limited. Along with the future population increase, the surplus labour force should be absorbed in non-agricultural sectors by development of cottage industries and increasing job opportunities for the younger generation who would commute between Ayy and job sites in the urban corridor by bus services.

The Tafila area has much room for expansion of fruit trees, and for a second large scale fattening centre. Afra-Burbeita hot springs which are located in this sub-region should be developed as a model multipurpose project for tourism, greenhouse horticulture, irrigated agriculture and fresh-water aquaculture.

The Bseira area has much potential for expansion of fruit trees like Tafila. With development of the proposed Dhana resort, it should become a famous tourist spot for the fine spectacle of Dhana Valley.