No.

JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF WATER AND IRRIGATIONTHE HASHEMITE KINGDOM OF JORDAN

THE STUDY ON
WATER RESOURCES MANAGEMENT
IN
THE HASHEMITE KINGDOM OF JORDAN

FINAL REPORT
VOLUME X
SUMMARY REPORT

December, 2001

YACHIYO ENGINEERING CO.,LTD.

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PREFACE

In response to a request from the Government of the Hashemite Kingdom of Jordan, the Government of Japan decided to conduct the study on Water Resources Management in the Hashemite Kingdom of Jordan and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Noboru Saeki of Yachiyo Engineering Co., Ltd. to the Hashemite Kingdom of Jordan, five times between February 2000 and September 2001.

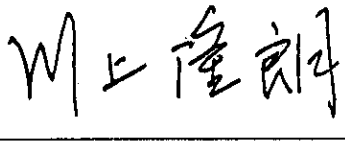
In addition, JICA set up an advisory committee headed by Dr. Masahiro Murakami, Professor of Kochi University of Technology, between February 2000 and December 2001, which examined the study from specialist and technical points of view.

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

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

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

December 2001



Takao Kawakami
President
Japan International Cooperation Agency

December 2001

Mr. Takao Kawakami
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

We are pleased to submit to you the final report of the Study on Water Resources Management in the Hashemite Kingdom of Jordan. The report includes the advise and suggestions of the authorities concerned of the Government of Japan and your Agency. Also included are comments made by the Ministry of Water and Irrigation, the Hashemite Kingdom of Jordan. This report consists of Summary Report, Main Report, Supporting Report and Drawings.

The report deals with the present conditions of water resources management in the Hashemite Kingdom of Jordan and presents the master plan for water resources management with the target year of 2020, as well as the results of the pre-feasibility study for the priority projects proposed in the master plan.

In accordance with the contract with your Agency, we Yachiyo Engineering Co., Ltd. in implemented this study during the period of February 4, 2000 to December 27, 2001. Based on a deep understanding of the existing conditions in the Hashemite Kingdom of Jordan we have prepared a plan that is feasible and can be implemented.

Finally we sincerely hope that this report will be effectively used for the realization of the master plan. We wish to express our deep gratitude to your Agency, the Ministry of Foreign Affairs and other concerned Governmental Agencies for the close cooperation and assistance extended to us during the Study.

Very truly yours,

Noboru Saseki
Team Leader
The Study on Water Resources Management
in the Hashemite Kingdom of Jordan

The Study on Water Resources Management in The Hashemite Kingdom of Jordan

FINAL REPORT VOLUME X
SUMMARY REPORT

Table of Contents

ABSTRACTION

1. Background of the Study

(1) Unbalance between Water Demand and Supply

The population of Jordan has recently been growing due to massive influx of refugees and displaced persons and high natural growth rate. Rapid population growth rates estimated during the past decade at 3.9% (1990 to 1999) is compound with rising per capita consumption twice as fast.

In addition urban expansion, mainly concentrated in Amman, Zarqa, Irbid, and Balqa, generated pressures on nearby water resources. This makes competition between various demands against very limited water resources availability sharp. Water demand has therefore constantly exceeded the supply in the urban areas. As the frequent cut off of the water supply and restricted water supply, the citizens have suffered inconvenience in their daily life.

Against the background described above, it has been promoting the country to conserve and ration water consumption.

(2) Restricted Water Resources

According to the Water Stress Index* which indicates the degree of the water shortage, Jordan is classified in the category of "Absolute Scarcity" and the water resources is chronically short to the demands. Due to the arid to semi-arid climate of the country, annual rainfall amounts highly fluctuate year by year with 85% of the total rainfall not being available for use due to high evaporation rates. The recent drought conditions and decreasing tendency of rainfall during past three years have exasperated the availability of surface water in the country**. Due to the reasons mentioned above, more than half of the total water resources depend on the groundwater resource of which the nonrenewable groundwater occupies at 14%. The regional groundwater level decline and groundwater quality deterioration have taken place because of the over abstraction of the renewable groundwater. Therefore, it is needed that the groundwater development management and quality conservation plan will be formulated standing on the long-term aspects.

For the surface water, although peace water is being conveyed from Israel to Jordan, this project implies sensitive factors and its amount will be subject to change according to the political and climatic conditions.

* Water Stress Index is the value of annual raifall divided by the total population (m^3/capita/year) The value of under 1,700 is regarded as "Existing of Stresses", under 1,000 is regarded as "Scarcity" and under 500 is regarded as "Absolute Scarcity"

** Despite the lack of evidence that such a decrease in rainfall indicates global climatic change, some studies predict that the rainfall in the Middle East Area may fall to 10% to 15% after 50years (Hardley Center, UK) (Chapter 5.6).

(3) Request of the Study

Because of the limited water resources mentioned above, it is of the utmost importance for the government of Jordan to utilize the restricted water resources efficiently and to allocate the water resources properly. In September, 1997, the Government of Jordan requested Japanese Government to conduct the comprehensive study for the formulation

of the water resources management master plan with the Ministry of Water and Irrigation (MWI) as a counter part agency.

In response to the request of the Government of Jordan, JICA dispatched preparatory study team and the Scope of Work for the Study was agreed upon between both sides, and signed in October, 1999.

2. Outline of the Study

(1) Basic Policy of the Study

In this Study, the Water Resources Management Master Plan was formulated, covering the period until year 2020, and aiming at "Unified, comprehensive and sustainable management of the water resources", and "Strategic development of remaining scarce water resources" while having in mind the future goal of "Shift to water re-cycling society". Special aspects in the country, "global climatic change and characteristic of climatic change of the arid region", and "cooperation for regional peace water development" are considered in formulation of the Master Plan. The relationship among these problems is schematically shown in next figure.

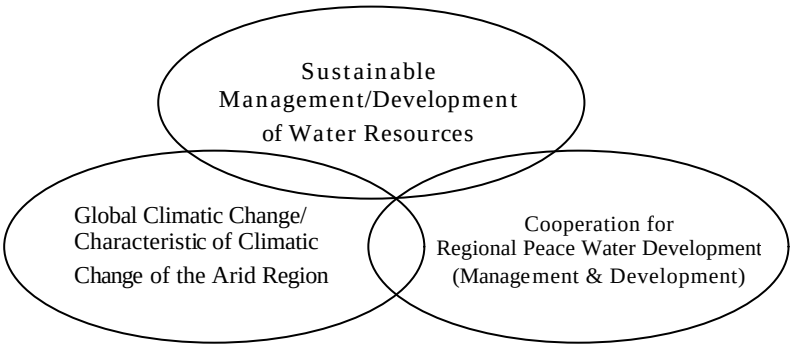


Fig.-1 The problems on the Water Resources Management in Jordan

The comprehensive water resources management master plan for the twelve Governorates has been formulated in the Study under the circumstances mentioned above. Furthermore, the system and database of "Digital Master Plan", which was prepared in MWI with the technical cooperation of GTZ, was utilized for the formulation of the master plan. The Study area, target year of planning and water resources to be developed in the master plan are shown below:

Study Area:	Whole Jordan and twelve Governorates in Jordan
Target Year: of Planning Horizon	Short Term---------- 2000 to 2005 Mid Term----------2006 to 2010 Long Term----------2011 to 2020
Water Resources:	In addition to the conventional water which comprised of surface water, peace water, renewable groundwater and fossil fresh groundwater, the non-conventional water resources which were desalinated brackish groundwater, desalinated sea water and treated wastewater were considered as water resources.

(2) Contents of the Study

The Study Team started the Study in February, 2000 and conducted Phase-1 Investigation which aimed to formulate the Water Resources Management master Plan and Phase-2 Investigation which aimed to carry out the Pre-Feasibility Study on the priority projects selected in the Master Plan. The general flow of the Study is shown in Fig.-2.

1) Formulation of Water resources Management Master Plan

For the formulation of the Water Resources management Master Plan, examinations were done on both of "Water Resources Management: Conventional/Non-conventional Water resources" and "Water Resources Management: Quantitative Management, Qualitative Management and Institutional/Legislative Management" under the umbrella of "Jordan's Water Strategy" and "Water Policies"

In the course of the formulation of the Water Resources management Master Plan, the Municipal/Industrial/Touristic (MIT) demand and agriculture demand were tried to be balanced with the restricted water supply as much as possible by taking account of the study results of USAID and GTZ projects. After the global balancing of water demand and supply in whole Jordan, the water resources development and water resources management plans including inter-Governorate water allocation plan and water conveyance plan were formulated for twelve governorates in order to supply the water efficiently.

The schematic concepts of the Water Resources Management Master Plan were shown in three drawings in the coming pages.

2) Pre-Feasibility Study on Selected Priority Projects

Selection of the priority projects for the Pre-Feasibility Study was done in Phase-2 Investigation. The selected priority projects for the Pre-Feasibility Study are as follows:

① Treated Wastewater Reuse Scheme of Five Existing Treatment Plants
Ma'an (including expansion of treatment plant), Abu-Nuseir, Fuhis, Tafielah, and Wadi Essir

② Construction of Wadi Zarqa Treatment Plant

③ National Water Supply Control System Integrating Surface and Groundwater

④ Municipal Water Distribution Networks Rehabilitation
Karak, Tafielah, Ma'an, Madaba and South Amman

⑤ Al Wehda Dam Water Supply Project/Irbid]

The outline of the Water resources Management Master Plan is summarized in the Part-I and the main points of the Pre-Feasibility Study results on the selected priority projects are summarized in the Part-II in this Summary Report.

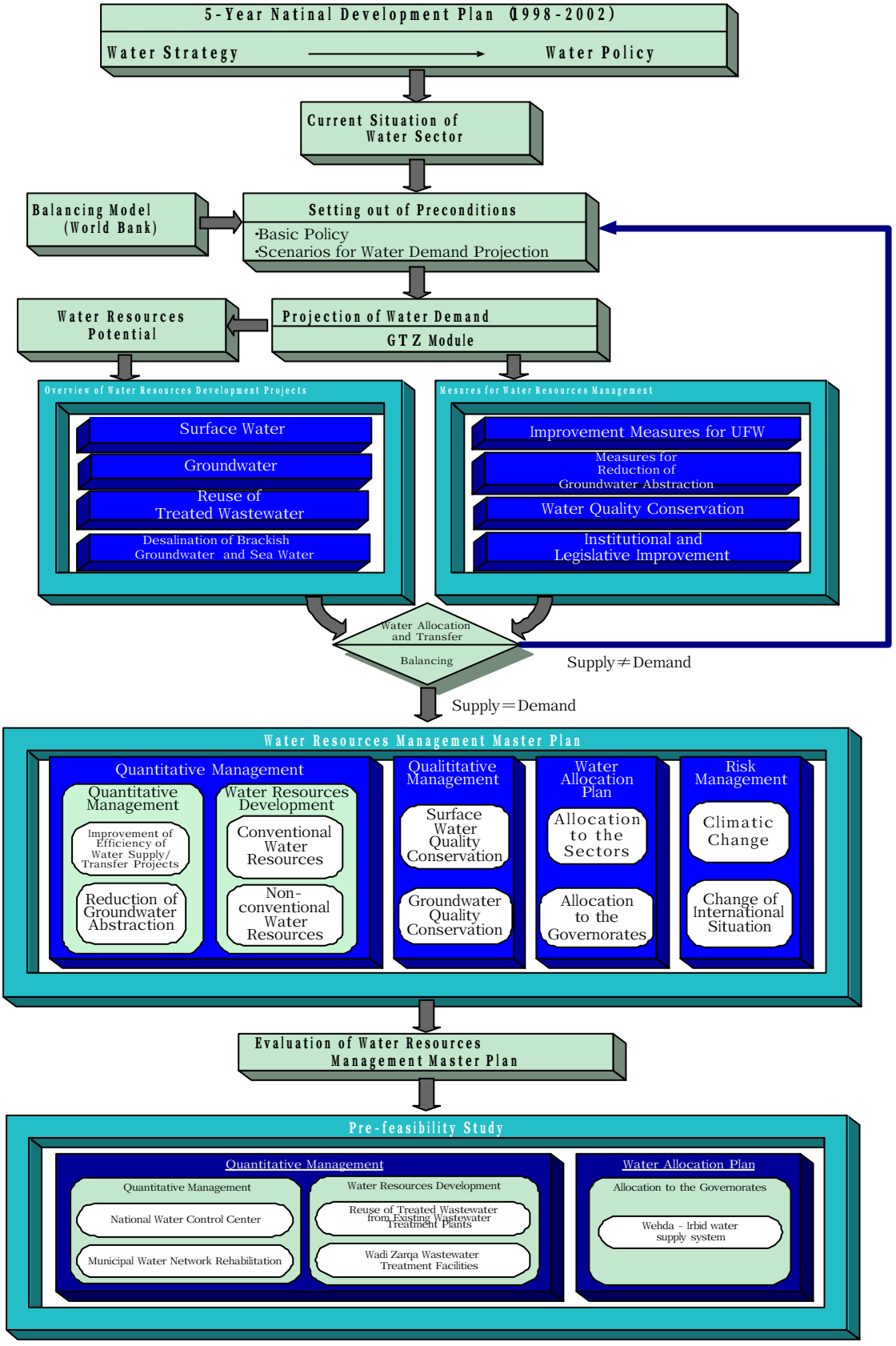


Fig.-2 General Flow of the Study

General Concept of Water Resources Management Master Plan in The Hashemite Kingdom of Jordan

Background

- Increasing Water Demand
- Water Stress Index 170m3/capita/year (1999) (Under 500 is regarded as "Absolute Scarcity of Water Resources)
- Limited Water Resources
- Global Climatic Change

↓

National Water Strategy

↓

Sustainable Management and Development of the Water Resources

Problems

- Environment (Necessity of Reduction of Groundwater Abstraction)
- Water Demand (Necessity of Control of Water Demand)
- Amount of Water Resources (Necessity of New Development)

↓

Water Resources Management Master Plan

Quantitative Management

Quantitative Management
- Improvement of Efficiency of Water Supply/ Transfer Projects
- Reduction of Renewable Groundwater Abstraction

Water Resources Development
- Conventional Water Resources
- Non-Conventional Water Resources

Qualitative Management
- Surface Water Quality Conservation
- Groundwater Quality Conservation

Water Allocation
- Allocation to the Sectors
- Allocation to the Governorates

Risk Management
- Climatic Change
- Change of International Situation

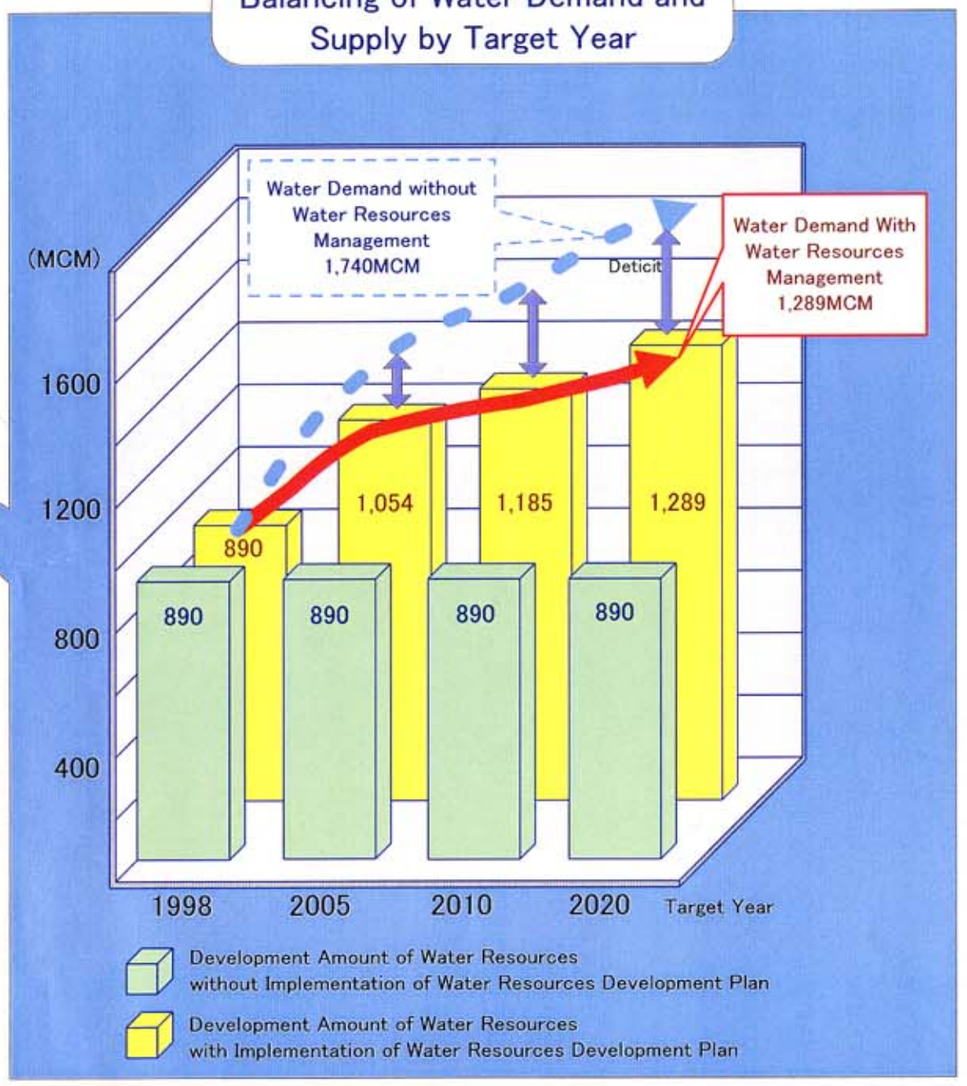
↓

- Unified and Comprehensive and Sustainable Management of Water Resources
- Strategic Development of Remaining Scarce Water Resources
- Risk Management

↓

Toward Water Re-cycling Society

Balancing of Water Demand and Supply by Target Year



Comprehensive Water Resources Management

Quantitative Management

- Quantitative Management
  - ・Improvement of Water Supply System
    - Improvement of UFW*(Rehabilitation Plan of Existing Water Supply System, Establishment of National Water Supply Control System)
    - Improvement of Institution (Improvement Plan of Institutional and Legislative System)
  - ・Reduction of Renewable Groundwater Abstraction
- Water Resouces Development (Conventional/Non-conentional)

Qualititative Management — Water Quality Conservation (Surface Water /Groundwater)

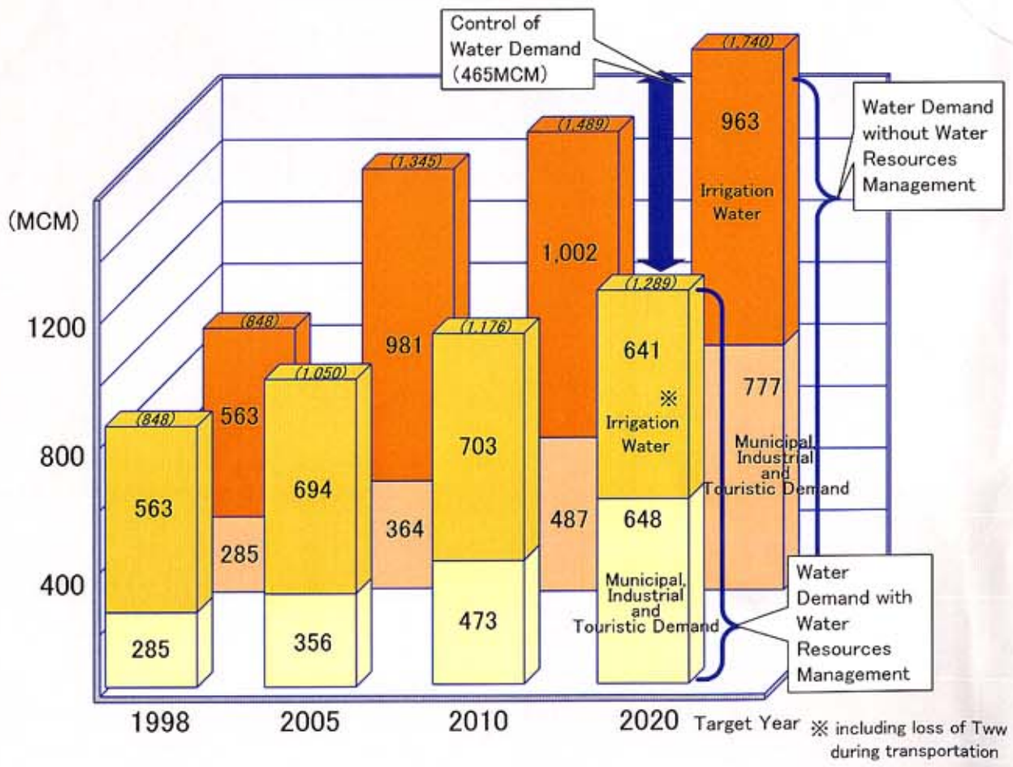
Water Allocation Plan — Water Allocation and Transfer

Risk Management

→

- Securing of Necessary Quantity
- Conservation of Quality
- Apropriate Water Allocation
- Risk Management

Change of Water Demand by Target Year



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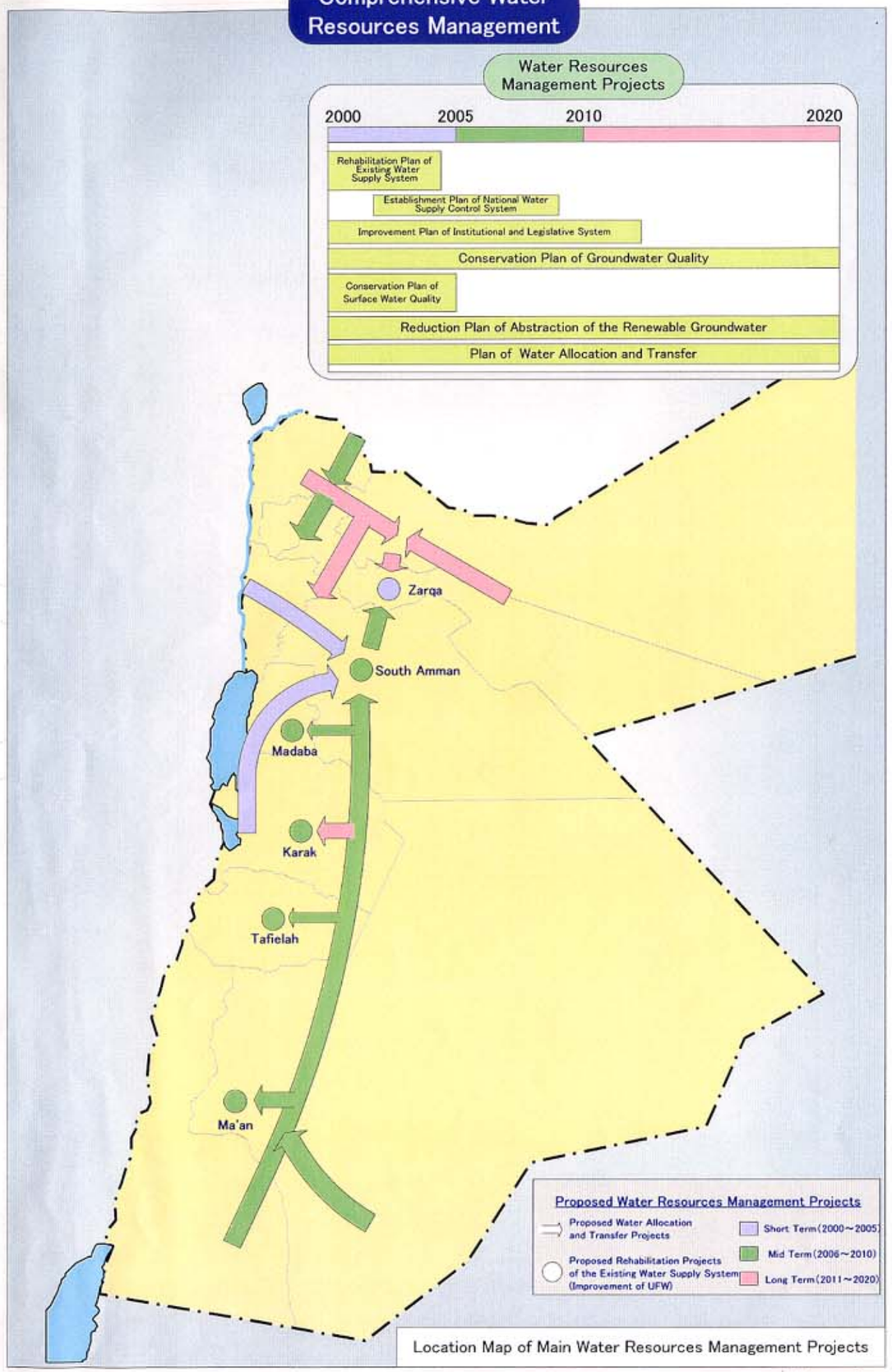


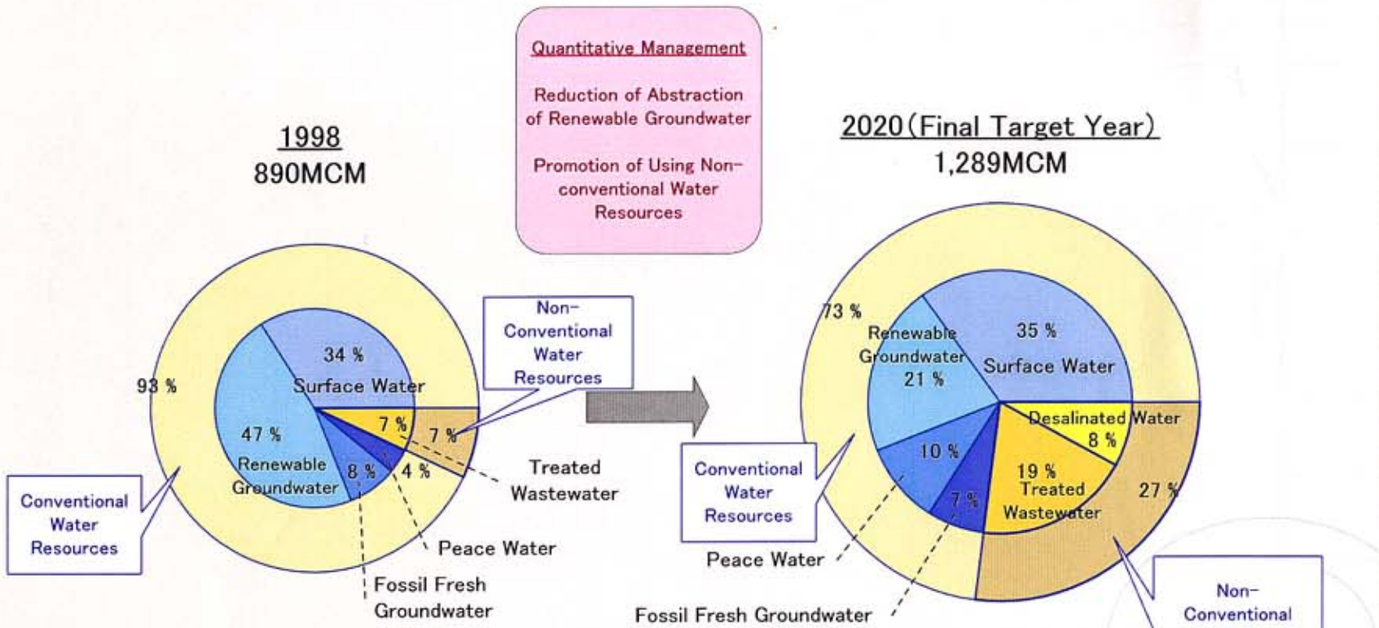
Location Map of Main Water Resources Management Projects

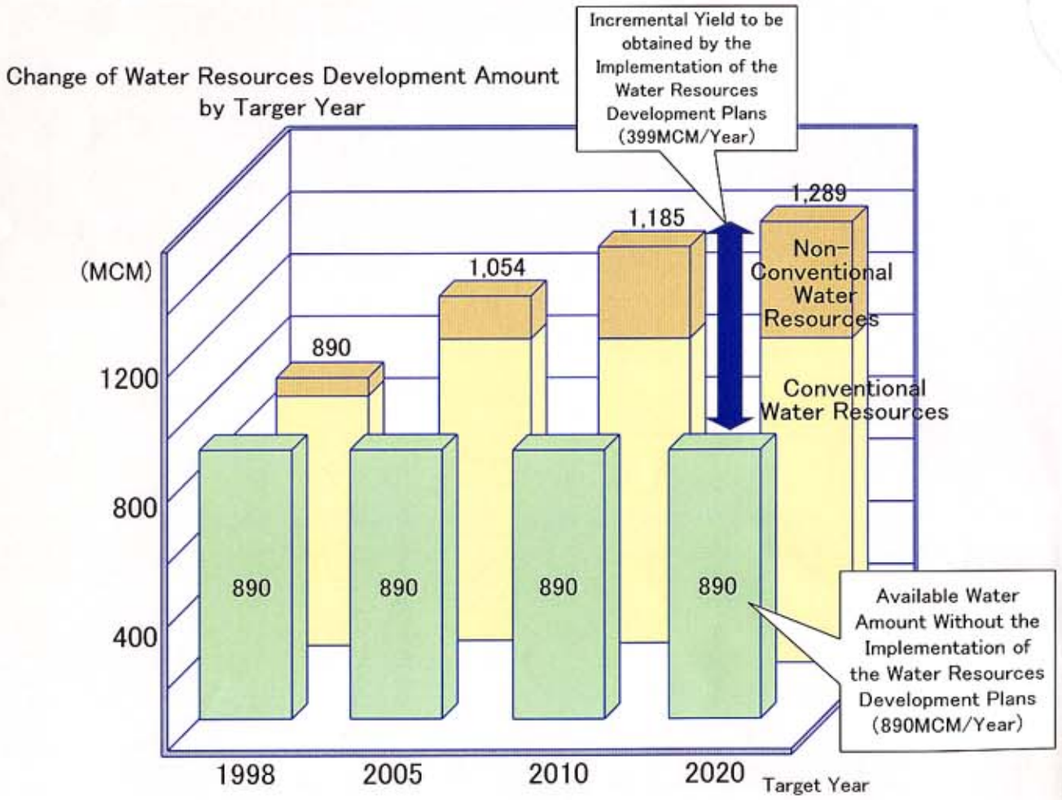
Water Resources Development

Quantitative Management

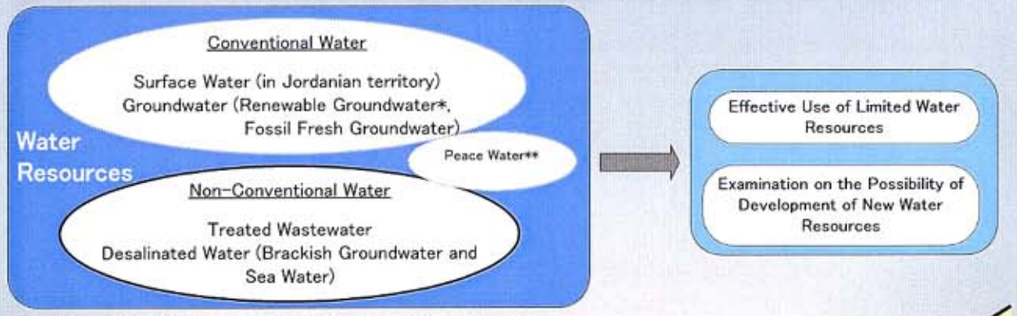
Reduction of Abstraction of Renewable Groundwater

Promotion of Using Non-conventional Water Resources





Strategic Water Resources Development



* Further Development Shall not be done because of the over drafting.

** It is classified as intermediate type between Conventional and Non-Conventional because it may contain desalinated water in future.

Location of Water Resources Development Projects

I Introduction

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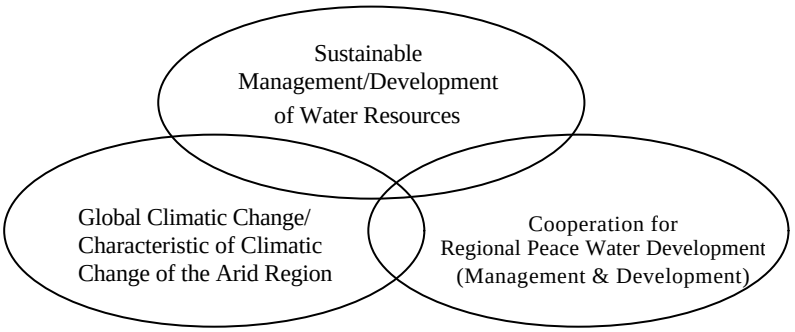

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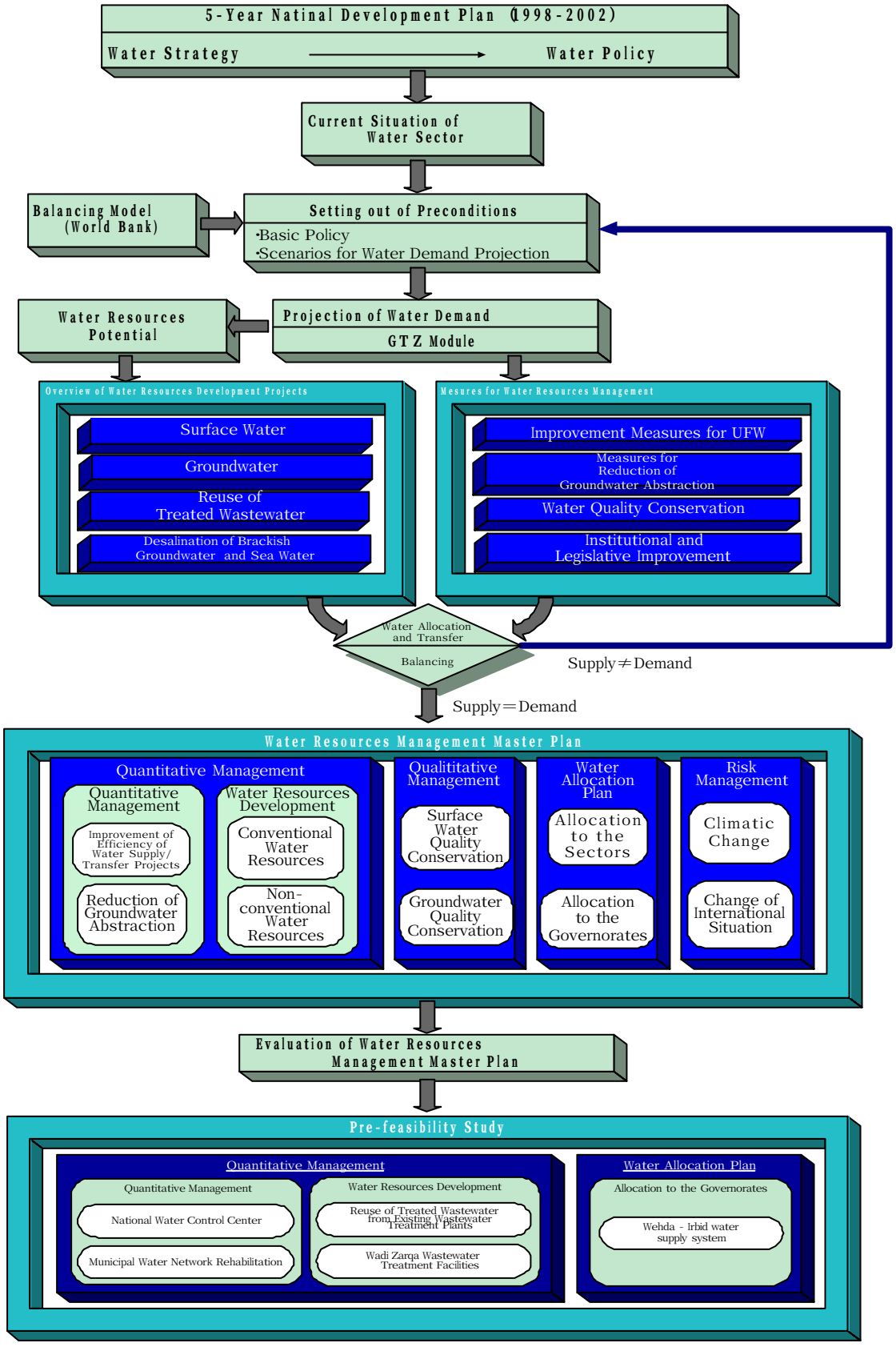

Fig.-2 General Flow of the Study