JAPAN INTERNATIONAL COOPERATION AGENCY

DEPARTMENT OF THE ENVIRONMENT
MINISTRY OF JIHAD-E-AGRICULTURE
THE ISLAMIC REPUBLIC OF IRAN

THE STUDY ON INTEGRATED MANAGEMENT FOR ECOSYSTEM CONSERVATION OF THE ANZALI WETLAND IN THE ISLAMIC REPUBLIC OF IRAN

NIPPON KOEI CO., LTD.

LIST OF VOLUMES

Volume I	**:**	**Executive Summary**
Volume II	**:**	**Main Report**
Volume III	**:**	**Supporting Report**
Volume IV	**:**	**Data Book**

EXCHANGE RATE

US$ 1 = IRR 8,652, Yen 100 = IRR 7,955
(as of June 30, 2004)

PREFACE

In response to a request from the Government of the Islamic Republic of Iran, the Government of Japan decided to conduct The Study on Integrated Management for Ecosystem Conservation of The Anzali Wetland in the Islamic Republic of Iran and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Hirofumi Sadamura of Nippon Koei Co., LTD. between May, 2003 and December, 2004.

The team held discussions with the officials concerned of the Government of the Islamic Republic of Iran 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 Islamic Republic of Iran for their close cooperation extended to the study.

March 2005

Etsuo Kitahara,
Vice-President
Japan International Cooperation Agency

Mr. Etsuo Kitahara
Vice-President,
Japan International Cooperation Agency
Tokyo, JAPAN

Letter of Transmittal

Dear Sir,

We are pleased to submit herewith the final report of "The Study on Integrated Management for Ecosystem Conservation of the Anzali Wetland".

The Anzali Wetland is internationally known as an important wetland for migratory birds on the southern coast of the Caspian Sea, and was registered as a Ramsar site in 1975. However, it was added to the Montreux Record of wetlands being degraded by human activities in 1993. The environment of the Wetland is deteriorating due to inflow of wastewater, solid waste and sediment from its watershed.

This Study aimed at preparing the integrated management master plan for ecosystem conservation, implementing the pilot activities and conducting capacity development of the stakeholders for wetland conservation. The proposed master plan broadly covers the wetland ecological management plan, watershed management Plan, wastewater management plan, solid waste management plan, environmental education plan and institutional plan for implementation. As a pilot activity, eleven pilot activities such as environmental education program, eco-tourism, soil erosion control, etc. are selected and implemented in collaboration with Iranian stakeholder. Through these master plan preparation and pilot activities, the capacity development of the stakeholder was conducted.

We hope that this report and results of our activities will be effectively utilized by Department of Environment, Ministry of Jihad-e-Agriculture and relevant organizations of Iran, and consequently the Anzali Wetland will be successfully conserved and sustainably used. It is also our sincere hope that this study and report will contribute to foster a long lasting partnership and friendship between the two nations of Japan and Iran.

Finally, we wish to express our sincere appreciation to the officials of JICA, JICA Advisory Committee, Ministry of Foreign Affairs, Ministry of Environment, Ministry of Land and Transportation, the Embassy of Japan for Iran, JICA Expert for their continuous support throughout the Study. Also, we would like to express our great appreciation to the members of National Steering Committee and Local Steering Committee of Iranian side and other Iranian personnel concerned for their cooperation extended to us during the Study.

Yours faithfully,

Hirofumi Sadamura
Leader for JICA Study Team

The Study on Integrated Management for Ecosystem Conservation of the Anzali Wetland in the Islamic Republic of Iran

JAPAN INTERNATIONAL COOPERATION AGENCY

Location Map of the Study Area

Selke Wildlife Refuge

Anzali Lagoon

Swans in the Wetland

Migratory Birds in Winter

Lotus Flower in the Wetland

Caspian Tern in the Wetland

Present Conditions of Anzali Wetland and Its Watershed (1/2)

Upper Mountain Area (more than EL 2,500 m)

Rangeland Area (from EL 1,500 m to 2,500 m)

Forest Area (from EL 500 m to 1,500 m)

Plain Area (Lower than EL 500 m)

Downstream River Condition

Anzali Port and Caspian Sea

Present Conditions of Anzali Wetland and Its Watershed (2/2)

Overgrazing in the Upper Watershed

Degraded Area in the Upper Watershed

Sediment Runoff in the Upstream

Inflow of River Water with Silt

Discharge of Wastewater without Treatment

Polluted River Water

Environmental Pressure on Anzali Wetland (1/2)

Illegal Dumping of Solid Waste along River

Anzali Dumping Site beside the Wetland

Fishing in the Wetland

Hunting Hut in the Wetland

Expansion of *Phragmites* Area

Overgrowth of *Azolla* sp.

Environmental Pressure on Anzali Wetland (2/2)

THE STUDY ON INTEGRATED MANAGEMENT FOR ECOSYSTEM CONSERVATION OF THE ANZALI WETLAND

FINAL REPORT
Volume II Main Report

TABLE OF CONTENTS

APPENDICES

List of Tables

List of Figures

ABBREVIATIONS

B/C	Benefit-Cost Ratio
BEA	Business Environment Association
BOD	Biochemical Oxygen Demand
CEP	Caspian Environment Programme
CEPA	Communication, Education and Public Awareness
CHTO	Culture, Heritage, and Tourism Organization
COD	Chemical Oxygen Demand
COP	Conference of Parties
CPI	Consumer Price Index
DO	Dissolved Oxygen
DOE	Department of the Environment
DOE Guilan	DOE Guilan Provincial Office
EIA	Environmental Impact Assessment
El	Elevation
EIRR	Economic Internal Rate of Return
EMS	Environmental Management System
EPM	Erosion Potential Method
EU	European Union
FAO	Food and Agriculture Organization
FFS	Farmer Field Schools
F/S	Feasibility Study
FRO	Forestry and Range Organization
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
GOJ	Government of Japan
GOI	Government of Islamic Republic of Iran
GPS	Global Positioning System
GRDP	Gross Regional Domestic Product
GWWC	Guilan Water and Wastewater Company
HEEG	Higher Education Environment Group
HQ	Headquarter
HUDO	Housing and Urban Development Organization
IEE	Initial Environmental Examination
IEG	Islam and Environment Group
IMF	International Monetary Fund
IMO	Industrial Mining Organization
IPM	Integrated Pest Management
IRR	Iranian Rial
ISO	International Organization for Standardization
ISW	Industrial Solid Waste
ITTO	Iran Touring and Tourism Organization
IUCN	The World Conservation Union
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
MCM	Million Cubic Meter
MOE	Ministry of Energy
MOED	Ministry of Education
MOE Guilan	MOE Guilan Provincial Office
MOIM	Ministry of Industries and Mines
MOJA	Ministry of Jihad-e-Agriculture
MOJA Guilan	MOJA Guilan Provincial Directorates
MORT	Ministry of Roads and Transportation

M/P	Master Plan
MPO	Management and Planning Organization
NCSD	National Council for Sustainable Development
NGO	Non Governmental Organization
NPV	Net Present Value
NRGO	Natural Resources General Office
NWWEC	National Water and Wastewater Engineering Company
O&M	Operation and Maintenance
PEC	Provincial Environmental Committee
PPP	Polluter Pay Principle
PRA	Participatory Rural Appraisal
PSIAC	Pacific Southwest Inter-agency Committee
PSO	Ports and Shipping Organization
RAN	Rural Advisers Network
RAP	Resettlement Action Plan
REAN	Rural Environment Advisers Network
RET	Rural Environment Team
RWO	Regional Water Organization
RWWC	Rural Water and Wastewater Company
SCI	Statistical Center of Iran
SEG	Schools Environmental Group
SS	Suspended Solid
SWIM	Solid Waste Improvement Meeting
SWIM-H	Solid Waste Improvement Meeting for Hospital Waste
SWIM-I	Solid Waste Improvement Meeting for Industrial Waste
SWIM-M	Solid Waste Improvement Meeting for Municipal Waste
SWM	Solid Waste Management
The Study	The Study on Integrated Management for Ecosystem Conservation of the Anzali Wetland
TDS	Total Dissolved Solid
T-N	Total Nitrogen
TOR	Terms of Reference
T-P	Total Phosphorus
UN	United Nations
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USD	United States Dollar
US EPA	United States Environmental Protection Agency
VAT	Value Added Tax
WEMP	Wetland Ecological Management Plan
WGLEP	Working Group on Landuse, Environment and Population
WEAT	Wetland Environmental Action Team
WG	Working Group
WGLEP	Working Group on Landuse, Environment and Population
WL	Water Level
WMD	Watershed Management Department
WMP	Watershed Management Plan
WPDT	Wetland Professional Development Team
WTP	Willingness-To-Pay
WWTP	Wastewater Treatment Plant

ABBREVIATIONS (MEASUREMENT UNIT)

Length

mm	millimeter
cm	centimeter
m	meter
km	kilometer

Area

m^2	square meter
km^2	square kilometer
ha	hectare

Volume

m^3	cubic meter
l, L	liter
MCM	million cubic meter

Concentration

ppm	parts per million
mg/L	milligram per liter

Weight

mg	milligram
g	gram
kg	kilogram
ton	metric ton

Time

sec	second
min	minute
hr	hour
yr	year

Currency

IRR	Iranian Rial
JPY	Japanese Yen
USD	United States Dollar

Others

%	percent
°C	degree centigrade
10^3	thousand
10^6	million
10^9	billion

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The Anzali Wetland covers an area of 193 km^2 in Guilan Province of Iran on the southern coast of the Caspian Sea. It is internationally known as an important wetland for migratory birds and was registered as a Ramsar site in June 1975 in accordance with the Convention on Wetlands of International Importance, especially as Waterfowl Habitat.

However, the water quality of the wetland is deteriorating due to the inflow of wastewater and solid waste from neighboring cities, including the provincial capital, Rasht. The Anzali Wetland is also getting drier and shrinking due to the inflow of sediment from the catchment area (approx. 3,610 km^2). In 1993, the parties of the Convention decided to designate the Anzali Wetland as a wetland on the Montreux Record because conservation of the Anzali Wetland was deemed a priority issue among the Ramsar sites.

The Iranian Government has been actively promoting conservation and wise use of the Anzali Wetland within its national policy for environmental conservation. Nevertheless, actions taken so far have been fragmented and have not reversed the course of environmental deterioration of this internationally important wetland.

Under the situation described above, the Government of Iran (GOI) asked the Government of Japan (GOJ) to extend technical co-operation for a comprehensive study on how to recover wetland functions and achieve conservation of the Anzali Wetland.

In response to the request, the Japan International Cooperation Agency (JICA) dispatched a Preparatory Study Team in November 2002. The Scope of Work for the Study on Integrated Management for Ecosystem Conservation of the Anzali Wetland (the Study) was agreed between JICA and the Department of the Environment (DOE) and Ministry of Jihad-e-Agriculture (MOJA), Iran on November 12th, 2002. The study is now referred to as the "Anzali Wetland Conservation Study".

1.2 Objectives of the Study

The objectives of the Study are as follows:

1) Development of an integrated Master Plan for the conservation of the Anzali Wetland through close collaboration between the JICA Study Team and the Iranian counterpart organizations;
2) Initiation of some of the measures identified by the Iranian national and local organizations concerned during the development of the integrated master plan; and
3) Assistance for capacity development of the organizations concerned and their staff, to eliminate the causes of the Anzali Wetland degradation (following

scientific research work) and to build up co-ordination mechanisms for overall wetland management.

1.3 Study Area

The study area covers the Anzali Wetland itself and its watershed as shown in the Location Map.

1.4 Work Schedule

The total work period of the Study is 26 months from February 2003 to March 2005. The study period is divided into two phases as given below.

1) Phase 1: Basic Study (February 2003 to February 2004)
   - Preparatory Work in Japan (Feb-Mar 2003: 0.5 months)
   - First Field Work in Iran (May 2003-Feb 2004: 10 months)
2) Phase 2: Formulation of Master Plan (May 2004 to February 2005)
   - First Home Work in Japan (May-June 2004: 1.5 months)
   - Second Field Work in Iran (July-Oct 2004: 3.5 months)
   - Second Home Work in Japan (Oct-Nov 2004: 1.5 months)
   - Third Field Work in Iran (Dec 2004: 0.5 months)
   - Third Home Work in Japan (Feb-Mar 2005: 0.5 months)

The overall work schedule is presented in Figure 1.4.1.

1.5 Organization for the Study

The study was jointly implemented by the JICA Study Team, members of Iranian counterpart organizations, and other stakeholders. The members of the JICA Study Team and the JICA Advisory Committee are listed in the Appendix-1. In order to ensure smooth conduct of the study, the Iranian side organized the National Steering Committee, Local Steering Committee and Technical Committee, and assigned counterparts to the study team. They are listed in Appendix-2.

Phase	Phase I: Study on Situation of Wetland and its Causes													-	Phase II: Formulation of Master Plan									
Study Stage	Preparatory Work		First Field Work Iran											-	First Home Work in Japan	Second Field Work in Iran				Second Home Work In Japan		Third Work In Iran	-	Third Work In Japan
Fiscal Year	2002		2003												2004									
Month	2	3	4	5	6	7	8	9(F)	9(L)	10	11	12	1	2	3-5(F)	5(L)-6	7	8	9	10(F)	10(L)	11	12(F)	12(L)-1	2
RASHT City Precipitation a Month	33mm	53mm	32mm	34mm	9mm	72mm	114mm	329mm	329mm	145mm	130mm	163mm	131mm	33mm	-	9mm	72mm	114mm	329mm	145mm	145mm	130mm	163mm	-	33mm

Work Item

Master Plan

【1-1】 Preparation of Inception Report (Ic/R)
- Work Items, Work Allocation
- Management Method of Study Committee
- Management Method of Workshops and Seminars
- Concept of News Letter Issue
- Concept of Capacity Development Implementation
- Concept of Pilot Actions and Implementation Method

【2】 Presentation and Discussion of Ic/R

【5】 Field Reconnaissance

【6】 Collection and Arrangement of Existing Data and Information
a) Socio-Economy
b) Administration and Organization
c) Policy, Legal Status and Convention
d) Community Development Plan
e) Climate and Hydrology
f) River, Water Body and Watershed
g) Soil Spillage and Sedimentation
h) Wildlife and Ecology
i) Land Use and Vegetation
j) Wetland Use
k) Sewerage System
l) Infrastructure Facilities
m) Water Quality and Substratum
n) Waste
o) Environmental Guideline
p) Existing EIA
q) Relevant Plans and Other Donors' Activities
r) Existing Reports of Survey and Planning
s) Others

【7】 Formulation of Capacity Development Implementation Plan

【13】 Pollution Source Survey
a) Water Pollution
- Type and Distribution of Pollution Source
- Generation and Runoff of Pollution Load
- Present Condition of Sewerage System and Future Plan

b) Waste
- Amount, Kind and Zone
- Present Condition of Waste Disposal and Future Plan
- Illegal Dumping Condition

【14】 Other Field Surveys
a) Soil and Geology
b) Water Level and Discharge
c) Sediment Runoff and Deposit
d) Inundation Area
e) Ecology (Wildlife, Fish)
f) Sewerage System
g) Waste
h) Water Level of Caspian Sea
i) Management System, Land Use, Lives of Inhabitants, Industrial Activity, Vegetation, etc.

【15】 Present Situation of Wetland Degradation and Identification of Causes

【16】 Formation of Pilot Activity Plan
a) Environmental Education, Enlightenment Activity
b) Community Development and Eco-tourism
c) Control of Sediment Runoff and Deposit
d) Waste Management
e) Waste Water Management
f) Small-scale Facilities
g) Conservation of Wetland

【17】 Formulation of Environmental Monitoring Plan
- Water Depth, Water Level, Sediment
- Water Quality, Birds, Fishes
- Vegetation, Residents, etc.

【18】 Preparation, Presentation and Discussion of Pr/R (1)

【19】 Analysis of Wetland Degradation and Evaluation
a) Influence by Water Pollution
b) Influence by Waste
c) Influence by Sediment Inflow and Deposit
d) Others

【20】 Implementation of Pilot Activities /Interim Evaluation

【21】 Support for Environmental Monitoring /Interim Evaluation

【22】 Study on Basic Principle for M/P Formulation
1) Concept of M/P
2) Setting of Vision and Goal
3) Planning Area and Target Year
4) Setting of Target (Conservation Level)
5) Approach and Strategy
6) Components of M/P
7) Proposal of M/P Prototype

【23】 Preliminary Study of Alternatives
1) Environmental Zoning Alternatives
2) Component Plans for Zoning Alternatives

【24】 Preparation, Presentation and Discussion of Pr/R (2)

【25】 First Wetland Environmental Conservation Seminar

【26】 Comparative Study of Proposed Plans
- Technical Aspect, Economic Aspect, Financial Aspect, Organization and Institution Aspects
- Proposal of the Optimum Plan

【27-1】 Preparation of Interim Report (It/R)

【27-2】 Submission and Presentation of It/R (Fourth Advisory Committee Meeting)

【28】 Presentation and Discussion of It/R

【29】 Additional Data Collection and Supplemental Field Survey

【30】 Implementation of Pilot Activities (Continuation/New)

【31】 Support of Environmental Monitoring (Continuation/New)

【32】 Formulation of M/P of Integrated Management for Ecosystem Conservation of the Wetland
1) Wetland Conservation Plan
2) Land Use and Watershed Management Plan
3) Sewerage Development Plan
4) Waste Management Plan
5) Environmental Education Plan
6) Environmental Monitoring Plan
7) Capacity Development Plan

【33】 Project Implementation Schedule and Project Cost Estimate

【34】 a) Initial Environmental Examination (IEE)
a-1) Preliminary Scoping
a-2) First Stakeholder Meeting
a-3) IEE of Proposed Projects
a-4) Second Stakeholder Meeting
a-5) Preparation of IEE Document
b) Economic and Financial Evaluation
c) Technical Evaluation

【35】 Evaluation of the Result of Capacity Development

【36】 Formulation of Project Implementation Plan (I/P)

【37】 Proposal on Follow-up Projects and Activities

【38-1】 Preparation of Draft Final Report (Df/R)

【38-2】 Submission and Presentation of Df/R (Sixth Advisory Committee Meeting)

【39】 Presentation and Discussion of Df/R

【40】 Second Wetland Environmental Conservation Seminar

【41】 Preparation and Submission of F/R

Pilot Activity Plan and Environmental Monitoring Plan

Report (Advisory Committee Meeting)

【1-2】 Submitting and Presentation of Ic/R (First Advisory Committee (A/C) Meeting)

Second A/C Meeting

Third A/C Meeting

Fifth A/C Meeting

Seventh A/C Meeting

Workshop (WS)/ Seminar & New Letter

【3-1】 First W/S — Importance and Validity of Integrated Management M/P

【3-2】 Second W/S — Conservation and Management of Wetlands Registered of the Ramsar Convention

【3-3】 Third W/S — Pilot Activity Plan and Environmental Monitoring Plan

【3-4】 Fourth W/S — Study on Wetland Degradation

【3-5】 Fifth W/S — Progress and Outcome of Pilot Activity and Environmental Monitoring

【3-6】 Sixth W/S — Relation between Anzali Wetland and Community Economy

【3-7】 Seventh W/S — Evaluation of Achievement of Capacity Development

【4-1】 News Letter (No.1)

【4-2】 News Letter (No.2)

【4-3】 News Letter (No.3)

【4-4】 News Letter (No.4)

【4-5】 News Letter (No.5)

Government of Iran

Central Committee

Technical Committee

Local Committee

【1-3】 Examination of Ic/R by the Government of Iran, Comment Preparation

First St/C・M/M

Second St/C・M/M

Third St/C・M/M

Fourth St/C・M/M

Fifth St/C・M/M

Comment Preparation for Df/R

Subletting Works

【8】 Water Quality and Substratum Survey

【12】 Plankton and Benthos Survey

First Survey (Jun.)

Second Survey (Sept.)

Third Survey (Dec.)

【9】 Sounding Survey

【10】 Social Survey

【11】 Institution Survey

Figure 1.4.1 Overall Work Flow of the Study

CHAPTER 2 PRESENT CONDITIONS OF THE STUDY AREA

2.1 Socio-Economy

2.1.1 National Socio-Economy

(1) National Economy

The GDP of Iran in 2001[1] was 741,068 billion Rials (USD 86 billion at the current currency value in 2003. The average annual growth rate of GDP was 23.1% between 1997 and 2001 (SCI, 2002[2]). Iran has the second largest oil and gas reserves in the world, and the national economy heavily depends on oil-related sectors. As much as 16.1% of the GDP was from the oil-related sectors in 2001. The GDP shares of major sectors[3] are mining (15.5%), manufacturing (15.1%), wholesale and retail (14.5%), real estate (11.6%) and agriculture (10.9%). However, the highest percentage of employment is seen in the agricultural sector at around 23%. To protect the livelihood of the farmers, the Government subsidizes various kinds of agricultural products to stabilize their domestic prices by providing guaranteed purchasing prices.

(2) National Budget

The total governmental budget in 2003 was about 968,000 billion Rials (USD 112 billion), comprising public budget, governmental corporation budget, bank budget, and budget of governmental affiliated enterprises. Among the budget items, the government public budget to be used by executive bodies for the annual programs including development projects is 436,022 billion Rials (USD 50 billion)[4]. Approximately 50% of government revenues and 70 - 75% of exports are derived from the oil sector (IMF, 2002).

[1] Under the Iranian calendar, the year starts on 21 March of the Christian year and ends on 20 March in the next year. In addition, to convert the Iranian year into Christian year, 621 is added to the former; ex. Iranian year 1383 equals Christian year 2004.
[2] Iran Statistical Yearbook 1381, Statistical Center of Iran (SCI), Autumn 2003
[3] The categories of the major economic sector are based on the International Standard Industrial Classification (ISIC), and the oil-related sectors are included in a number of different sectors in the ISIC system.
[4] The amount of the governmental budget includes budgets used by both central and provincial governments.

Table 2.1.1 Summary of the National Government Budget

(Unit: billion Rials)

Items	1999	2000	2001	2002	2003
Government public budget	109,699.5	127,816.2	164,266.9	273,228.3	436,022.8
Government corporation budget*[1]	162.959.3	213,579.8	265,247.9	391,187.9	495,256.5
Banks budget*[2]	16,992.0	21,033.9	28,317.2	37,586.1	51,350.2
Budget of government-affiliated enterprises*[3]	3,062.5	5,474.5	6,861.3	7,140.8	7,730.4
Duplications	16,498.2	7,254.2	8,715.0	15,840.8	22,098.8
Total	276,215.2	360,668.1	455,978.2	693,302.2	968,261.1

Note: The figures in the table are the primary approved budget.
*[1]- Comprising institutes, government corporations and insurance companies included in the Budget Law for mentioned years.
*[2]- Including Central Bank and ten other banks. Also including Post-Bank Co. as 1999.
*[3]- Including Defense Industries Organization, Port and Shipping Organization and other institutions included in the Budget Law for the mentioned years.
Source: Iran Statistical Yearbook 1381, Statistical Center of Iran (SCI), Autumn 2003

Table 2.1.2 Breakdown of Government Budget in 2000

(Unit: billion Rials)

Items	2000	(%)
1. Revenues	104,640.8	100
(1) Oil and gas	59,448.5	56.8
(2) Taxes	32,842.1	31.4
(3) Government monopolies and ownerships	439.9	0.4
(4) Sale of goods and services	6,615.3	6.3
(5) Miscellaneous	5,294.7	5.1
2. Expenditures	108,316.2	100
(1) Current expenditures	85,865.4	79.3
(2) Development expenditures	22,450.8	20.7

Note: Special revenues and expenditures are excluded in the above figure. Minor discrepancies in total are due to rounding the figures.
Source: Government budget law (referred and summarized from the Annual Review 2000, Central Bank of the Islamic Republic of Iran)

(3) Population

According to the 1996 Census, the total population of Iran was about 60.1 million in 1996. The estimated total population in 2003 is about 66.4 million (SCI, 2002). According to the population structure by age group, there is a remarkable feature that the age group under 30 years old represents about 68% of the total population.

(4) Five-year Development Plan

The national economy of Iran is planned based on a five-year development plan, and activities and required budgets in each fiscal year are considered based on the five-year development plan. The third five-year development plan for 2000 – 2004 is under implementation. Overhaul of state enterprises, reduction of government subsidies, control of inflation, and job creation were among the priorities of the third five-year plan. Each province develops its

provincial five-year development plan based on the national plan. From the first to third five-year development plans, each province has prepared a provincial five-year development plan based on the national five-year development plan. The top-down planning approach has caused difficulties for the provinces in trying to realize target figures in many of the economic aspects. Considering the past lessons, preparation of the fourth provincial five-year development plans are being led by each province, according to the MPO.

2.1.2 Regional Socio-Economy

(1) Administrative Division

There are in total 16 Shahrestans (townships) in Guilan province. The study area consists of 6 Shahrestans, 13 Bakhshes (counties), 10 Shahrs (cities), and 32 Dehestans (rural agglomerations), as shown in Table 2.1.3. There are 6 Bakshes in the Rasht Shahrestan, but only 3 Bakhshes are included in the study area. In other Shahrestans, all Bakhshes are located in the study area.

Table 2.1.3 Administrative Divisions in the Study Area

Ostan	Shahrestan	Bakhsh	Shahr / Dehestan
Province	Township (or Sub-province)	District (or County)	City or Town/ Rural district (or Rural agglomeration)
Guilan	Rasht	Khomam	Khomam, Chopark Khaneh, Chokam
		Markazi (central)	Rasht (Provincial capital), Peerbazar, Humeh, Pasikhan, Lakan
		Sanger	Sanger, Sanger, Saravan, Eslam Abad
	Anzali	Markazi (central)	Bandar Anzali, Lichar Kihassanrood, Chahar Farizeh
	Somehsara	Tolam	Tolam, Hendokhaleh, Tolam
		Markazi (central)	Somehsara, Ziabar, Tahergoorab, Kasma
		Mirzakoochak Jangali	Markien, Gorab zarmikh
	Shaft	Markazi (central)	Shaft, Molasara, Jirdeh
		Ahmadsargorab	Chobar, Ahmadsargorab
	Fuman	Markazi (central)	Fuman, Rood Peesh, Looleman, Gasht, Gurab Pas
		Sardar Jangal	Masuleh, Alian, Sardar Jangal
	Masal	Shanderman	Sheikh Neshin, Shaderman
		Markazi (central)	Masal, Humeh, Masal

Source: JICA Study Team

(2) Population

The total population of Guilan province and study area are estimated at around 2.5 million and 1.1 million in 2004 respectively based on the 1996/97 Census. Estimated population of the study area by Shahrestan (township) for 2004 (Table 2.1.4) shows that the population is dense in the urban area, especially in Rasht. 56% of the population in the watershed is concentrated in Rasht, followed by Somehsara (12%) and Anzali (11%). 46% of the total

provincial population lives in the study area. According to the MPO, the population increase in the urban cities is not only due to increase of population density, but also due to the merging of suburb municipalities into the urban cities. As mentioned in the third five-year development plan of Guilan Province, slowing of the population growth is greater than in other parts of the country due to successful results of the population program in the province[5].

Table 2.1.4 Estimated Population of Study Area by Township in 2004

Township	Total Population		
	Total	% of Total Study Area	% of Total Province
Anzali	132,297	11.4%	5.3%
Rasht	647,452	56.0%	25.8%
Shaft	75,512	6.5%	3.0%
Somehsara	138,665	12.0%	5.5%
Fuman	110,579	9.6%	4.4%
Masal	52,111	4.5%	2.1%
Total of Study Area	1,156,616	100.0%	46.1%
Province Total	2,508,605	-	100.0%

Source: Estimated by JICA Study Team based on MPO's estimation

(3) Regional Economy

The GRDP of Guilan province in 2000 was 16,361.8 billion Rials (SCI, 1381)[6]. The GRDP of Guilan province is ranked at 10 out of the 28 provinces in Iran. The vehicle and personal/household goods category is ranked first in terms of the value added in 2000, and agriculture/hunting/forestry and manufacturing follow as main sectors. The current economic development activities in Guilan province are based on the third five-year development plan of Guilan province for 2000–2004. Although strengthening of agricultural-related industry was emphasized in the first and second provincial five-year development plans, introduction and expansion of non-agricultural sectors such as new manufacturing and tourism industries were also prioritized in the third five-year plan. In terms of shift from an oil dependent national economy to a non-oil industrial economy in the future, Guilan province is an important province with rich natural resources and favorable climate along with other northern provinces.

[5] According to MPO Guilan, the population program commenced in 1996, 10-years earlier than in other provinces in Iran. In addition, the net immigrant rate between inflow and outflow of the population at provincial level is very low.

[6] According to MPO Guilan, only the data of GRDP in 2000 is available at the provincial level and no estimation for the past and subsequent years, including future estimation, is available.

(4) Agriculture

Guilan province is a major agricultural area for rice, silk, and tea, and the province is also one of the major domestic summer tourist destinations, especially along the coast of the Caspian Sea, including the Anzali Wetland area. Rice production is the main agricultural activity in the province. In the third five-year development plan of Guilan province, the following priorities for the agricultural sector are considered for the plan period.

- Increase of productivity per unit area for agricultural produce such as rice, wheat, vegetables, oats, peanuts, tobacco, forage, and summer crops.
- Increase of biological control against pests, herbal diseases and weeds.

Quantitative targets of the agricultural plan for the third five-year development plan are shown in the following table.

Table 2.1.5 Agricultural Targets during the Third Development Plan in Guilan Province

Target Item	2000	2004 Target
1. Fighting pests and herbal diseases	352,800 ha	388,080 ha
2. Increase in efficiency of agricultural automation	0.68 hp/ha	1.03 hp/ha
3. Increase of production of rice seed	700 ton	950 ton
4. Increase of agricultural produce by using breeding and other methods	982,000 ton	1,180,000 ton
5. Increase of wet-wheat produce	5,136 ton	7,000 ton
6. Increase in production of rain-fed farming	8,344 ton	12,000 ton

Source: Third Socio-Economic and Cultural Development Plan of the Guilan Province 2000–2004

(5) Industry

There are six industrial parks in the study area contributing to urban employment opportunities outside the agricultural sector. The number of factories for food and beverages is the largest in the province due to the abundance of water resources compared to other areas in Iran. Fur garment factories are the second largest industry.

The third five-year development plan of Guilan province[7] presented the following targets for the establishment of industrial parks. However, the strategies for specific industrial sectors to be promoted in Guilan province are not mentioned in the plan.

Table 2.1.6 Planned Industrial Parks during the Third Development Plan in Guilan Province

(Unit: ha)

Type of Industrial Park	Land Area
1. Development of urban industrial park to be started	203
2. Development of urban industrial park to be completed	527
3. Development of rural industrial park to be started and completed	390
Total	1,120

Source: Third Socio-Economic and Cultural Development Plan of the Guilan Province 2000–2004

[7] Third Socio-Economic and Cultural Development Plan of the Guilan Province 2000 – 2004

The expected investment amount for establishment of industrial parks during the third five-year development plan is shown below. In the table, there is no information on the investment from some sectors such as private companies.

Table 2.1.7 Investment Plan for Establishment of Industrial Parks

(Unit: million Rials)

Year	2000	2001	2002	2003	2004	Total
1. National and provincial budget	25,813	4,254	4,150	6,640	7,470	48,327
2. Public and non-governmental organization	0	0	16,748	19,269	21,826	57,843
3. Others	0	3,096	0	0	0	3,096
Total	25,813	7,350	20,898	25,909	29,296	109,266

Source: Third Socio-Economic and Cultural Development Plan of the Guilan Province 2000–2004

(6) Tourism

Guilan Province, especially the Bandar Anzali area along the Caspian coast, is one of the most popular domestic destinations for summer holidays in Iran. Around 184,000 domestic tourists came into Guilan province in 2002, mostly from nearby provinces, whilst around 3,100 foreign tourists visited the area. The main tourist attractions are located in Bandar Anzali, Rasht, Masuleh, and Fuman. Tourist accommodations in the study area are concentrated in Rasht and Anzali. Tourism targets according to the third five-year development plan for Guilan province are shown below.

- Increase of annual tourists from 124,000 people to 280,000 people
- Increase of capacity of tourist accommodation from 3,000 beds to 4,600 beds

The total cost for the above is estimated at around 40 billion Rials from government and 12 billion Rials from the private sector and NGOs.

(7) Major Development Plan

1) Long Term Development Plan for Guilan Province 1996 – 2021

A long-term development plan for Guilan province was published in 1997. The period of the long-term plan is 25 years from 1996 to 2021. The target period of the long-term plan is close to the target year of the Master Plan. The plan outlines the future direction of provincial development for various aspects such as the social, industrial, educational, and cultural sectors.

In the plan, it is forecast that the percentage of the workforce in the agricultural sector will gradually decrease in the rural area, while that of the service sector will increase. In the urban area, the proportion of the workforce in the industrial sector will increase, while that in the service sector will decrease, though the latter will still represent more than 50% of the total population.

2) Third Five-Year Plan of Guilan Province 2000 - 2004

The Third Socio-Economic and Cultural Development Plan of Guilan Province 2000 – 2004 (The third five-year plan) was prepared with a review of past implementation of the previous five-year plan. This is essentially a compilation of sectoral development plans developed by provincial offices of various ministries.

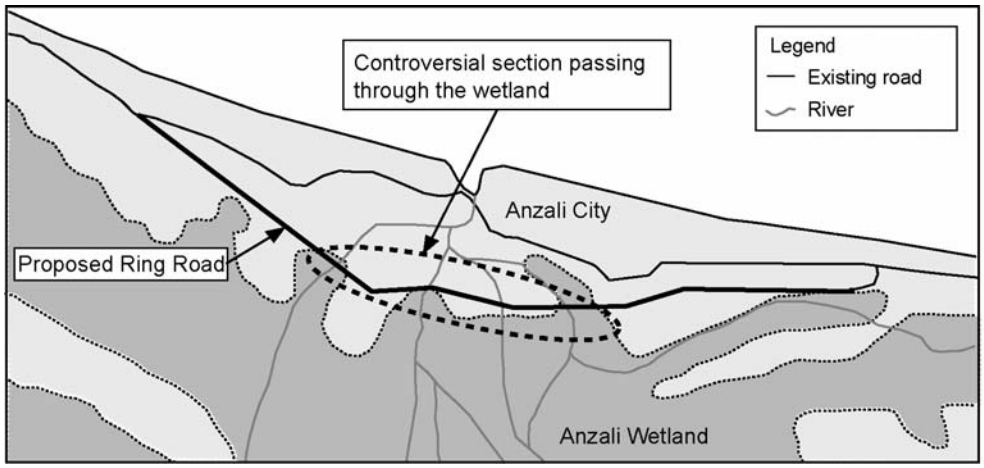
3) Urban Development Plan for Rasht City

An Integrated and Detailed Design for Rasht City was published by the Housing and Urban Development Organization of Guilan in 2000. The target period of the 10-year plan is from 2000 to 2010. In the plan, land use zones are designated based on the past and present details of various aspects of Rasht City. This plan is now expected to be revised in the near future.

4) Urban Development Plan for Bandar Anzali City

A detailed urban development plan for Bandar Anzali City was prepared by the Housing and Urban Development Organization of Guilan in 2001, based on a master plan prepared in 1989. In the detailed plan, land area by type of land use is designated for several zones of Bandar Anzali City. However, this plan seems to have become outdated already.

The southern boundary for the detailed plan is based on a ring road, which was planned to be newly constructed as shown in the following figure. The development plan for the ring road has been postponed since DOE raised an objection based on the potential serious environmental impact on the Anzali Wetland. This has not been solved so far, but according to the Housing and Urban Development Organization of Guilan, it is planned that the urban development master plan will be revised next year. Based on the detailed plan, a set of regulations for building construction standards and other kinds of development control in the plan area was published in 2001.



Source: Urban Development Plan of Anzali City, 2001.

Figure 2.1.1 Overlay of Environmental Zones and Anzali Development Plan

5) Urban Development Plan for Somehsara City

A master plan for Somehsara City was prepared in 1989. The target year of the plan was 1998. In the plan, construction rules by type of urban land use to be regulated are proposed. According to the plan, around 1 km^2 of land is needed for expansion, mainly for residential use.

(8) Household Income

The average annual net incomes of households in urban and rural areas in Guilan province were 28,641 and 19,316 thousand Rials/year/family, respectively, in 2002. Compared to the national average in 2002 at 33,105 and 19,003 thousand Rials/year/family in urban and rural areas respectively, the average annual net income in the urban area is lower while that in the rural area is slightly higher in Guilan Province since agriculture is dominant in the rural area.

Table 2.1.8 Average Annual Household Income in Guilan Province

(Unit: thousand Rials/year)

Year	Urban	Inc. Rate	Rural	Inc. Rate	Average	
1999/00	14,221	20.1%	11,376	21.1%	12,799	20.5%
2000/01	18,752	31.9%	12,047	5.9%	15,400	20.3%
2001/02	20,625	10.0%	16,007	32.9%	18,316	18.9%
2002/03	28,641	38.9%	19,316	20.7%	23,979	30.9%
2003/04*	35,857	25.2%	23,203	20.1%	29,530	23.2%
2004/05*[1]	44,892	25.2%	27,873	20.1%	36,383	23.2%

Note: The figures in the parenthesis are national average data.
*[1] - Estimated by JICA Study Team
Source: Guilan Statistical Yearbook 2003/04, Iran Statistical Yearbook 2002/03, Statistical Center of Iran

The proportions of the population below the poverty line as an absolute poverty index in urban and rural areas of Guilan province in 2001 are 10.4% and 13.7%, respectively, as shown below.

Table 2.1.9 Poverty Line of Urban and Rural Residents in Guilan Province

Year	Number of People below Poverty Line	% of the Population	Poverty Line of a Family (Rials/household/month)
Urban Area*[1]			
2000	123,003	10.6	1,219,914
2001	123,490	10.4	1,122,243
Rural Area*[2]			
2000	134,186	11.2	969,439
2001	165,270	13.7	972,921

Note: *[1]- Poverty line of a family with 4.5 members
*[2]- Poverty line of a family with 5 members
Source: Evaluation and Analysis of the Distribution of Income, Poverty and Economic Conditions of Families in Guilan Province (1995 – 2001), MPO Guilan, 2003

(9) Provincial Budget in Guilan Province

A summary of provincial revenue and expenditure of Guilan province is shown below. The total revenue/expenditure in 2002 was about 2,007 billion Rials (USD 232 million). The expenditure used for development projects in 2001 was about 508 billion Rials (USD 59 million).

Table 2.1.10 Summary of the Guilan Provincial Budget

(Unit: million Rials)

Item	1998	1999	2000	2001	2002
1. Revenue*[1]	758,121	853,109	1,081,499	1,437,840	2,006,661
(1) Provincial public revenue*[2]	199,890	283,850	380,358	436,530	479,056
(2) National public revenue*[3]	558,231	569,259	701,141	1,001,310	1,527,605
2. Expenditure*[1]	758,121	853,109	1,081,499	1,437,840	2,006,661
(1) Current expenditure*[4]	616,137	695,870	897,776	1,118,579	1,498,614
(2) Development expenditure*[5]	141,984	157,239	183,723	319,261	508,047

Note: *[1]- The figures in the table are the actual and realized figures.
*[2]- The provincial revenue consists of taxes, government monopoly and ownership, merchandise sale and services, insurance premiums and other revenue.
*[3]- The national public revenue is a budget allocated from the central governmental budget to province.
*[4]- The current expenditure is used to maintain the level of the government's socio-economic activities.
*[5]- The development expenditure is used for development projects.
Source: Guilan Statistical Yearbook 2003

The breakdown of the expenditures from provincial budgets in 2002 is shown below. These figures show budget allocation only from provincial budget since data on national budgets allocated to the organizations are not available. The total development expenditures used for projects activities related to this master plan were about 199 billion Rials (USD 23 million).

In addition to this, substantial budget is allocated from the central government directly to various local organizations for national projects.

Table 2.1.11 Expenditures from Provincial Budget by Executive Organization Related to M/P in 2002

(Unit: million Rials)

Organization	Current Expenditure*[1]	Development Expenditure*[2]	Total
1. MOJA	59,984	32,995	92,979
2. DOE	7,653	2,270	9,923
3. NRGO	17,117	16,505	33,622
4. GWWC	-	20,071	20,071
5. RWWC	3,475	93,368	96,843
6. Tourism Organization	-	882	882
7. Municipalities	-	32,873	32,873
Sub-total	88,229	198,964	287,193
8. Other organizations	1,410,384	309,083	1,719,467
Total	1,498,613	508,047	2,006,660

Note: *[1] - The current expenditure is used to maintain the level of government's socio-economic activities.
*[2] - The development expenditure is used for development projects.
Source: Guilan Statistical Yearbook 2003

2.2 Natural Conditions

2.2.1 Climate

The climate in the northern region of Iran (comprising Guilan, Mazanadaran and Golestan provinces and where the Anzali Wetland lies) is referred to as the Caspian or Hyrcanian climate. Its influence on this thin coastal strip of land along the Caspian Sea, coupled with the close proximity of the Alborz Mountain Range to the south, results in a climate that is unique from the arid climate that is typical in the rest of Iran.

Wind in this region comes from two main directions. The predominant wind is from the north-west as a result of continental air movements, namely the Atlantic and Mediterranean fronts, while the Alborz Mountain Range causes a local southerly wind which starts in the mountains and moves northwards down the mountains and towards the plains and coast. Rainfall is abundant in this region, varying greatly between 400-2,000 mm per year. The rainfall is the greatest in the west and gradually decreases towards the east. Evaporation increases from west to east with a regional average of 800 mm. The temperature is mild, ranging between -0.8°C - 37.3°C with an average of 17°C. Relative humidity varies depending on the location and season, having ranges between 24% - 100% and a regional average of 66%. The climate in the Anzali Wetland watershed is characterized by two distinct types. The lowland area to the north between El. -25m to 500m is characterized by warm temperatures, high moisture and abundant rainfall during the summer with a mild climate during the winter. The climate between El. 500m to 3,000m is noticeably different from the lowland, characterized by cooler temperatures, drier conditions and less rainfall.

2.2.2 Topography

The Anzali Wetland watershed is located in the northern part of the country and along the coast of the Caspian Sea approximately between N36 ° 55' and 37 ° 32' and E 48°45' to 49°42'. The watershed has a maximum elevation of about El. 3,105 m at the mountains, while the Caspian Sea coast has an elevation of about El. - 25 m. The watershed of the Anzali Wetland is bordered by the fan of the Sefidroud River to the east, the Alborz Mountain chain to the south and west, and the Caspian Sea to the north.

The Anzali Wetland watershed is geomorphologically divided into 2 types of landforms, a lower plain flat land in the north and a mountainous area in the south. The lower plain flat land, namely the Anzali Plain, is approximately 60 km wide and 20 to 40 km long, and the mountainous area is approximately 70 km wide and 25 km long. The plain, generally below El. 100 m, consists mainly of the Anzali Wetland and wide paddy area. The natural gradient is less than 1 % in the plain inclined toward the Anzali Wetland, and the gradient of the mountainous area increases to more than 25 % from the limit of the plain up to EL. 2,500 to 3,000 m. The relation between the topography and land uses in the Anzali Wetland watershed is shown in Figure 2.2.1.

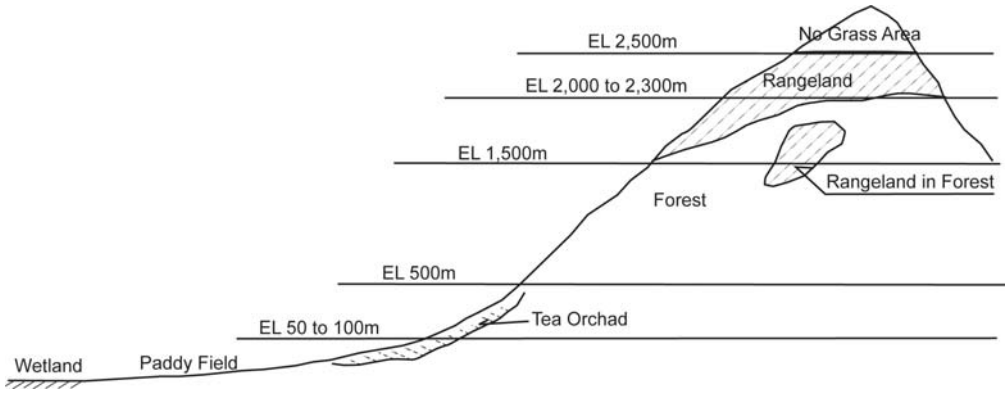


Figure 2.2.1 Typical Profile of the Anzali Watershed

2.2.3 Hydrology

(1) Precipitation and Meteorology

Coastal precipitation is highest in the watershed (Anzali Station: 1,828 mm/year, 21 years) and decreases southward (Rasht Station: 1,271 mm/year, 30 years, Ghalehroudkhan Station: 1,619 mm/year, 27 years). Precipitation is most abundant between October and January, while it is the least abundant between April and July as shown by the monthly precipitation records for selected stations in Table 2.2.1 below. This seasonal change is less apparent towards the mountains. The average annual rainfall for the watershed was 1,200 mm[8].

[8] Calculated in this Study based on rainfall data by MOE.

Table 2.2.1 Monthly Precipitation

(Unit: mm)

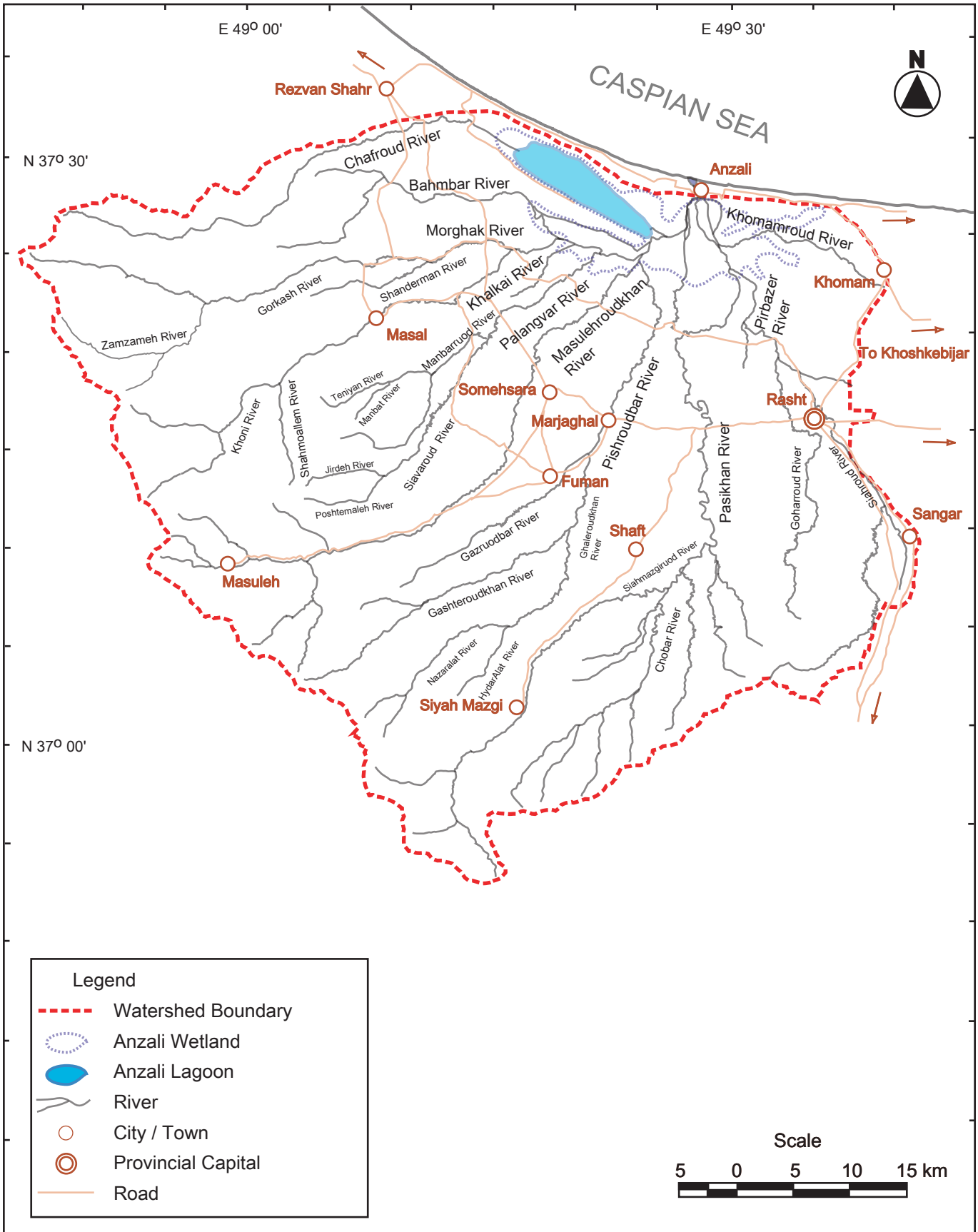
Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Anzali	182.8	133.1	111.2	50.7	50.9	43.0	46.0	130.2	197.1	338.8	299.7	244.6	1,828.1
Rasht	131.4	121.7	76.6	59.0	46.3	44.6	53.4	119.5	195.1	177.2	150.2	110.8	1,271.5
Ghalehro udkhan	105.9	117.5	95.5	106.1	105.4	108.8	119.5	238.7	220.0	170.5	143.7	101.5	1,618.9

Source: data by MOE

(2) Rivers in the Watershed and Discharge Characteristics

The Anzali Wetland watershed has a catchment area of 3,610 km^2. There are 10 major river systems entering the wetlands. The sub-catchment areas range between 100 and 700 km^2. These rivers have perennial flow with origins in the Alborz Mountains to the south. Starting from the eastern-most side of the wetland, the Khomamroud River flows westward and enters the wetland from the east. The Pirbazar and Pasikhan Rivers flow northward and merge just before entering the wetland. The Pishroudbar (also called Shakhraz), Masulehroudkhan, Palangvar, Khalkai, Morghak and Bahambar Rivers flow northeast and enter the wetland area. The Chafroud River alone enters the Anzali lagoon from the west. All rivers eventually drain into the Caspian Sea via the Anzali wetland. The location of the rivers is shown in Figure 2.2.2.

The water year for rivers of the Anzali watershed starts roughly in September (exact month is based on the Iranian calendar) until August of the following year. Examination of monthly discharge data (Table 2.2.2) reveals that there are two periods of high flow for the rivers in the Anzali Wetland watershed. The first occurs in October/November due primarily to runoff during the rainy season. The second occurs in February/March due to snowmelt from the mountain areas. The annual mean discharge into the wetlands is estimated to be 76.14 m^3/s, or 2,400 MCM. This value is similar to that estimated in MOJA, 1989, which was reported to be 75 m^3/s. Annual average discharge by river at MOE discharge stations is given in Table 2.2.3 below.



The Study on Integrated Management for Ecosystem Conservation of the Anzali Wetland in the Islamic Republic of Iran

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 2.2.2
Rivers in the Anzali Watershed

Table 2.2.2 Monthly Discharge into the Anzali Wetland

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average (m^3/s)
63.0	68.3	81.5	67.7	49.7	33.0	31.4	33.8	73.8	106.8	95.4	65.7	76.1 *

Note: There are minor rivers that are no longer monitored; inclusion of historical discharge data results in an overall average of $76.1 m^3/s$
Source: data by MOE

Table 2.2.3 Average Annual Discharge of Rivers in the Anzali Wetland Watershed

No.	River	Station	Number of Years	Average Annual Discharge (m^3/s)
1	Chafroud	Roudbarsara	27	2.13
2	Bahmbar	Aghamahaleh	16	1.91
3	Morghak	Kotemjan-M	16	3.55
4	Khalkai	Kotemjan -K	16	4.62
5	Palangvar	Kalsar	15	7.09
6	Masulehroudkhan	Chomesghal	16	5.84
7	Shakhazar	Laksar	15	10.45
8	Pasikhan	Nokhaleh	15	22.98
9	Siahroud	Behdan	12	9.45
10	Khomamroud	none	5.5	3.89
	Total		-	76.1

Source: data by MOE

During the rainy season, some of the rivers overtop their banks in the lower reaches just prior to entering the Anzali wetland. Based on flood damage records collected by MOJA Guilan (records from 1996 to 2003), low-lying areas (generally between El. -20 to -25m) surrounding the Pasikhan, Pishroudbar, Masulehroudkhan and Khalkaii rivers underwent flooding which caused damage to agricultural land, transmission lines and to a lesser extent buildings. When the dates in which the floods occurred were crosschecked with MOE discharge records, they indicated that the periods of high water level generally lasted for 2 to 4 days. Due to the fact that these events occur annually, the floods are not due to extreme storm events but due to the combination of insufficient flood conveyance capacity of the rivers and the lack of flood plain management.

Irrigation water shortages or drought in the watershed were not reported to be a problem by MOJA Guilan. This is because any irrigation water shortages as a result of natural runoff are supplemented by trans-basin inflow from two diversions on the Sefidroud river. The first is via the Tarik dam, which lies approximately 35 km downstream of the Sefidroud dam. Water is diverted by the dam through the Fuman tunnel (L=15km, capacity $8 m^3/s$) where it feeds the Fuman irrigation system[9], a gravity-fed system which covers most of the irrigated areas in the watershed through a series of gates, siphons and open channels. The second diversion is via

[9] The uptake is 150 – 300 million m^3/year depending on the hydrological condition of the year. The water is supplied during the rice cultivation season of May – August.

the Sangar dam, which lies a further 20km downstream of the Tarik dam. This diversion dam supplies irrigation and commercial water to the area surrounding Rasht.

(3) Historical Caspian Water Level

The water level of the Caspian Sea is measured at Anzali Port and the average annual water level between 1930 and 2000 is shown in Figure 2.2.3.

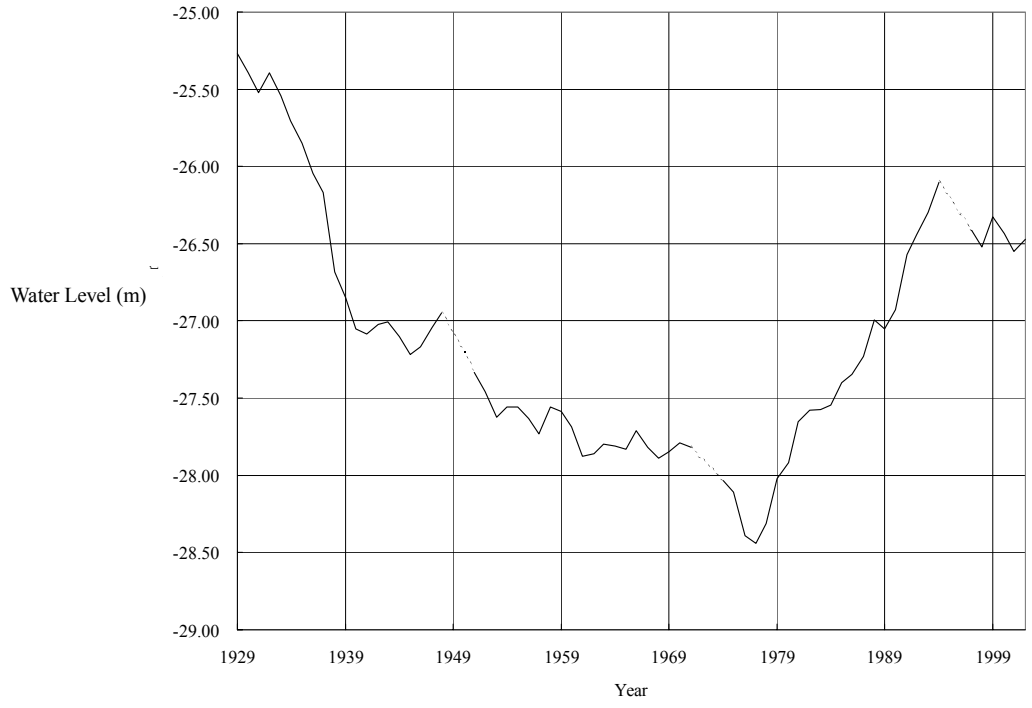


Figure 2.2.3 Average Annual Water Level of Caspian Sea

The maximum water level during this period was -25.27m in 1929 and the minimum was -28.44m in 1977. Since 1977, the water level had begun to rise, reaching a recent maximum of -26.10m in 1994. However, the water level has receded since then. The maximum and minimum levels from the records by decade are summarized in Table 2.2.4 below.

Table 2.2.4 Maximum and Minimum Caspian Water Levels

(Unit: El. m)

Years	1930s	1940s	1950s	1960s	1970s	1980s	1990s
Maximum	-25.39	-26.82	-26.57	-27.49	-27.79	-26.99	-26.10
Minimum	-26.85	-27.22	-27.73	-27.89	-28.44	-27.92	-26.93
Average over 10yrs	-25.91	-27.05 (-1.14)	-27.40 (-0.35)	-27.81 (-0.41)	-28.08 (-0.27)	-27.43 (+0.65)	-27.40 (+0.03)

Source: data provided by MOJA, based on Anzali Port Authority data

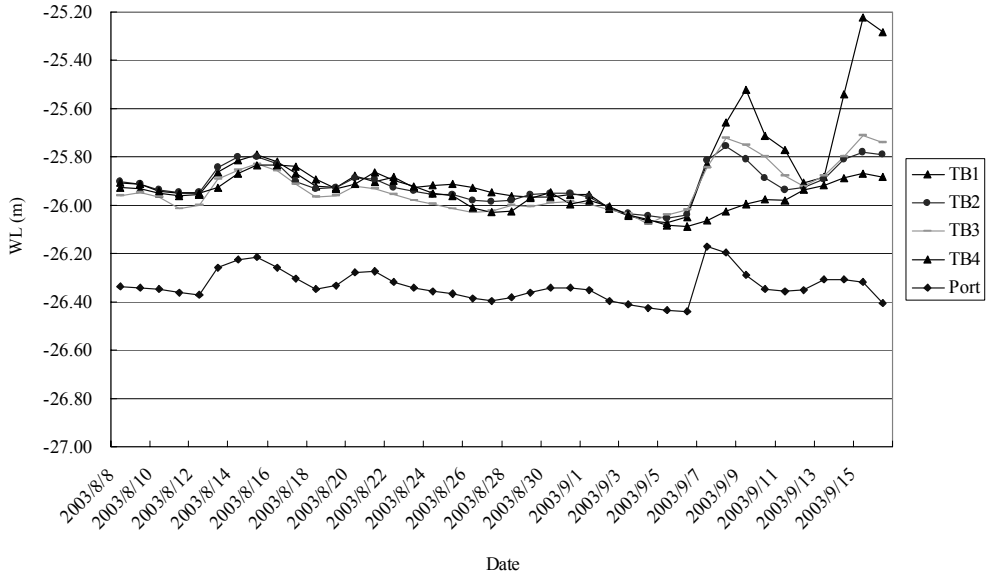
(4) Caspian Water Level and Relation to Wetland Water Level

Presently, the Anzali wetland water level is not measured. Historical records of water level measurement were also not available. Observations on the relationship between the Caspian Water Level to the wetland water level were made using data from (i) visual site observations, (ii) study of past aerial photos, and (iii) limited water level measurements taken during the Study.

Visual observations indicated that the wetland water level appears to be influenced by the level of the Caspian Sea and not by the rivers discharging into the wetland. During normal conditions, the surface water level from the Caspian Sea to the wetland is continuous without any break in water profile. During times of heavy flood, the narrow channel to the Anzali port at the Gazian Bridge acts as a surface water control point, resulting in an increase in water level of the wetland.

Comparison of two aerial photos taken in 1982 and 1994 also support this relationship. The difference in mean Caspian Sea water level at Anzali port was +1.48m (-27.58m in 1982 to -26.10m in 1994) while the aerial photos showed an increased open surface water area of the wetland during the same period. It is noted that this may not be true for the entire wetland. Some localized areas, such as the Siakeshim protected area, were influenced by other factors such as reed growth and depressed topography that limited the open surface water area.

The limited water level measurements in the wetland during the Study also supported this relationship. The water levels at four locations in the wetland, namely at the Pirbazar/Pasikhan river confluence, Hoseinbekandeh, Siakeshim outlet and Abkenar, were compared to the Anzali port water levels for the same period. The daily water levels for the 40 days measured are shown in Figure 2.2.4. As shown, there is a relatively good relationship between the wetland water level fluctuation and the Caspian Sea water level fluctuation. Exception is made during rainfall events as indicated by the sudden rise in water level at the Pirbazar/Pasikhan confluence, due to localized flooding.



Source: JICA Study Team

Figure 2.2.4 Measured Water Level in the Anzali Wetland

2.2.4 Geology and Soil

The geology of the Anzali Wetland watershed is classified into two geological zones, the Quaternary zone and the Pre-Tertiary zone. The plain area in the northern part of the watershed is widely covered by the Quaternary zone consisting of Plistocene to recent sediments, whereas the mountainous area in the southern part is underlain by a Pre-Tertiary zone consisting of Lower Paleozoic to Neogene Formations and some intrusive rocks.

The oldest bedrock in the watershed is the Pre-Paleozoic formation. It is exposed mainly along the upstream of the Shiamazgiroud River, the Gashutroudkhan River, the east bank of the Masulehroudkhan River and the Morghak River. Above the Pre-Paleozoic formation is a Paleozoic Formation. The Lower Paleozoic formation is of limited occurrence in the watershed. The Upper Paleozoic formation is widely developed along the upstream of the Khalkaii River, the Shahmoalem River and the Teniyan River. Triassic-Jurassic, lower and upper Cretaceous formations are scattered on the eastern and western parts of the mountainous area, upstream of Masulehroudhan River and the south part of the Rasht.

Along the foot of mountainous area, recent deluvial and fluvial deposits have developed in the form of a narrow bank from east to northwest.

In the plain area of the watershed, the underlying zone is older in the southern part than in the northern part and is subdivided into 1) the lower alluvial, flood-plain and deltaic deposits distributed only along some rivers, especially in the eastern part of the watershed; 2)

pleistocene marine deposits distributed widely in the plain; 3) beach deposits overlying pleistocene marine deposits in the form of a narrow zone; and 4) upper alluvium and flood plain deposits distributed along the rivers, recent deposits distributed along the Caspian Sea, and most recent deposits of the Sefidroud River's fan, distributed south-east of Rasht.

The soil types in the area are classified into two types, namely mountainous soils and plain soils. The mountainous soils are composed of lithic leptosols, dystric cambisols, humic cambisols, mollic leptosols, calcaric regosols, gleyic cambisols and calcaric cambisols while eutric cambisols, eutric gleysols and gleyic luvisols are distributed widely in the plain area. These soils, especially eutric cambisols and gleyic luvisols, are usually acidic soils with a deep and heavy structure. Around the wetland, mollic gleysols and calcaric regosols are dominant. Both soils have developed from gleyic coastal sand, but the former has a significant hydromorphic feature with fertile topsoil.

2.2.5 Vegetation

Approximately 42% of the study area is covered by a forest known as the Hyrcanian Forest, which constitutes a narrow band along the Caspian Sea. Depending on the elevation, the forests in the study area can be divided into three types of forest: lower elevation forests, intermediate forests and higher elevation forests.

The main tree species of the lower elevation forests in the Querco-Buxetum association are Alnus subcordata, Quercus castaneifolia, Gleditsia caspica, Carpinus betulus, Tilia begonifolia, Buxus sempervirens, Diospyrus lotus and Parotia persica. In this association, two important species Quercus castaneifolia and Buxus sempervirens are intensively cut. Thus, the other species are dominant. Anthropogenic impact and cattle grazing are the main problems in the regeneration process of this association.

The main tree species of the intermediate forests (El. 700-1,000 m) in the Querco-Carpinetum and Parrotio-Carpinetum associations are *Carpinus betulus, Quercus castaneifolia, Zelkowa carpinifolia, Acer insign, Alnus subcordata, Diospyrus lotus* and *Fraxinus coriarifolia*.

Higher elevation forests (El. 1,000-2,300 m) consist of *Fagetum hyrcanum* with two associations of *Rusco-Fagetum* on calcareous soil and Arctostaphylo-Fagetum on silt soil with acidic pH. In both associations Beech (*Fagus orientalis*) is the dominant tree species. Other important tree species are *Carpinus betulus, Alnus glutinosa, Fraxinus coriarifolia, Acer insign,* and on southern slopes *Quercus mucranthera, Carpinus betulus* as well as *Ulmus glabra* are present.

Above the forests (El. more than 2,300 m) the area is covered by grasslands (rangelands) and bare lands. The vegetation in the rangelands consists of several species such as Labiatae spp.,

Compositae spp. and Gramineae spp. However, the density is low because of grazing pressure.

2.2.6 Land Use

The Landsat Images of 1987, 1991 and 2002 were analyzed in the Study. The latest land use conditions of the watershed in 2002 are shown in Figure 2.2.5 and Table 2.2.5 below.

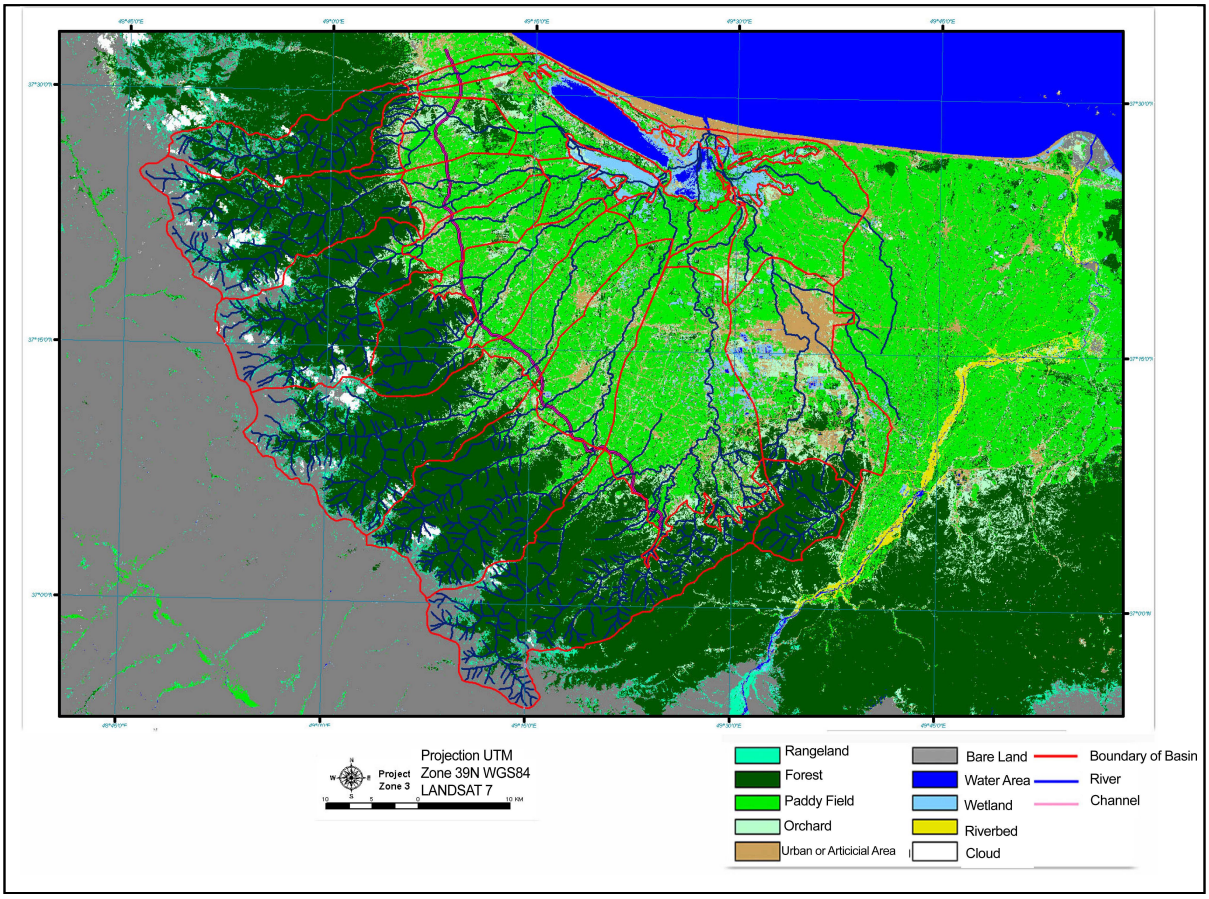


Figure 2.2.5 Land Use Map of Anzali Wetland Watershed (Satellite Image 2002 Landsat 7)

Table 2.2.5 Land Use Based on LANDSAT Images

Category	1987		1991		2002	
	km^2	%	km^2	%	km^2	%
Lagoon/Pond	57.5	1.6	57.7	1.6	45.5	1.3
Wetland	72.0	2.0	61.0	1.7	118.0	3.3
Orchard	460.2	12.8	467.7	13.0	311.2	8.6
Paddy/Farmland	1,073.6	29.8	1,062.6	29.5	962.5	26.7
Forest	1,331.6	36.9	1,401.3	38.9	1,513.5	42.0
Rangeland	73.6	2.0	211.2	5.9	107.7	3.0
Bare land	356.8	9.9	145.1	3.9	255.9	7.1
Urban area	181.4	5.0	200.2	5.6	292.4	8.0
Total	3,606.8	100.0	3,606.8	100.0	3,606.8	100.0

Among the land use categories, forest has the largest share at 42 %, followed by paddy field/farmland (26.7%) and orchard (8.6%) in that order. Changes in land uses in the study area are identified through the above analysis. Detailed results of the assessment are given in the Supporting Report Part 4 "Watershed Management", and some of findings are highlighted as follows.

1) Paddy/farmland has reduced by about 100 km^2 from 1991 to 2002. It is probably attributed to the increase of tree plantations (Poplar plantation) in the plain area.
2) Consequently, it is assumed that the expansion of forests from 1,401 km^2 to 1,513 km^2 between 1991 and 2002 were mainly owing to the conversion of farmland to tree plantation.
3) The areas of rangeland (mountain grasses) and bare land have fluctuated year by year. This is mainly because:
   - the bare land in 1987 might include opened forests since a clear cutting method was a main practice in 1980's; and
   - the weather conditions in the respective years might affect the growth of grasses in the rangeland.
4) The sum of rangeland and bare land has not changed since 1991 (356 km^2 in 1991 and 363 km^2 in 2002), though the areas of rangeland and bare land have fluctuated in the same period. It is, therefore, speculated that the total of rangeland and bare land would be approximately 360 km^2.

Since the data presented in Table 2.2.5 must be influenced by the climatic situation of the respective shooting times, the Study Team mainly used those data to grasp the land use changes in the entire study area for the last 15 years and identify the relationship between the land use change and wetland environment. The areas of rangelands and forests in the upper watershed were determined based on the NRGO's statistics data.

2.3 Ecological Conditions of the Anzali Wetland

A wetland generally consists of complex ecological interactions of (i) biological, (ii) physical and (iii) chemical components such as plants, animals, soils and water. These produce and maintain vital functions including wildlife habitats, nutrient cycle, water storage, flood mitigation, groundwater recharge and discharge, erosion control and water purification.

The Anzali Wetland is composed of diverse ecosystems including freshwater lagoons, extensive reed-beds, shallow impoundments and seasonally flooded meadows. Ecological components of the wetland interact in a complex manner, which provide important habitats for many fishes and wintering waterfowls (Scott, D.A. ed, 1995). Ecological conditions of the Anzali Wetland are described in this chapter with literature review and the field survey that was conducted between 2003 and 2004 with the assistance of the JICA Study Team.

2.3.1 Biological Components

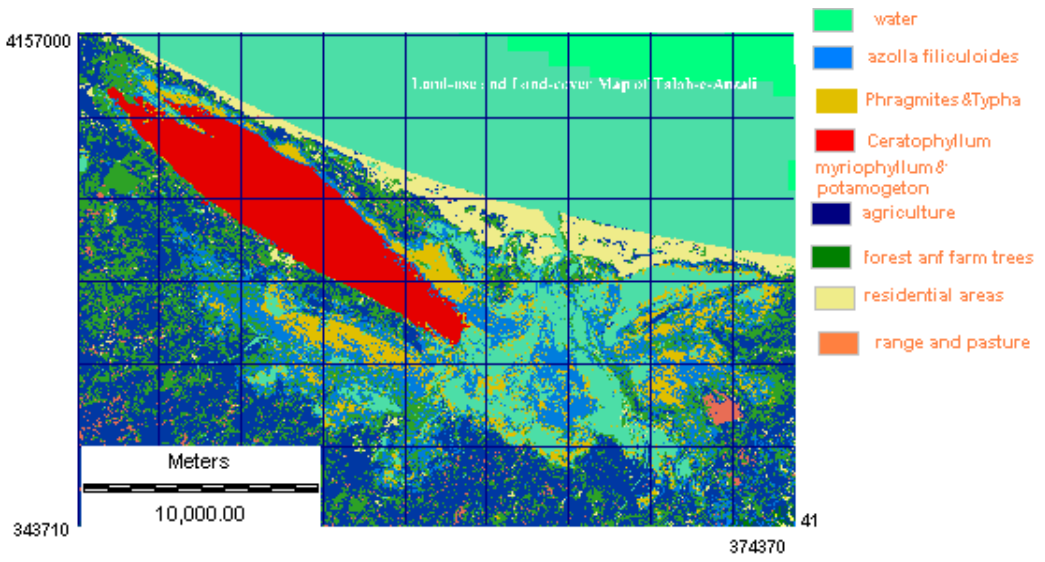
(1) Flora

1) Plant Community

The vegetative community of the Anzali Wetland is largely classified into the (i) *Phragmites* community, (ii) submerged plants community and (iii) *Azolla* community (Figure 2.3.1). The *Phragmites* community is largely distributed in the shallow area of the eastern wetland, and covers about a quarter of the wetlands excluding the lagoon. The submerged plants community covers almost the entire area of the lagoon. The *Azolla* community covers about a quarter of the Anzali Wetland except for the lagoon.

2) Species Composition

Dominant plant species in the wetland appear to be *Ceratophyllum demersum, Typha latifolia* and *Phragmites australis* according to the net weight measurement. It was recorded that there were 31 species of *macrophyte* in the wetland (Yecom consultant, 1989). A field survey was conducted on the *macrophyte* by the Caspian Sea Bony Fishes Research Center from August 2003 to October 2003 (Table 2.3.1). A total of 24 species was identified, but no threatened species was found in reference to the Red Data Book of Iran compiled by the Research Institute of Forest and Rangelands and the Red List of IUCN.



Source: Guilan University (1999)

Figure 2.3.1 Vegetation Map of the Anzali Wetland

Table 2.3.1 Number of Identified Plant Species Recorded in the Field Survey

(Unit: no.)

Life Form	Western	Siakeshim	Eastern
Emergent plants	5	3	6
Floating plants	5	3	5
Submerged plants	6	4	5
Others	3	0	1
Total	19	10	17

Source: Result of Field Survey made by Caspian Sea Bony Fishes Research Center (2004).

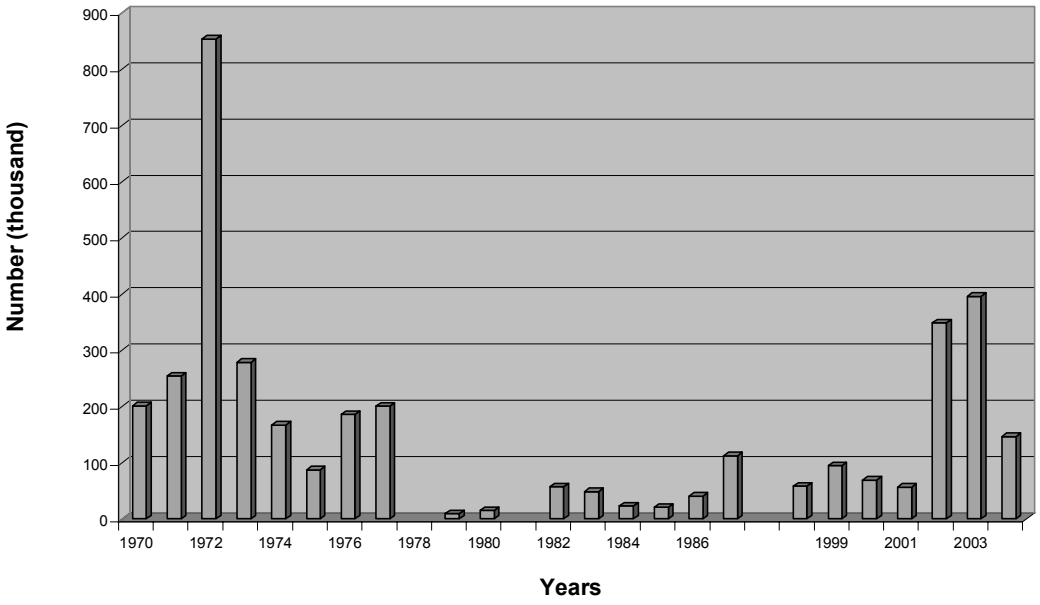
(2) Avifauna

1) Bird Population

The total of 140 migratory bird species are known in Iran, which includes 63 breeding species, 62 wintering species, 13 transit species and 7 rare species (Yecom consultant, 1989). The record also indicates that 77 species of migratory birds (53% of all birds) fly to the Anzali Wetland. The wetland supports a large breeding colony of *Chlidonias hybridus,* small colonies of six species of Ardeidae, and a large resident population of *Porphyrio porphyrio*. It also supports wintering concentrations of ducks, geese, swans and coots.

A bird population census has been carried out in the wetland since 1970, which shows large fluctuations in the number of migratory species (Figure 2.3.2). Human

pressure due to uncontrolled hunting may be the most serious factor affecting the population, but the reason for the increase in the migratory bird population during 2002 and 2003 is likely related to the Siberian weather which was relatively cold so that many birds have flown to Iran for survival. The reason for the decrease in 2004 is presumably because the Siberian weather was rather mild compared with the weather in 2002 and 2003.



Note: There is no data in 1978, 1981, between 1988 and 1997
Source: Yeakom Consultant (1989), DOE(2004)

Figure 2.3.2 Number of Migratory Birds during the Last 30 Years

In addition to the above census, a bird survey was conducted in the seven representative bird habitats of the wetland from August 2003 to March 2004 by the DOE Guilan (Figure 2.3.3). The result is shown in Table 2.3.2 with the record of 89 species of migratory birds and 146,000 individual birds. Wintering waterfowl of 27 species and 110,000 individuals were identified. The population of *Anas crecca* (Common Teal) was 40% of all the birds recorded, which showed the highest population of migratory birds followed by *Fulica atra* (Common Coot) of 30% and *Anas querquedula* (Garganey) of 18%. These three species account for 88% of all the wintering waterfowl.

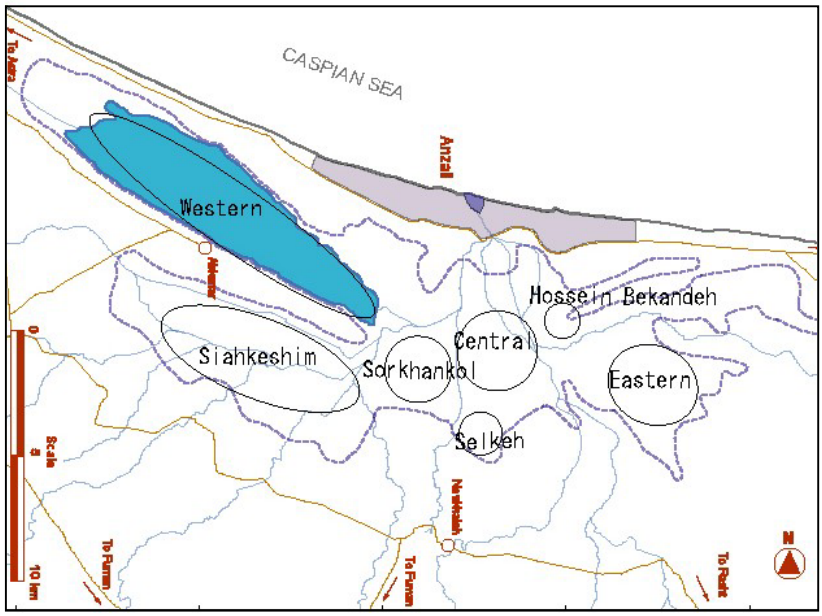


Figure 2.3.3 Field Survey Areas

Table 2.3.2 Number of Identified Bird Species and Individuals Recorded in the Field Survey

(Unit: no.)

Indicator	1	2	3	4	5	6	7
species/individuals	62/9,056	42/15,406	50/9,324	70/18,888	42/32,525	38/8,748	63/49,607

Note: 1: Eastern, 2: Hosseinbekandeh, 3: Central, 4: Selkeh, 5: Sorkhankol, 6: Western, 7: Siakeshim
Source: Result of Field Survey made by DOE Guilan (2004).

2) Feeding Behavior of Birds in Relation to the Ecological Feature of the Wetland

Birds have different feeding methods that are adapted to specific habitat types. Distribution of birds with the classification of feeding methods is likely to indicate a level of diversity in the ecological feature of the wetland. Birds with different feeding methods are classified in Table 2.3.3, and the bird population of each group is shown in Table 2.3.4.

Table 2.3.3 Feeding Methods of Waterfowl

Feeding methods	Feature	Main species
Surface feeding 1 -dabbling and sieving-	Sieving tiny food particles in surface water	*Anas clypeata*, *Anas crecca*, *Anas platyrhynchos*
Surface feeding 2 -head underwater-	Upending to reach aquatic plants and other food items	*Anas penelope*, *Cygnus cygnus*
Diving underwater	Diving to eat fish, small aquatic animals and plants	*Aythya ferina*, *Anthya marina*, *Fulica atra*
Feeding on land	Feeding plants on land	Geese

Table 2.3.4 Number of Identified Waterfowl Species and Individuals Recorded in the Field Survey

Feeding methods	1	2	3	4	5	6	7
Surface feeding 1 -dabbling and sieving-	5/55,288	5/25,558	4/16,142	6/17,615	5/31,981	4/9,351	5/76,997
Surface feeding 2 -head underwater-	4/1,369	2/644	2/1,137	5/1,792	5/2,019	4/336	5/2,382
Diving underwater	7/24,379	9/29,510	4/11,172	12/13,320	8/19,013	7/8,823	8/24,605
Feeding on land	1/125	1/125	0/0	2/268	1/14	1/7	1/35
Total	17/81,161	18/55,837	10/28,451	25/32,995	19/53,027	16/18,517	19/104,019

Note: 1: Eastern, 2: Hosseinbekandeh, 3: Central, 4: Selkeh, 5: Sorkhankol, 6: Western, 7: Siakeshim
Number of species and individuals (in January) are shown as "species/individuals"
Source: Result of Field Survey made by Caspian Sea Bony Fishes Research Center (2004).

The birds classified into "Surface feeding 1" mainly feed on plants that grow near the water surface. The Anzali Wetland is surrounded by the paddy fields, which are often used by these birds as feeding sites. The largest number of birds in this group was recorded in Selkeh so that this area with its surrounding paddy fields may indicate an appropriate combination of resting and feeding sites for this group of birds.

A high percentage of "Surface feeding 2" species was recorded in Sorkhankol. This area holds a larger area of surface water compared with that of Selkeh so that the area is likely more suitable to the birds in this group with respect to the availability of aquatic foods.

The birds grouped in "Diving underwater" are abundant in Selkeh, Sorkhankol and Hosseinbekandeh while the birds in "Surface feeding 1" are distributed all over the wetland except for the western part. It suggests that these areas are deep enough to provide a suitable volume of submerged plants and small fishes.

The birds in the group of "Feeding on land" are mainly geese that are distributed in Selkeh, Hosseinbekandeh and in the eastern part of the wetland. These areas are surrounded with paddy fields so that these areas may also be a suitable combination of feeding and resting sites for geese.

3) Threatened Species

Threatened[10] species of birds found in the field survey were listed in the following table. There was a significant decrease in the population of *Anthya nyroca* (Ferruginous Pochard) in the last two decades. Many species of raptors are

[10] Many common species are categorized as "protected" in the Red Data Book in Iran, and only the "endangered" species in the Red Data Book were selected as threatened species.

threatened, of which there is only one known breeding pair of *Haliaeetus albicilla* (White Tailed Eagle) around the Anzali Wetland (DOE pers. com.).

Table 2.3.5 List of Threatened Bird Species Recorded in the Field Survey

No.	Scientific Name	A	B	Location						
				1	2	3	4	5	6	7
1	*Phalacrocorax pygmaeus*	EN	LR	○	○	○	○	○	○	○
2	*Aythya nyroca*	EN	LR		○	○	○	○		○
3	*Falco naumanni*	EN	VU	○		○	○			
4	*Falco pelegrinoside*	EN	-				○			○
5	*Falco peregrinus*	EN	-	○		○				
6	*Aquila clanga*	-	VU	○	○	○	○	○	○	○
7	*Haliaeetus albicilla*	EN	LR				○			○
8	*Pelecanus crispus*	EN	LR				○			
Total Number of Species		7	6	4	3	5	7	3	2	5

Note 1: 1: Eastern, 2: Hosseinbekandeh, 3: Central, 4: Selkeh, 5: Sorkhankol, 6: Western, 7: Siakeshim
Note 2: A: Red Data Book of Iran (1999) DOE
EN: Endangered
B: 2003 IUCN Red List of Threatened Species (2003) IUCN
VU: Vulnerable, NT: Near Threatened, LR: Lower Risk
Source: Result of Field Survey made by DOE (2004).

Anthya nyroca

Haliaeetus albicilla

Figure 2.3.4 Pictures of *Anthya nyroca* and *Halaeetus albicilla*

(3) Ichthyofauna

1) Fish Population

The annual fish catch was between 5,400 and 5,700 tons until the 1940s. The fish harvest declined to about 75 tons (1980s) due to a decrease in the water level of the Caspian Sea since the 1950s (Nezami, S. 1993). It is currently known that there are 49 fish species in the Anzali Wetland, of which 39 species are native and 8 species are non-native (Abbasi *et al*., 1999).

A fish survey was conducted from September 2003 to January 2004 by Caspian Sea Bony Fishes Research Center in association with the JICA Study Team. A total of 34 species and 12,488 individuals including both native and exotic species of fish were identified in the survey (Table 2.3.6).

Table 2.3.6 Number of Identified Fish Species and Individuals Recorded in the Field Survey

Taxon / Survey Area	Western	Siakeshim	Central	Eastern
Clupeidae	1/1	0/0	0/0	4/6
Cyprinidae	14/539	14/4,680	11/493	17/4,672
Gobiidae	0/0	1/3	1/3	3/10
Others	4/52	4/419	5/201	4/611
Total	19/592	19/5,142	17/697	28/6,057

Note: Number of species and individuals are shown as "species/individuals"
Source: Result of Field Survey made by Caspian Sea Bony Fishes Research Center (2004).

Endemic species to Caucasus - Black Sea area, *Alburnus filippii* (Kura bleak), *Barbus capito* (Bulatmai barbell) and *Rutilus rutilus caspicus* (Roach), were found in the survey. Exotic species identified in the survey included *Carassius auratus gibelio* (Prussian carp), *Ctenopharyngodon idella* (Grass carp) and *Gambusia holbrooki* (Eastern mosquito fish).

The survey indicates that fish abundance is higher in Siakeshim and the eastern part of the wetland compared with the western and the central parts. The high density of *Phragmites* in the shallow parts of Siakeshim and the eastern part of the wetland make primary habitats for smaller fish. In contrast, the western and the central parts have a large amount of open area and deep-water areas (2 to 3 m depth). These different features of the wetland may be affecting the distribution of different species and size of fish.

2) Threatened Species

A total of 16 threatened species[11] was found in the survey, which is listed in Table 2.3.7. Many of these species were found in the eastern part of the wetland, but only one individual *Clupeonella cultriventris* (Black sea sprat), *Abramis brama orientalis* (Carp bream), *Rutilus rutilus caspicus*, *Perca fluviatillis* (European perch) and *Neogobius melanostomus* (Round goby) were found in the survey.

[11] Many common species are categorized as Least Concerned and Data Deficient in the Red Data Book in Iran, and those species were excluded from the threatened species.

Abramis brama orientalis

Perca flubiatilis

Figure 2.3.5 Pictures of *Abramis brama orientalis* and *Perca flubiatilis*

Table 2.3.7 List of Threatened Fish Species Recorded in the Field Survey

No.	Scientific Name	1	2	Location
1	Clupeonella cultriventris	-	DD	Eastern
2	Abramis brama orientalis	VU	-	Eastern
3	Barbus capito	CD	-	Central, Siakeshim
4	Carassius auratus gibelio	NT	-	All parts
5	Chalcalbunus chalcoides	-	DD	All parts
6	Cyprinus carpio	-	DD	All parts
7	Leucaspius delineatus	CD	-	All parts
8	Rutilus frisii kutum	-	DD	Eastern, Siakeshim
9	Rutilus rutilus caspicus	NT	-	Eastern
10	Scardinius erythrophthalmus	CD	-	All parts
11	Vimba vimba persa	NT	-	Eastern, Western
12	Esox lucius	CD	-	All parts
13	Perca fluviatillis	VU	-	Central
14	Neogobius kessleri	-	DD	Eastern
15	Neogobius melanostomus	-	DD	Eastern
16	Proterorhinus marmoratus	VU	-	Eastern, Central, Siakeshim
	Total Number of Species	10	6	-

Source: Results of Field Survey made by Caspian Sea Bony Fishes Research Center (2004).
1: Red Data List of Fish in Iran, (2002)
VU: Vulnerable, CD: Conservation, NT: Near Threatened
2: 2003 IUCN Red List of Threatened Species (2003) IUCN
DD: Data Deficient

(4) Other Fauna

1) Mammals

It has been reported that 31 species of mammals in 14 families inhabit the Anzali watershed (Guilan regional watershed company, 1999). There is a population of *Lutra lutra* (Eurasian Otter) in the wetland (DOE pers. com.). *Lutra lutra* is listed as "Vulnerable[12]" in the IUCN Red List, but the present ecological status of the species is largely unknown.

[12] Species in this category are not critically endangered / endangered but are facing a high risk of extinction in the wild in the medium-term future.

2) Reptiles

Four species of snakes (*Natrix natrix*, *Oligodon taeniolatus*, *Coluber juglaris* and *C. najadum*) as well as five species of lizard occur in the Anzali Wetland (Soctt, D.A. (ed), 1995).

3) Amphibians

Frogs from four families represented by 13 species are distributed around the wetland, of which two species (*Batrachuperus persicus*, *Rana macrocnemis* or *Rana pseudodalmatina*) are protected (Riazi, 1996; Baloch M. and Hajgholi K. 2000).

2.3.2 Physical Components

(1) Land Use Around the Wetland

General land use patterns around the Anzali Wetland are shown in Figure 2.3.1. The wetland is surrounded by agricultural areas that are primarily paddy fields. There are also tree plantations with *Populus* spp. and alders. There are small areas of pasture lands (less than 10 ha) around the wetland, but one of the pasture lands at the east side of the wetland is large (about 100 ha). Large industrial areas do not exist around the Wetland, and Bandar Anzali City is located between the shoreline of the Caspian Sea and the Anzali Wetland.

(2) Main Features of Wildlife Habitats

Key elements of the major wildlife habitats in the Anzali wetland include reed beds, aquatic beds, lagoon, rivers and others. It is possible to define eight habitat distinct areas, the eastern part, Hosseinbekandeh, central, Selkeh, Sorkhankol, western part, Siakeshim and rivers. These habitats and the features of the major habitats are summarized in the following table (see Figure 2.3.3 for the locations of the habitats).

Table 2.3.8 Main Features of the Major Habitats in the Anzali Wetland (1/2)

Name	Main Features
Eastern part 	Status: Not in the legally protected areas Structure: This area is shallow and mainly covered by *Phragmites*, but small open water spaces are dispersed throughout. Condition: Since the area is far from human activities, artificial disturbance is small. Water quality is hyper-eutrophic. Function: Many organisms are able to inhabit relatively free from the direct artificial disturbance. Issue: Many threatened species require a low level of COD. Furthermore if *Phragmites* continues to spread, the habitat for waterfowl will be lost.
Hosseinbekandeh 	Status: Proposed No-hunting area Structure: This area is deeper than the eastern part and the density of *Phragmites* is lower. Condition: It is one of the main hunting areas. It is possible to gain access by speedboat. Water quality is hyper-eutrophic. Function: The number of species is not very high, but the number of waterfowl is at the same level as Siahkeshim. The density of birds is high and it is important as a wintering area. Issue: Illegal hunting
Central 	Status: Not in the legally protected areas Structure: There are open water areas. It is deeper than the eastern part. Condition: This area is located between Pirbazar River and Anzali Port. Many boats pass through this part and polluted water also flows into the central part. Function: The biodiversity is relatively low. However, some local fish such as *Abramis brama* spawn in this area. Issue: Spawning ground should be protected from boat use and water pollution.
Selkeh 	Status: Wildlife Refuge Structure: This area has a balanced condition. The density of *Phragmites* is suitable, and there is large amount of open water. Condition: This area is well protected by DOE. Function: Biodiversity is high. There are plenty of bird species and density is also high. Many of the threatened species inhabit the area. Issue: The problem which was observed by the Study Team is overgrowth of *Azolla*.
Sorkhankol 	Status: Wildlife Refuge Structure: There are large open areas. Water is deep (about 2 m). Condition: This area was a fishing area, and fishermen enter the area in spite of attempts at control. Function: The number of waterfowl species is large. This area is also important as the spawning ground for some fish such as *Abramis brama* and *Rutilus frisii kutum*. Issues: Illegal hunting and fishing.

Table 2.3.8 Main Features of the Major Habitats in the Anzali Wetland (2/2)

Name	Main Features
Western 	Status: Not in the legally protected areas Structure: This area is a lagoon and the western end is marsh in which the density of *Phragmites* is suitable. The lagoon is a large open water area. Condition: Fishing and hunting are active. Many boats enter the area. Regarding the western end, artificial disturbance is low. Water quality is relatively high. Function: There are many adult fish inhabiting the lagoon. The marsh in the western end has high potential for waterfowl.
Siahkeshim 	Status: Protected area Structure: *Phragmites* overgrow the entire area. Water depth is low. Condition: Water quality is relatively high. Function: This area includes many species of birds. Compared to Selkeh, the density is low. However this area is still very important because *Haliaeetus albicilla* inhabits the area, and some fish move to the river through Siahkeshim for spawning. Issue: This area is in danger of encroachment.
Rivers 	Status: Not in the legally protected areas Structure: Downstream of Rivers such as Kolesar, Massuleh and Siahdarbishan Condition: Fishing is active. Small dams for agriculture have been constructed. Water quality is getting worse. Function: Rivers are important habitats as the spawning ground of some species such as *Rutilus frisii kutum* and *Vimba vimba persa*. Issue: There is little water in those rivers for irrigation in summer.

(3) Sedimentation

It is known that the Anzali Wetland was much deeper in the past and recently became shallower. However the annual amount of sediment is not large. It was estimated that approximately 400,000 tons/year of sediment is produced in the upland where 110,000 tons/year (30%) of sediment deposit in the wetland but the rest (70%) or 290,000 tons/year of sediment flows out to the Caspian Sea. The sedimentation rate was found higher in the Anzali port, major junctions of channels and in the Siakeshim area. In the parts where water flow is slow and vegetation overgrows, rapid succession to dry land is progressing.

(4) Fluctuation in the Water Level of the Caspian Sea

In the 1960s, two channels were constructed in the north eastern section of the wetland, and roughly 5,000 ha were reclaimed for agriculture. In the 1970s to 1980s when the level of the Caspian Sea was low, the emergent part of the Anzali Wetland, including the western part of

the Siakeshim, was converted to agricultural land, and DOE had to re-delineate the boundary of the Siakeshim Wildlife Refuge, and downgrade it to a protected area. As the water level started to increase in the late 1980s to 1990s, some of the illegal agricultural lands were flooded and abandoned.

Fluctuation of the Caspian Sea affects the wetland ecosystem as well as the land use pattern around the wetland. If the Caspian Sea water level rises, fish habitat will expand, though fish habitat will be reduce along with the Caspian Sea water level lowering. Plant composition will also be affected. Emergent plants will increase while submerged and floating plants will decrease with the Caspian sea water level down. It also changes water quality including salinity of the wetland, which affects distribution of fish (Holčil and Oláh, 1992[13]). The impact of Caspian Sea water level to birds is not clear.

2.3.3 Chemical Components

(1) Water Quality

A water quality survey was conducted in the wetland three times between September and December in 2003. The results of the surveys are shown in Table 2.3.9. High values of COD, T-N and T-P were recorded throughout the wetland where most of the wetland except for Siakeshim were classified as highly polluted water (COD >30 mg/L) based on the US EPA eutrophication criteria for COD. As for the T-P concentrations, the wetland is also classified as eutrophic according to the three international eutrophication criteria (Vollenweider : 0.03 - 0.1mg/L、US EPA: >0.02mg/L、OECD: 0.035 - 0.1mg/L).

Table 2.3.9 Water Quality of the Anzali Wetland

(Unit: mg/L)

Area	Eastern	Central	Estuary	Siakeshim	Lagoon	Average
COD	35	39	43	27	44	39
DO	7.8	7.1	7.3	7.6	8.3	7.7
T-P	0.32	0.20	0.30	0.17	0.09	0.21
T-N	2.0	2.2	2.7	2.0	2.5	2.4
Chl. *A*	3	9	28	16	31	21

Source: Result of Water Quality Survey made by DOE (2004).

Eutrophication causes significant impacts on the wetland ecosystem. The high levels of incoming nutrients, such as phosphorus and nitrogen, seem to be causing excessive growth of macrophytes, such as *Phragmites*, *Azolla*, various submerged plants such as *Ceratophyllum demersum* and phytoplankton in the wetland, particularly in the eastern part. Dead plants

[13] J. Holčil and J. Oláh, Fish, Fisheries and Water Quality in Anzali Lagoon and Its Watershed, FAO, UNDP/IRA/88/001, 1992.

rapidly accumulate in the bottom sediment making the wetland shallower. Once the water depth becomes shallower than about 0.5 m, macrophytes, such as *Phragmites* flourish. Deposition of detritus is part of the natural processes, but it consumes dissolved oxygen in water and accelerates succession of the wetland to a dry land.

(2) Source of Pollution

Inflow of polluted wastewater from domestic, industrial and non-point sources is the main cause of water pollution (also see Section 2.6). The direct consequence of the inflow of the polluted water is organic materials. This problem is remarkable in the Pirbazar River downstream of Rasht and in a channel near the Anzali Port since untreated domestic wastewater flows into these waterways. In these water bodies, the level of COD is as high as 100 mg/L, which is similar to the level of raw sewage, and the DO level is low due to decomposition of organic materials in the water. In such waters, fish species that are tolerant to pollution such as carp become dominant. Solid waste is another pollutant, and a large amount of garbage reaches the Anzali Wetland. The amount of the solid waste dumped to the rivers is roughly estimated to be 66 tons/day[14]. Such garbage may contain hazardous chemicals and is also detrimental to the landscape of the Anzali Wetland. The toxic substances contained in waste can directly cause negative impacts on the flora and fauna of the Wetland.

2.3.4 Ecological Issues and Concerns

Biological, physical and chemical components of the Anzali Wetland are linked and interact with each other in a complex manner. Ecological condition of the wetland is maintained based on the delicate balance of those components. The Anzali Wetland represents unique and significant ecological as well as economical values. However, there are some factors threatening the future sustainability of this nationally significant wetland. These values and threatening factors are discussed in this section as a basis of the needs of the wetland conservation.

(1) Wetland Values

1) Ecological Values

In addition to the wetland functions, there is a significant ecological feature that is unique to the Anzali Wetland. The Wetland is located in the middle of two flyways, the Africa-Eurasian flyways and Asia-Pacific flyways, crossing each other (Figure

[14] Because the solid waste that reaches the wetland is thrown illegally and indiscriminately, it is difficult to estimate the solid waste load to the wetland, and this estimate should be taken as a first cut estimate.

2.3.6). Other wetlands in the southern coast of the Caspian Sea located in the flyway represent a similar ecological importance, but the Anzali Wetland receives a higher number of migratory birds flying to the Middle East (Table 2.3.10). This remarkable feature of the Wetland indicates nationally as well as internationally significant ecological value.

Table 2.3.10 Importance of Ramsar Sites along the Southern Caspian Sea

Name	Location	Area	Importance
Anzali Wetland	Guilan province, close to the Anzali city	19,200 ha	Provides habitats to several threatened species. Supports over 1% of the regional Middle East wintering populations of several species of wildfowl. Important spawning and nursery grounds for several fish.
Kiashahr Lagoon	Guilan province, 15km northwest of Rasht	500 ha	Provides important habitat for Phlacrocorax pygmaeus. Over 1% of the regional wintering population of three species. Important breeding and nursery ground for various fish.
Amrkelayeh Lake	Guilan province, 60km east of Rasht	1,230 ha	Provides important habitat for Phlacrocorax pygmaeus. Over 1% of the regional Middle East populations of three species.
Fereydoon Kenar	Mazanderan province, 13km southeast of Babolsar.	5,427 ha	Provides wintering habitat to some species of threatened birds. Especially support the entire western population of Grus leucogeranus. Over 1% of the regional populations of some species
Miankaleh Peninsula	Mazandaran province, 2km west of the Torkeman city	100,000 ha	Provides wintering habitat to four species of threatened birds. Supports over 1% of the regional Middle East breeding population of wildfowl. Important spawning and nursery ground for various fish.
Gomishan Lagoon	Border with Turkmenistan,4km north of the small town of Gomishan	17,700 ha	Supports vulnerable bird species. Supports over 1% of the populations of the wildfowl observed within the site.

Source: Ramsar Information Sheet

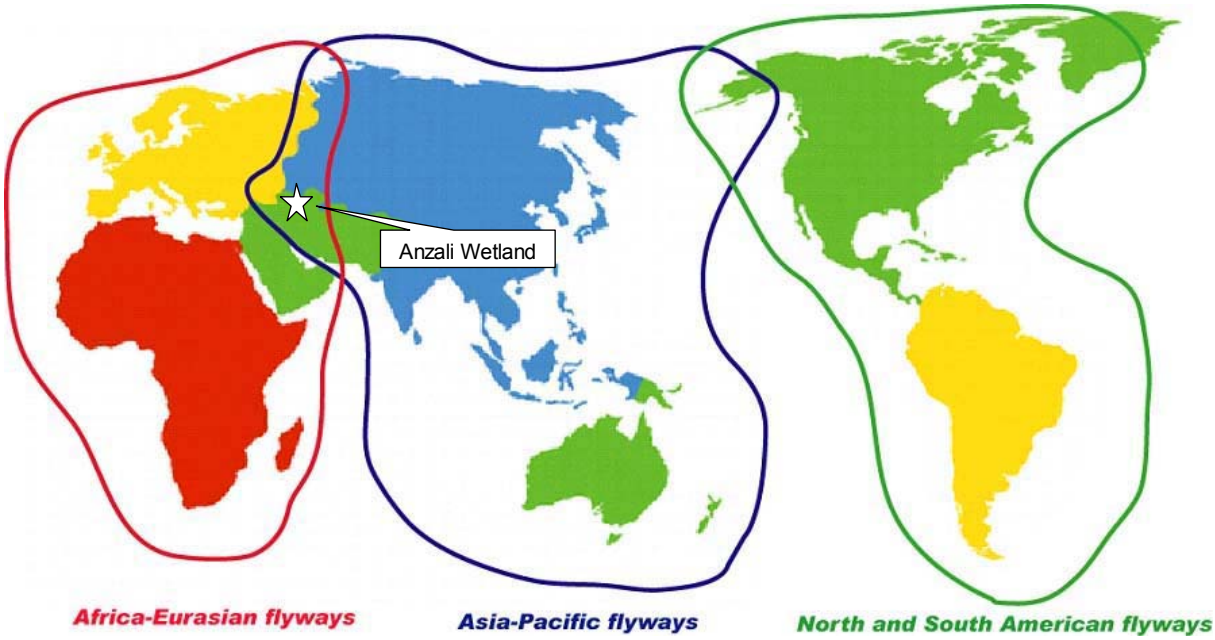


Figure 2.3.6 Location of the Anzali Wetland in Flyways

2) Economic Values

Major economic values of the Anzali Wetland are associated with fishing, hunting and other recreational related activities. A significant number of the local people are involved particularly in fishing and hunting, which is important to the local economy. The annual fish catch is about 400 tons and potential market value is about 10 billion Rials per year (Table 2.3.11). Approximately 100,000 birds/season are harvested, and the potential market value is approximately 3 billion Rials per year (Table 2.3.12)

Table 2.3.11 Market Value of the Fish of the Wetland

Items	Catch Weight (ton)	Price (Rials/kg)	Total Value (1,000 Rials)
Prussian carp	192	25,000	4,800,000
Pike	73	40,000	2,920,000
Common carp	38	10,000	380,000
Catfish	25	30,000	750,000
Total	328	-	8,850,000

Source: Caspian Sea Bony Fishes Research Center, 2004. Anzali Fish Market (2004).

Table 2.3.12 Market Value of the Waterfowl of the Wetland

Game Type	Harvested	Price (Rials/bird)	Total Value (1,000 Rials)
Waterfowl	100,000	30,000	3,000,000

Source: DOE (2004)

In summer, the Wetland provides recreational activities for many visitors, including motor-boating and kayaking. The number of visitor to the Wetland is estimated at about 40,000 per year. Most of the visitors use boats, and on average five visitors use one boat which costs 250,000 – 500,000 Rials, visitors pay about 3 billion Rials per year in total. Tourism may be expanded to include sailing and wind-surfing. The Wetland also has a high potential for ecotourism activities that are in a form of environmentally sustainable use of natural resources.

3) Other Values

The ecological values of the Anzali Wetland can provide unique opportunities for scientific research and education. Similar to the esthetic values of the Wetland, these values are also difficult to quantify in monetary term.

(2) Threatening Factors

1) International Recognition of the Wetland

The Anzali Wetland was listed in the Montreux Record of Ramsar Convention in 1993, which suggests that the ecological conditions of the Wetland are deteriorated. The process of this degradation is rather complicated, but the most serious factors affecting the ecological conditions of the Wetland are human induced impacts. Key activities causing negative impact to the Wetland need to be clearly identified and appropriate counter measures should be implemented. The Montreux Record claims that the implementation of conservation actions in the Wetland is an imminent requirement.

2) Human Impacts

Human activities causing negative impacts to the Wetland are largely composed of activities in (i) the Wetland, (ii) Surrounding coastal and flat areas, (iii) forest and rangelands in the upland. Most of the activities with negative impacts change water quality and quantity of the Wetland, disturb natural habitats and harvest/kill excessive number of wildlife. Major human activities that need to be managed in a sustainable manner for the conservation of the Wetland are summarized as follows.