Abbreviations

Abbreviations and Local Terms

ADB	Asian Development Bank
AREEO	Agricultural Research, Education and Extension Organization
CIS	Commonwealth of Independent States
ECO	Economic Cooperation Organization
FAO	Food and Agriculture Organization of United Nations
GPG	Golestan Provincial Government
IBRD	International Bank for Reconstruction and Development
IRRI	International Rice Research Institute
I&D	Irrigation and Drainage
JICA	Japan International Cooperation Agency
M&E	Monitoring & Evaluation
MoE	Ministry of Energy
MoRT	Ministry of Roads and Transportation
MoCJ	Ministry of Construction Jihad
MoH	Ministry of Health
MoJA	Ministry of Jihad-e-Agriculture
MPO	Management Planning Organization
OIC	Organizations of Islamic Conference
O&M	Operation and Maintenance
R.O.W	Right-Of-Way
RC	Reinforce concrete
SCS	Soil Conservation Scheme
SWRI	Soil and Water Research Institute
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture

Political Division	
Ostan	Province
Shafrestan	District
Shahr	City
Bakhsh	Sub-District
Dehestan	Village
Deh	Settlement

Iranian Terms	
anjoman-e deh	Rural Meetings (Before the Revolution)
rud	river
band	weir
abbandan	farm pond
debit	Discharge, flow (French)
chah	well
cheshmeh	spring
mirab	water master
qanat, ghanat	sub-surface canal
Shura	Regional Council
Bank Keshavarzi	(Iranian Agriculture Bank)
TID	Technical and Infrastructure Deputy
khosh-neshin	Landless people
Bank-e Keshavarzi	Agriculture Bank
Duneshgah-e Keshavarzi	Agriculture University
Ettahadi-ye Taavoni-ye Rustai	Federation of Agricultural Rural Cooperative
khod-kafa'I	Self-sufficient Economy
Markaz-e Amuzesh-e Keshavarzi	Agriculture Education Center
Markaz-e Khadamat-e Keshavarzi	Agriculture Service Center
Sharkatie Falahat	Agricultural Society
sahm	Stock
sahm-dar	Stock holder
Sharkat-e Taavoni-ye Towlid-e Keshavarzi	Agricultural Producers Association
Sharkat-e taavoniha-ye rusta'I	Rural Cooperative (established in 1955)

Measurement Units	
mm	millimeter
cm	centimeter
m	meter
km	kilometer
ha	hectare
cm^2	square centimeter
m^2	square meter
km^2	square kilometer
lit	liter
m^3	cubic meter
lit/sec	liters per second
m^3/sec	cubic meter per second

Measurement Unit (Cont.)	
MCM	Million Cubic Meter
cms	cubic meter per second
m/sec	meter per second
ppm	parts per million
mg/lit.	milligrams per liter
abdang	Iranian unit of discharge. 1.0 abdang = 0.25 m^3/sec
g	gram
kg	kilogram
ton	metric ton
sec	Second
min	Minute
hr	Hour
No.	Number
Nos.	Numbers
m.s.l	Mean Sea Level
FWL	Full Water Level
HWL	High Water Level
LWL	Low Water Level
PGD	Persian Gulf Datum
HP	Horse Power
EC	Electrical Conductivity
ET	Evapotranspiration
HYV	High Yield Variety
O&M	Operation and Maintenance
IRR	Internal Rate of Return
B/C	Benefit Cost Ratio
FY	Fiscal Year
SAR	Sodium Absorption Ratio
TDS	Total Dissolved Solids
E.C	Electrical Conductivity
dS/m	deci Siemens per meter= mS/cm = 1000micro S/cm
ESP	Exchangeable Sodium Percentage

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THE STUDY ON
IMPROVEMENT OF IRRIGATION, DRAINAGE AND AGRICULTURAL DEVELOPMENT FOR GORGAN PLAIN, GOLESTAN PROVINCE IN THE ISLAMIC REPUBLIC OF IRAN

DRAFT FINAL REPORT

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Chapter 1	Introduction

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

The Golestan province, located in the northern region of Iran, was separated from the Mazandaran province in 1998, becoming the newest province in the country. Agriculture sector plays the most important role in the Golestan province employing about 45.5% of the economically active population and the agricultural production of the province is significant considering its contribution of 10% and 30% of wheat and cotton production of the country respectively.

The Study Area is located in the Gorgan plain of Golestan province, facing towards the Caspian Sea in the west. It is an important agricultural production area of wheat and other crops in the Province. The main reason is that it is supposed to possess a great agricultural potential due to the large plain area. On the other hand, there are factors that can reduce the production and restrict the improvement of productivity such as improper utilization of the existing irrigation facilities, possibility of salinization problems, insufficient drainage, etc. Hence, it is urgently necessary to prepare an agricultural development plan mainly based on the irrigation and drainage, which can be used as a sustainable development model for the future Gorgan plain agriculture.

Under these circumstances, the Government of Iran has requested to the Government of Japan for the realization of the Study on the Agricultural Development Plan in the Gorgan Plain of Golestan Province, in November 1999. As a response to this request, the Government of Japan sent a Preliminary Study Team though JICA in February 2001, and the Scope of Works was signed on March 12, 2001.

Based on the Scope of Works, JICA dispatched a Study Team, and the Study Team conducted the 1st, 2nd and 3rd Field Studies in Iran from January 2002 and the Draft Final Report is prepared at the end of the 3rd Home Office in Japan.

1.2 Objectives of the Study

The Study has the following two major objectives:

1) Implementation of Feasibility Study (F/S) in the Priority Areas

During the Phase I, an inventory survey was carried out to select the priority areas. During the Phase II, Feasibility Study (F/S) was carried out in these selected priority areas.

2) Technical Transfer to the Counterpart Personnel

To realize technical transfer to the counterpart personnel of the Ministry of Jihad-e-Agriculture on each aspect of the Study.

1.3 Study Area

The total Study Area is 800 km^2, which is situated in the Golestan Province (Bandar-e-Torkman, Kordkuy, Aq Qala and Gorgan districts). The Study Area shall be extended to the surrounding areas, if necessary.

1.4 Scope of the Study

The Study is carried out in 2 Phases. The division and study contents of each phase are listed below:

(1) Phase I (January 2002 to June 2002)

1) 1st Field Survey in Iran (January 2002 to February 2002)

- Collection and Analysis of Existing Data and Information
- Conduct Surveys such as Hydrology, Soil, Regional Economy, Regional / National Marketing, Rural Community and Water Quality

2) 1st Home Office Work in Japan (March 2002)

- Elaboration of the Basic Concepts of the Agricultural Development (Possibilities of Agricultural Development)
- Preparation of the Interim Report (1)

3) 2nd Field Survey in Iran (May 2002 to June 2002)

- Explanation and Discussion of the Interim Report (1)
- Preparation of an Overall Irrigation and Drainage Plan
- Rural Community Survey and Marketing Survey
- Initial Environmental Examination (IEE)
- Selection of the Priority Areas
- Preparation, and Discussion of the Progress Report (1)

(2) Phase II (July 2002 to March 2003)

1) 2nd Home Office Work in Japan (August 2002)

- Evaluation of Possibilities of Agricultural Development and Selection of Priority Areas
- Preparation of the Interim Report (2)

2) 3rd Field Survey in Iran (September 2002 to October 2002)

- Explanation and Discussion of the Interim Report (2)
- Preparation of Topographic Survey Map
- Field Survey for Case Study of Selected Area
- Preparation of the Project Plan for the Priority Areas
- Preparation and Discussion of the Progress Report (2)

3) 3rd Home Office Work in Japan (December 2002)

- Final Confirmation of the Possibilities of Agricultural Development and the Project Plan for the Priority Areas
- Case Study of Selected Area
- Preparation of the Draft Final Report

4) 4th Field Survey in Iran (January 2003)

- Explanation and Discussion of the Draft Final Report

5) 4th Home Office Work in Japan (February 2003)

- Preparation of the Final Report

1.5 The Study Team and the Counterparts

The Study Team and the respective counterparts are as follows:

Assignment	Study Team	Counterparts
Leader / Regional Development / Project Evaluation	Satoru KIDO	Mohammad reza BANIAGHIL Hossein TASLIMI
Irrigation / Drainage	Seishiro SUZUKI	Mohsen ZAMANI Rahmatollah KAZEMINEJAD (Hossein TASLIMI)
Hydrology	Lyrio Massaru NAKASE	Ahmad reza GHANNAD Nooraddin SENSIBLI
Agronomy	Hiroshi IKEDA	Sohrab SOHRABI
Regional Socio-Economy	Akemi ISHIKAWA	Hyoosef HASEMI Said ROSTAMI
Soil / Environment	Chellasamy MURUGABOOPATHI	Mohammad Reza ABBASI Mehrjoo ALIREZA

Chapter 2

Socioeconomical Background and Existing Conditions of the Country and the Golestan Province

CHAPTER 2

SOCIOECONOMICAL BACKGROUND AND EXISTING CONDITIONS OF THE COUNTRY AND THE GOLESTAN PROVINCE

2.1 General Profile of Iran

The Islamic Republic of Iran covers an area of 1,650,000 km^2. The territory is located between 44°02′and 63°20′latitude north and between 25°00′and 39°47′longitude east. About 52% of the country is covered by mountains and deserts, and 16% of the area is situated at 2,000 m above mean sea level. The Elbourz Mountains is situated along the Caspian Sea and the Zagros Mountains run along the Persian Gulf in the northwest part of the country. The climate is classified as Continental climate in the plateau zone, Mediterranean climate in the areas surrounding the Caspian Sea, Arid zone in the eastern area and semi-tropical zone in the southern gulf area.

2.1.1 Social Conditions of Iran

(1) Population

Population of Iran as estimated by Statistical Center of Iran is shown below:

Population of Iran

Year	1976	1986	1991	1996	2000
Population	33,708,722	49,445,010	55,837163	60,055,488	63,900,000*
Annual Growth Rate (%)	2.7	3.9	2.5	1.5	1.5*

* Estimated by Statistical Center of Iran

Source；Iran Statistical Yearbook 1379 , Statistical Center of Iran, 2001

(2) Employment

Among total employed population of 14,572,000 persons, 26.04%, 31.45%[1] and 42.49% are engaged in agriculture, industry and service sector, respectively.

Relative Distribution of Employed Population Aged 10 and Over (Unit: %)

Major Industry Group	1997	1998	1999	2000
Agriculture	25.24	26.11	27.36	26.04
Industry	31.57	32.07	30.62	31.45
Service	43.15	41.76	42.27	42.49
Activities not specified and not stated	0.04	0.06	0	0.01
Total	100	100	100.25	100

Source: Iran Statistical Yearbook 1379, Iran Statistical Center (2001)

No drastic changes occurred in the share of employment of three economic sectors in the recent four years. Unemployment rate has gradually increased from 11.5% in 1995 to 13.5% in 1999 (Statistics ECO, 2001).

(3) Literacy

There are generation and gender gaps in literacy rate. Adult literacy rate (age 15 and above) is 74.6% and youth literacy rate (age 15-24) is 93.2% in 1998 (UNDP, 2001). Female adult literacy rate (age 15 and above) is 67.4 %, while male adult literacy rate is 82 % in 1998 (UNDP, 2001).

[1] Note: Including mining and quarrying, manufacturing, electricity, gas and water supply and construction.

(4) Health

The estimated infant mortality rate in the year of 2001 is relatively high, 29.04 deaths per 1,000 live birth. And the estimated life expectancy at birth in the year of 2001 is 69.95 years and that of male and female is 68.61 and 71.73 years, respectively (CIS, 2001).

(5) Religion

The national religion is Islam, Shiite, the 12th Emam. Among total population of about 60 million, Moslem (Shiite-89% and Sunni-10%) occupies about 99%. The rest 1% comprises of Zoroastrian, Jewish, Christian and Bahai (CIS, 2001).

(6) Ethnic Groups and Languages

The majority of the population is Persian (51%). The other ethnic groups are Azeri-Turkish (24%), Gilaki and Mazandarai and Baluchi (8%), Kurd (7%), Arab (3%), Lur (2%), Baloh (2%), Turkmen (2%) and others (1%). The official language is Persian. Besides Persian, people speak languages including Turk, Kurdish, Luri, Balochi, Arabic and Turkish (CIS, 2001).

2.1.2 Economic Conditions of Iran

(1) Outline

The 3rd Five Year Plan (2000 to 2004) promotes the restructuring of the economy, introduction of foreign currency, etc. The inflation rate was higher than 20% until 1996. However, after 1996, it lowered down up to 12.6% in the year of 2000.

(2) GDP by Sectors

The share of contribution of each sector is shown in the following Table.

Share of Contribution to the GDP by Sector (%)

Sectors	1997	1998	1999	2000
Petroleum	14.5	9	15.1	22.4
Non-petroleum	85.5	91	84.9	77.6
Primary	14.4	16.6	14.2	12.9
Secondary	19.9	19.5	19.2	17.8
Tertiary	51.2	54.9	51.5	47
Total	100.0	100.0	100.0	100.0

Source : "Economic Trends No.24 First Quarter 1380", Central Bank of Iran, compiled by JETRO Tehran

(3) Trend of Iranian Trade

Due to the share of the crude oil and the natural gas is prominent with 85% in the trade, the trade balance depends on its prices. The trend of trade balance is shown in the following table.

Trend of Trade Balances (Unit: US$ million)

	1996	1997	1998	1999	2000
Trade Balance	7,402	4,258	-1,168	7,597	13,138
Export	22,391	18,381	13,118	21,030	28,345
Petroleum and Natural gas	19,271	15,471	9,933	17,089	24,226
	-86.10%	-84.20%	-75.70%	-81.30%	-85.50%
Non- Petroleum	3,120	2,910	3,185	3,941	4,119
	-13.90%	-15.80%	-24.30%	(18.'%)	-14.50%
Import	14,989	14,123	14,286	13,433	15,207

Source: "Economic Trends No.2 Fourth Quarter 1379", Central Bank of Iran, compiled by JETRO Tehran

(4) Export of Agricultural Products

The amounts of export of the agricultural products are shown in the following table.

Agricultural Products in Non-petroleum Export (Amount is US$ million)

Products	1999		2000	
	Amount	Ratio	Amount	Ratio
Pistachio nut (Fresh/dried)	315.1	9.37	318.6	8.47
Raisin	53.9	1.6	55	1.46
Tomato Puree	37.1	1.1	40.8	1.08
Sheep Leather	5.3	0.16	40.2	1.07
Caviar	26.1	0.78	38.5	1.02
Sheep Hide	46.1	1.37	31.2	0.83
Others	2871.4	85.62	3238.5	86.07
Total	3362	100	3,762,8	100

Source: "Iran Trade Statistics 1999 and 2000", Iran Customs Administration, compiled by JETRO Tehran

(5) Import of Agricultural Products

The amounts of import of the agricultural products are shown in the following table.

Import of Major Agricultural Products (Unit; Metric ton)

Item	1996	1997	1998	1999	2000
Wheat	3,810,423	5,941,947	3,465,201	6,155,936	5,612,749
Rice	915,229	637,498	631,293	1,021,836	1,167,217
Soybean oil	765,759	366,500	286,935	830,741	797,106
Sugar	824,380	1,189,582	872,220	1,333,840	922,694
Barley & Rye	314,890	605,239	207,437	423,487	1,049,743
Maize Seed	1,445,703	1,510,028	806,012	1,007,053	1,228,461
Soybean	0	0	192,500	393,985	498,045
Soybean Meal	680,070	390,915	501,510	435,175	560,276

Source: "Iran Trade Statistics 1999 and 2000", Iran Customs Administration, compiled by JETRO Tehran

(6) Trends of Iranian External Debt

As a result of the monetary policies boosted for the repayment of medium and long-term debt, the external debt of Iran in 2000 was decreased to half of the amount of 1996.

Trend of External Debt

	1996	1997	1998	1999	2000
External Debt	16,835	12,117	13,999	10.357	7,952
Short term	4,557	3,289	4,503	3,618	3,678
Medium and Long Term	12,278	8,828	9,496	6,739	6,061

(Source: "Economic Trends No.24 First Quarter 1380", Central Bank of Iran, compiled by JETRO Tehran)

2.1.3 Agricultural Policy

In Islamic Republic of Iran, the Socio-Economic and Cultural Development Plan for 5 years has been planned based on the article 123 of the Constitution. After 1979 revolution, the first and second Five Year plans were carried out, and the third Five Year Plan (2000 to 2004) was planned and executed from March 2000.

The third five year development program (1999-2004) for economical, social and cultural development has the main objective of cutting the economic dependency on oil, and increasing

the exportation of non-petroleum products. However, strengthening of agriculture infrastructure is of great importance to achieve these goals. The major outlines of agricultural development policy are as follows:

1) To focus on suitable agricultural products to support the economy not based on oil, such as oil seeds
2) To achieve proper agricultural conditions to increase national investment and investing it in other areas
3) To complete unfinished projects and implementing regional projects in small scales
4) Programming of regional development projects in regard to needs, existing resource and potentials of the area.
5) Adjustment of government and the related organizations
6) Increase the exploitation of natural resources for agriculture development
7) Improve the conditions of agro-industries
8) To build or complete the production line of agricultural products and industries
9) To direct plans of other sectors related to water, energy, transportation, banks in order to support agricultural sector
10) To provide facilities for agricultural development plans, natural resources and directing government credits and banks to invest in this sector and developing shareholding system.

2.1.4 Agricultural Conditions in Iran

(1) General

Iranian agriculture is characterized by extensive arable lands, diverse climatic conditions, a growing rural population and a growing work force that contribute to the growth and development of the sector. The 4 types of climate and 12,000 different varieties of flora enable the country to produce a wide range of temperate, subtropical and tropical crops. Besides, there is often a temperature difference of 40-50 degrees centigrade at any one time between some areas, which makes it possible to produce, a variety of crops throughout the year. Owing an ample sunshine (an average of 300days, excluding the Caspian Coastal region) the agricultural products, especially garden products, are of high quality of colour, texture and taste (Keshavarz, 2000).

Agriculture is an important sector in Iranian economy providing about 24% of the GDP from 1995 to 2000, and 22.2% of the population (census 1996) are engaged in agriculture. Golestan province was the second ranked among 29 provinces of the country.

(2) Agriculture Production

The cultivated area, production and yield of annual crop of the country is shown in the following Table.

Annual Crop Production in 1999~2000 (the Country)

Crops	Area (ha)					Production (ton)			Yield (kg/ha)	
	Irrigated		Rain fed		Total	Irrigated	Rain fed	Total	Irrigated	Rain fed
	Ha	%	ha	%	ha					
Wheat	2,162,064	39.0	2,938,653	62.2	5,100,756	6,026,979	2,060,777	8,087,756	2,788	701
Barley	543,517	9.8	650,960	13.8	1,194,487	1,240,440	445,599	1,686,039	2,282	685
Paddy	534,331	9.4	0	0.0	534,341	1,971,462	0	1,971,462	3,690	0
Maize	181,263	3.3	344	0.0	181,610	1,117,834	1,873	1,119,707	6,167	5,445
Pea	20,657	0.3	624,895	13.2	645,552	19,930	222,449	242,379	965	356
Lentil	10,603	0.2	195,203	4.1	205,806	10,599	67,738	78,337	1,000	347
Cotton	223,499	4.3	22,728	0.5	246,231	469,050	28,074	497,124	2,099	1,235
Sugar Beet	162,738	2.9	0	0.0	162,741	4,332,172	0	4,332,172	26,621	0
Oil Seeds	132,110	2.4	76,012	1.6	208,124	173,167	73,740	246,907	1,311	970
Potato	165,750	3.0	3,112	0.1	168,865	3,625,546	32,489	3,658,035	21,874	10,440
Tomato	114,914	2.1	3,751	0.1	118,667	3,147,624	43,375	3,190,999	27,391	11,564
Melon	65,099	1.2	1,495	0.0	66,595	987,094	6,875	993,969	15,163	4,599
Water Melon	69,083	1.3	13,990	0.3	83,074	1,587,547	62,493	1,650,040	22,980	4,467
Cucumber	77,703	1.4	234	0.0	77,938	1,340,279	2,824	1,343,103	17,249	12,068
Alfalfa	519,261	9.4	36,968	0.8	556,238	3,794,045	65,084	3,859,129	7,307	1,761
Straw	160,367	2.9	72,749	1.5	233,119	3,559,229	1,171,906	4,731,135	22,194	16,109
Others	214,468	3.9	70,264	1.5	284,732					
Total	5,541,053	100	4,726,515	100	10,267,668					

Source: Agricultural Statistics Yearbook 1999-2000

(3) Self-sufficiency of Agricultural Products

Self-sufficiency rates of main crops (%, 2000)

Year	Wheat	Rice	Pulse	Potato	Onion
1995	72.3	66.7	100.5	100.1	102
1996	72.4	74.6	104.1	100.1	100
1997	62.8	78.7	127.4	102.6	106.8
1998	77.2	81.4	101.9	101.7	111
1999	58.5	69.7	-	101.4	105.1

Ref: A Statistical Glance at 2001 Agriculture in the Islamic Republic of Iran, MOAJ, Iran.

Self-sufficiency rates of the main crops in Iran, from 1995 to 1999 are shown in the above Table. The rates of wheat and barley were 58.5% and 69.7% in 1999. It is necessary to recover the self-sufficiency rate of wheat that is the staple food in Iran.

(4) Agricultural Research, Education and Extension

The Agricultural Research, Education and Extension Organization (AREEO) of the Ministry of Agriculture is in-charge of the overall administration, management and coordination of the agricultural research, extension and education in Iran. AREEO comprises of a well distributed network of 13 national research institutes, 33 provincial research centers, and more than 100 research stations to cover all agro-ecological zones of the country. AREEO's activities are an indispensable component in agricultural planning in the Third Scio-economic Development Plan of the Government (2000-2004).

2.1.5 Livestock Conditions

The number of livestock and meat production in Iran are shown in the following Table.

Livestock Numbers and Meat Production in Iran (1999-2000)

	Items	Unit	1999	2000 Preliminary
Cattle and Bovine Meat				
1	Cattle numbers at beginning of a year	1,000 heads	8,785	8,048
	Females	1,000 heads	7,265	6,656
	of which: Dairy cows	1,000 heads	3,821	3,500
2	Calf crop (born over a year)	1,000 heads	2,896	2,654
3	Live cattle imports	1,000 heads	0	0
4	live cattle exports	1,000 heads	0	0
5	Cattle losses	1,000 heads	1,200	203
6	Slaughter	1,000 heads	2,433	2,229
7	Cattle numbers end of a year	1,000 heads	8,048	8,270
8	Average carcass weight at slaughter	Kg/head	105	119
9	Bovine meat production	1,000 MT	256	266
10	Bovine meat imports	1,000 MT	26	16
11	Bovine meat exports	1,000 MT	0	0
Sheep and Goats				
1	Sheep and goat numbers at beginning of a year	1,000 heads	79,657	79,657
2	Lamb and kid crop	1,000 heads	27,535	27,535
3	Live sheep and goat imports	1,000 heads	0	0
4	Live sheep and goat exports	1,000 heads	0	0
5	Sheep and goat losses	1,000 heads	2,315	2,315
6	Slaughter	1,000 heads	25,220	25,220
7	Sheep and goat numbers end of a year	1,000 heads	79,657	79,657
8	Average carcass weight at slaughter	Kg/head	17	17
9	Bovine meat production	1,000 MT	432	436
10	Bovine meat imports	1,000 MT	0	0
11	Bovine meat exports	1,000 MT	0	0
Total meat				
1	Total meat production	1,000 MT	721	729
2	Total meat imports	1,000 MT	26	16
3	Total meat exports	1,000 MT	0	0
Source: Ministry of Animal Husbandry				

According to the Table, 26,000 tons and 16,000 tons of bovine meat were imported in 1999 and in 2000 respectively, however, meat of sheep and goat were not imported. In regard to the meat of sheep and goat, it shall be considered that the self-sufficiency is achieved.

2.1.6 Food Processing

According to the report of Keshavarz Special Issue 2000, US$ 460m have been allocated to the private sector to establish more than 300 food processing plants during the First Five Year Plan in 1989 to 1996. In addition, investors in the food processing industry have also been granted with low interest loans. As shown in the following Table, which shows the quantity of products left after a domestic consumption and processing, there is a considerable room for an expansion of the food processing industry.

Surplus of selected crops after domestic consumption 1995/96 (1,000 tons)

Crops	Production	Consumption	Processing	Surplus
Apples	2,231	1,578	541	112
Dates	780	438	41	301
Citrus fruit	3,051	2,580	333	102
Grapes & raisins	1,845	1,116	800	71
Pistachio	238	78	160	-
Pomegranate	612	438	75	99
Potatoes	3,074	2,016	236	822
Vegetables & summer crops	6,747	4,512	1,130	1,105

Source: The report of Keshavarz Special Issue 2000

The total production capacity of the existing processing plants for the Iran's principal food products is shown in the following Table.

Production Capacities of Food Processing Industries

Items		In Operation	Under Construction
Apple	Concentrate	34	6
	Compote	40	-
	Dried slices	1.2	-
	Juice	60	-
Dates	Packaged	14	21
	Sugar		3
Grapes	Concentrate	18	3
	Juice	20	-
Oranges	Concentrate	6	5
	Juice	31	-
Pomegranates	Concentrate	15	15
	Juice	6	15.7
Potatoes	Chips	40	12
	Industrial chips	7	-
Tomato paste & ketchup		160	48.8
Cold storage		800	200

Source: The report of Keshavarz Special Issue 2000

To develop the necessary export markets, significant measures will be necessary to improve the quality of Iran's processed foods. Packing techniques must to be improved and high quality packing materials must be used. In addition, close compliance will have to be observed with international standards for raw and processed products.

2.1.7 Environment

(1) Environmental Organization and Its Responsibilities

In Iran, the Department of Environment (DOE) is responsible for the protection and enhancement of the environment, the prevention and control of any form of pollution or degradation leading to the disturbance of environmental balance, and for conducting all matters related to wildlife and the aquatic biota of the territorial waters. The Vice President of the Islamic Republic, who directs the daily operations of DOE heads the department with 4 deputies.

DOE is responsible for 10 national parks with a total area of 1,277,560 hectares, five national monuments covering 1,798 hectares, 25 wild life refuge measuring 1,921,504 hectares, 47 protected areas spread over 4,813,086 hectares and 17 wetlands. The sum of these area equals to 8,013,948 hectares or 5% of the entire land area[2].

Each province of Iran has a DOE provincial directorate, which monitors all the aspects of environmental protection and the implementation of the department's programs. DOE is in-charge for defining the national regulations and standards for preserving and enhancing the quality of environment. A major part of this responsibility includes the provision of expert studies in human and industrial pollution, desertification, deforestation, soil erosion, rangeland degradation, improved water resource management and protection of biodiversity. Considering the rapid development of the country, DOE is responsible for monitoring the quality of air and water.

The legal division of DOE prepares the comprehensive draft guidelines that detail regulations in accordance with the international environmental laws, standards and conventions. This series of legislative measures are introduced to the parliament for ratification and once they are approved, these mandates provide the necessary legal powers towards the implementation of these measures.

(2) Environmental Laws, Planning and Management

The Environmental Protection Act (1974) is the major law for environmental conservation in Iran. The Supreme Council of the Environment is a legislative body that enacts relevant regulations for the environmental protection. It is chaired by the President of the Islamic Republic and the other members of the council are the Ministers of Agriculture, Foreign Affairs, Industry, Interior, Health and Medical Education, the Heads of the Department of Administration and Planning and the Institute of Standard and Industrial Research. The laws enacted to protect the environment are as follows:

- Regulations for forested areas in 1920
- Municipality law concerning air pollution, solid waste disposal and reduction of industrial pollution in 1955
- The Environmental Protection and Enactment Act (EPEA) in 1974
- The executive rule of EPEA in 1975
- The clean air act in 1975
- Article 50 of the Constitution of the IRI approved in December 1979
- The Water Pollution Prevention Guideline in 1984
- The wastewater effluent standard in 1991
- The Amendment of Water Pollution Prevention Guideline in1994
- The Amendment of wastewater effluent standard in 1994
- Air Pollution Control Law in 1995
- Industrial Siting Guidelines
- Environmental Impact Assessment Guidelines and Framework in 1995
- Air Pollution Emissions Standards in 1998

The major development projects require an Environmental Impact Assessment (EIA) to evaluate the degree of damage on the environment, and the ways to reduce, eliminate or remedy these impacts. Projects needing an EIA and the methods of assessment will be reviewed and updated at intervals, to ensure that progress is made in keeping up with the technical know-how of international environmental bodies.

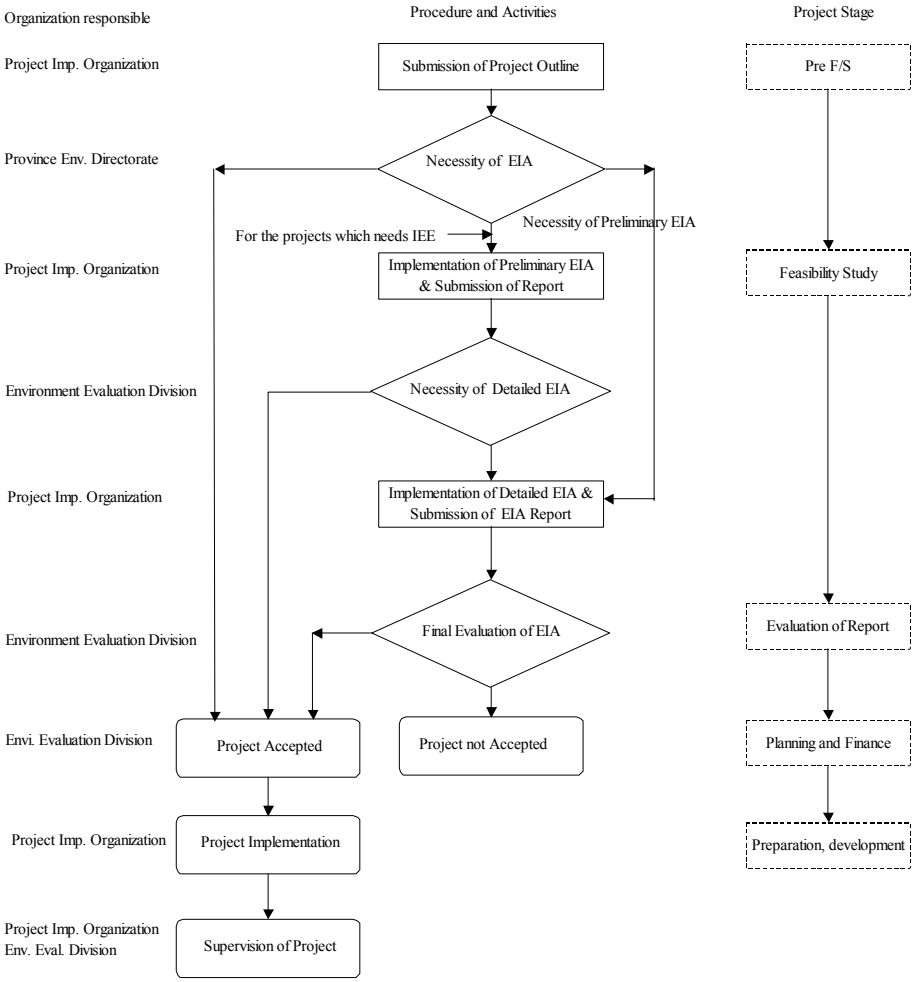
[2] A Glance at the Department of the Environment of the Islamic Republic of Iran

EIA needs to be carried out for the following projects:

- Petroleum industries of any kind
- Refineries
- Power stations with capacity of more than 100 MW
- Steel industries
  a) Units of melted materials with a capacity of 300,000 ton/year
  b) Units of forming with a capacity of 100,000 tons/year
- Dams of more than 15m high with area more than 400 ha area
- Dams which keep pollutant materials in any measure should be evaluated by the environmental office.
- Man-made lakes with area more than 400 ha area
- The size of the lakes that breed fish with an area of less than 400 ha should be supervised by the department of agriculture.
- Irrigation and drainage projects with an area of more than 5,000 ha
- Airports with a landing area of more than 2,000m
- Forestry projects
- Projects of oil or gas pipeline transportation

EIA procedure followed in Iran is shown below:

Evaluation Procedure of Environmental Impact Assessment in Iran



(3) International Environmental Role of Iran

Iran has accepted international legal responsibilities, which in part reflects its moral, ethical and scientific obligations to protect the biodiversity assets. The international conventions of which Iran is a member are as follows:

- Convention on Biological Diversity (CBD)
- Convention of Wetlands (Ramsar)
- Convention of Control of Transboundary Movement of Hazardous Waste
- Convention to Combat Desertification
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- United Nations Framework Convention on Climate Change (UNFCCC)
- World Heritage Convention (WHC)
- Montreal Protocol on Ozone-layer Depletion Substances
- Bio-safety Protocol

2.2 General Situation of the Golestan Province

2.2.1 Social Conditions

(1) Administration

Golestan province includes 11 districts (*Shahrestan*), 18 cities and 50 villages (*Dehestan*). The total area of the Province is 20,893km^2 and the population in 2000 was estimated as 1.6 million persons (MPO). 41.3% of the population is living in the 4 districts (Gorgan, Aq Qala, Bandar-e-Torkman and Kordkuy) of the Study Area. The population is centralized in Gorgan, the provincial capital, and Gonbad districts showing 40% of the total population of the Province. The distribution of the population in rural area decreased by 63% in 1986 to 58% in 1996, and there is a continuous migration of population from rural areas to urban areas.

(2) Employment

Gorgan district plays an important role in administration and marketing of the province. In Gonbad district, the people are mostly engaged trade and most of the population are Torkmans, since it is located near the border of Turkmenistan. Among the employment, the agriculture sector occupies approximately 40%, followed by service and industry sector. Judging from the high population in the rural area and the share of employment, agriculture is the most important sector in the province.

Employment of Economically Active Population

Items	1996	1997	1998	1999	2000	2001
Employment	90.12	86.33	88.59	84.19	85.26	85.18
Agriculture	46.19	34.49	38.12	40.54	40.72	43.83
Industry	19.91	27.48	25.36	24.02	26.17	21.57
Services	32.87	38.01	36.52	35.44	33.11	34.6
Unemployment	9.88	13.67	11.41	15.81	14.84	14.82

Source: Statistical Center of Iran, Statistics of Golestan 2001

(3) Health

The number of doctors and beds per thousand residents are 0.32 and 0.7 respectively. Existing number of doctors and medical facilities are shown in the following table.

Medical Facilities and Doctors

Items	1996	1997	1998	1999	2000
Hospital	16	18	19	19	19
Bed	1,110	1,199	1,180	1,185	1,111
Clinic	123	99	132	146	144
Radiology	22	25	25	30	34
Medical Doctors	593	689	738	847	843
Dentists	87	95	120	144	154

Source: Provincial University of Medicine and Hygiene Care, Statistics of Golestan 2001

(4) Religion

Among the total population of about 4 million in Mazandaran Province, the share of Moslem occupies more than 99%. The rest 1% comprises of Zoroastrian, Jewish, Christian and others similar to national data.

2.2.2 Economy

The primary sector (agriculture, livestock) is the most important sector in the province, followed by the tertiary sector (trade, services), and the secondary sector (industry) is almost inexistent. The annual growth rates of the primary and secondary sectors are parallel, though the secondary sector has a larger growth. There are 210 registered establishments in 1999 employing about 6,900 persons.

The shares of the Golestan province in the national general revenues are 2.4% in the current expenditure and 2.1% of the development expenditure, respectively.

Income of the Province

(Unit:Million rials)

Item	1998	1999		2000		2001
	Actual	Approved	Actual	Approved	Acutual	Approved
Tax income	63,551	67,629	82,949	83,871	101,415	87,371
Direct tax	59,137	64,889	74,875	77,404	92,729	79,621
Indirect tax	4,414	2,740	8,074	6,467	8,677	7,750
Government Income	290	11	488	738	591	1,428
Income from Public services	12,426	14,496	18,878	13,337	27,607	30,925
Other incomes	1,418	485	2,129	1,191	2,551	8,841
Total	77,685	82,621	104,445	99,137	132,155	128,574

Source:Golestan Financial Organization, Statistics of Golestan 2001

In the incomes of the province, the direct tax dominates 80% of the total income. At the beginning of the fiscal year, the income plan of the province has to be approved by the central government.

2.2.3 Province Agricultural Development Program

Based on the Central Government's third Five Years Development Plan, the Golestan province has established the Provincial Development Program in accordance with the national level development plan.

Development Expenditures in Ostans from General Revenues, by Ostan

(Unit:Million rials)

	1998		1999		
	Country	Golestan	Country	Golestan	% of 1998
Total	4,111,403	86,970	0	125,838	2.12
General Affairs	132,127	5,098	0	5,398	3.86
Social Affairs	3,034,982	63,556	0	82,832	2.09
Economic Affairs	944,294	18,316	0	37,608	1.94

Source: Iran Statistical Yearbook 1379, Statistical Center of Iran, 2001

The major Aspects of Agricultural Development Policies are as follows:

1. To increase agricultural products and income of the farmers and to improve the facilities of marketing
2. To develop agricultural training and activities specially in the field of soil, water and renewed natural resources
3. To carry out development plans of water resources such as reservoirs, irrigation and drainage systems to increase the irrigation potential
4. To organize agricultural cooperatives, improving the livestock sector in regard to the existing pasture lands
5. To improve the administrative structure or organizations related to the objectives of development of agricultural sector
6. To provide new technical methods to farmers (conversion of traditional method to modern agriculture)
7. Improving crediting system and investment in agricultural sector
8. Improvement and protection of natural resources by social and economical approaches.
9. Improvement and development of exportation of agricultural products.

2.2.4 Agricultural Conditions in the Golestan Province

(1) General

Agriculture in the province is mostly the agriculture in the climate of the plateau areas of the Elbourz Mountains, including partly in the climate of the coastal region of the Caspian Sea. The population engaged in agriculture is about 158,671 persons, which consist of 131,298 of men and 27,373 of women. The share of the population engaged in agriculture for the total working population is 45.6% in total, 45.9% in women and 45.5% in men, respectively.

(2) Agricultural Land Use

In the province, 630,718 ha of agricultural area were cultivated in 2000. The total irrigated land and rain-fed land were 282,400 ha (44.8%) and 348,318 ha (55.2%), respectively. The area of the total cultivated land for annual crops is 611,015 ha, of which irrigated and rain-fed areas occupy 269,702 ha (44.1%) and 341,313 ha (55.9%)respectively.

The cultivated area, production and yield of annual crops of the Golestan Province are shown in the following table.

Production of Annual Crops in the Golestan (1999/2000)

Products	Area (ha)					Production (ton)			Yield (kg/ha)	
	Irrigated		Rain fed		Total	Irrigated	Rain fed	Total	Irrigated	Rain fed
	ha	%	Ha	%	ha					
Wheat	112,458	41.7	197,357	57.8	309,857	390,777	439,603	830,380	3,475	2,227
Barley	3,386	1.3	70,677	20.7	74,064	8,608	63,680	72,288	2,543	901
Paddy	42,582	15.8	0	0.0	42,598	129,965	0	129,965	3,052	0
Cotton	66,772	24.8	13,050	3.8	79,847	120,714	16,511	137,225	1,808	1,265
Oil Seeds	22,592	8.4	27,716	8.1	50,316	46,624	28,014	74,638	2,064	1,011
Potato	6,886	2.6	110	0.0	6,999	64,638	1,245	65,883	9,387	11,318
Tomato	4,623	1.7	3,313	1.0	7,938	117,395	36,366	153,761	25,394	10,977
Water Melon	2,360	0.9	3,842	1.1	6,203	23,397	8,419	31,816	9,914	2,191
Alfalfa	49	0.0	0	0.0	49	223	0	223	4,541	0
Total	269,702	100.0	341,313	100.0	611,015					

Source: Agricultural Statistics Yearbook 1999-2000

In the Golestan Province, the main crops cultivated under irrigated farming are wheat, cotton, paddy rice, oilseeds, potatoes and barley. On the other hand, the main crops grown under rain-fed farming are wheat, barley, oilseeds, cotton and water melon. The total cultivated area of permanent crops in Golestan province is 19,704 ha, with 3.1% of the total cultivated area of 630,719 ha. The irrigated area for permanent crops (fertile trees) was 6,278 ha (31.9%), the rain-fed area was 1,974 ha (10 %), and the rest of 58% was for the sapling.

(3) Farm Economy

1) Price of farm machinery and farm materials

In Iran, the average annual increase rates of prices of farm machinery and farm materials during last 10 years are 29% of tractor (Ferguson 285), 26% of seeder, 33% of combine, 31% of 4 cylinders pump, 32 to 43% of chemicals and 38 to 42% of fertilizers, respectively. On the other hand, the average annual increase rate of the producer's price for agricultural products are 24% of wheat, barley and cotton, and 13% of potatoes.

2) Income of main crops

The net income per ha for the main crops from 1997 to 2001 are shown in the following Table.

Net Income in Main Crop Cultivation (Golestan province, in average, 1997-2001)

Unit: Rls/ha

Crops	Net Income per ha (Rls/ha)					
	1996/97	1997/98	1998/99	1999/2000	2000/2001	Average
Wheat (irrigation)	223,200	959,469	591,067	590,750	924,420	657,781
Paddy rice	948,000	5,732,000	4,205,000	1,892,000	1,892,007	2,933,801
Soybean (irrigation)	165,000	205,253	178,000	300,800	1,035,089	376,828
Maize (irrigation)	1,831,500	946,000	1,301,000	1,945,183	924,420	1,389,621
Cotton (irrigation)	242,500	215,900	50,000	-88,000	-1,053,283	-126,577
Wheat (rainfed)	-84,000	925,000	217,000	323,060	-7,370	274,738
Sunflower (rainfed)	-80,000	280,800	504,000	325,600	499,905	306,061

Source: Report of agricultural economy in Golestan province, 2000/2001

3) Farmers' living expenditure

The average annual increase rate of farmers' living expenditure during the last 10 years is 26% for food, 29% for others and 26% in total as shown in the following table.

Farmers' Living Expenditure in Average of Golestan Province (Rls/day)

Year	Food	Others	Sum
1992	-	-	2,224
1993	1,320	1,460	2,780
1994	1,918	2,080	3,998
1995	2,967	3,121	6,088
1996	3,258	3,876	7,134
1997	3,898	4,774	8,672
1998	5,132	5,920	11,052
1999	6,088	7,872	13,960
2000	6,634	9,311	15,945
2001	-	-	18,336
Average annual increasing rate during 10 years (%)	26	29	26

Source: Golestan Jihad-e-Agriculture Organization

The annual living expenditure of farm household is about Rls 6.7 million /year (US$837 /year). If the farmer cultivates wheat in winter and soybean in summer in irrigated field, the farmer's net income is Rls 924,420 /ha for wheat, Rls 1,035,089 /ha for soybean, with a total of Rls 1,959,509 /ha. Therefore, the farmer needs about 3.4 ha under irrigated land to earn the living expenditure of his family. In general, farmers have various side jobs, such as handicraft, animal husbandry, weaving of carpet, etc.

4) Summary

The agricultural characteristics of Golestan province are summarized as follows:

1. The rate of population depending on agricultural activities in the economically active population in Golestan province is very high (46%), when compared with the average rate of the country (22%).
2. Agriculture in Golestan Province is realized in the climate of the plateau areas of the Elbourz Mountains, partially including a climate of the coastal region of the Caspian Sea.
3. Golestan province has about 631,000 ha of cultivated lands (29% of the total area), which is ranked as second in the country.
4. The area with annual crops is about 611,000 ha, of which is 96.9% of the total cultivated land in Golestan province. The percentages of irrigated and rain-fed agricultural lands in the total land with annual crop cultivation are 44% and 56%, respectively.
5. The area of horticulture is about 20,000 ha, which is 3.1% of the total cultivated land in Golestan province. The share of Golestan province is ranked in 25th of the 29 provinces in the country in relation to the horticulture.
6. The main irrigated crops are wheat (42%), cotton (25%), paddy rice (16%), and oilseeds (8%). On the other hand, in the rain-fed farming, the main crops are wheat (58%), barley (21%), and oilseeds (8%).
7. In relation to the horticulture, the main crops are orange (24%), peach (18%), plum tangerine (10%), and olive (6%) in the irrigated farming. In rain-fed farming, the main fruit trees are plum (35%), walnut (18%), peach (13%), etc.

2.2.5 Livestock in Golestan Province

The number of livestock and animal products in each district of Golestan province are shown in the following table.

Number of livestock and Stock Farm Products (2000-2001)

District	% of number of livestock in each district for total number						Production	
	Sheep	Goat	Cattle	Buffalo	Camel	Horse & Donkey	Red meat	Milk
	%	%	%	%	%	%	%	%
Minoodasht	8.9	10.5	8.4	0.9	0.0	8.3	8.6	6.1
Kalaleh	20.9	24.5	17.7	0.9	3.0	19.3	19.4	13.1
Gonbad	31.2	21.3	33.9	14.0	75.0	6.7	32.0	30.4
Ali Abad	10.2	14.3	7.0	0.7	0.0	12.3	9.0	10.0
Aq Qala	**9.7**	**14.7**	**9.9**	**2.7**	**11.4**	**22.5**	**10.0**	**10.8**
Gorgan	**6.5**	**9.8**	**9.9**	**0.9**	**0.0**	**22.5**	**8.1**	**13.6**
Bandar Torkman	**9.2**	**2.5**	**6.9**	**4.1**	**10.7**	**6.6**	**8.1**	**8.0**
Kordkuy	**2.1**	**1.4**	**2.9**	**26.2**	**0.0**	**0.8**	**2.5**	**3.3**
Bandar Gaz	1.4	1.1	3.4	49.7	0.0	0.8	2.4	4.7
Unit	heads	heads	heads	heads	heads	heads	ton	ton
Total	2,563,263	167,975	332,5.33	2,143	4,151	21,617	25,718	309,887

Source: Golestan Jihad-e-Animal Husbandry Organization

In Golestan province, sheep takes priority in the number of livestock, with about 2.6 million heads, followed by cattle with 0.3 million heads. The livestock husbandry of Gonbad district is the most prosperous in the region. The four districts in the study area have about 30% of the total number of animals, about 29% of red meat production and about 36% of milk production. The livestock production in Golestan province, compared with that of the country are 3.5% in red meat, 5.5% in milk, 3.8% in chicken and 3.5% in eggs, respectively. In regard to poultry, as shown in the following table, the four districts of the Study Area have the share of about 49% in broiler and about 35% in layer in both of the total number poultry and production.

Poultry Production in Golestan Province (2000-2001)

District	Broiler		Layer		Non-industrial poultry	Production	
	Number of enterprises	Number of chicken	Number of enterprises	Number of chicken		Meat	Eggs
	%	%	%	%	%	%	%
Minoodasht	14	3.5	0	0.0	11.8	4.4	3.2
Kalaleh	2	0.4	0	0.0	6.4	0.5	0.5
Gonbad	98	25.1	1	33.0	33.3	25.0	32.3
Ali Abad	57	11.2	2	18.5	7.1	11.0	17.2
Aq Qala	12	6.6	**1**	6.8	7.0	6.8	6.5
Gorgan	124	22.2	**1**	19.9	13.0	22.8	19.1
Bandar-e-Torkman	36	7.2	**0**	0.0	6.1	6.7	0.5
Kordkuy	59	13.2	**1**	8.7	7.8	12.5	8.4
Bandar Gaz	53	10.6	2	13.1	7.5	10.3	12.4
unit	nos	nos	nos	nos	nos	tons	tons
Total	455	4,619,120	8	1,757,000	871,638	28,367	19544

Source: Golestan Jihad-e-Animal Husbandry Organization

The animal ration supply is carried out in three ways as mentioned below:

1) Pasture: The pastures of Government, which are about 1 million ha in Golestan province,

were transferred to the private enterprises, and the pasture production is sold to the farmers. The pasture growth is not good now.
2) Small-scale production of forage crops by farmers: alfalfa, barley, maize, etc.
3) Importation of feed.

As shown in the following table, the total digestive nutrients (TDN) are short for all livestock. In general, livestock is fed in the farms basically by self-production of alfalfa, soybean, maize, the residues after harvesting in summer, etc., in the traditional raising method.

Conditions of Feed in Golestan (2000-2001)

Feed demand of animal husbandry & poultry in Golestan Province	Feed production in Golestan Province	Shortage of TDN
(TDN, ton) 1,333,031	(TDN, ton) 1,05.3,794	(TDN, ton) 280,237

Source: Golestan Jihad-e-Animal Husbandry Organization

The processing industries related to animal husbandry in Golestan province is shown in the following table. The number of slaughterhouse is 15 in Golestan province, which are only traditional types, not enterprises, with the capacity for slaughterhouse of sheep are 500 heads and cattle are 2,000 heads per day, respectively.

Processing Industries Related to Livestock in Golestan (2000-2001)

Items	Capacity unit	Number	Nominal capacity	Employ-ment capacity	Remarks
1. Feed processing factory	tons/year	5	271,500	102	4 units in action.
2. Gorgan milk pasteurization factory	tons/day	1	270	237	
3. Dairy factories		13	6,900	107	3 units under construction.
4. Leather and fur	piece/year	3	657,336	62	
5. Wool spinning factories	tons/year	1	160	19	
6. Milk collecting center	tons/day	37	329	148	
7. Meet processing factories	tons/year	4	9,350	66	3 units under construction.
8. Complementary nutrients factories	tons/year	4	19,000	60	1 unit under construction.
9. Industrial slaughterhouse of poultry	nos/year	3		102	
10 Honey packing		1		6	Under construction.
Total		72			

The Government of Golestan province is planning to industrialize the livestock sector, but the plan has not succeeded yet.

2.2.6 Soil of the Golestan Province

(1) Soil Survey and Mapping

In Iran, soil survey and land evaluation studies are carried out by the Soil and Water Research Institute (SWRI) associated with Agriculture Research, Education and Extension Organization (AREEO) of the Ministry of Agriculture. SWRI has been involved in mapping of the soils of Iran for about 50 years and about 20 million ha[3] of land areas have been surveyed until now at three levels (reconnaissance, semi-detailed and detailed). SWRI is responsible for producing the National Soil Maps at 1:2,500,000 scale (Dewan and Famouri, 1964) and at 1:1,000,000 scale in digital format (Banaei, et.al).

[3] Moameni, A, Production Capacity of Land Resources of Iran, SWRI, MOA, Dec. 2000.

(2) Soil Resource and Land Capability of Golestan Province

During the past 50 years period, the surveys have been carried at three levels in the Golestan province and semi-detailed soil and land classification maps were prepared by SWRI, in 1972. These maps of the province, which are available at a scale of 1:50,000 were prepared from the field maps of 1:20,000 and aerial photographs. The surveys were also carried out after 1972 and the information was compiled into three soil resource and land capability maps of 1:250,000 scale in 1996 for the Mazandaran province, which included Golestan province.

The province can be broadly divided into the land types as shown below:

1. Elbourz Mountainous area at the southern part of the province
2. Hilly areas mostly distributed at the northeastern part
3. Plateaus and upper terraces distributed in the northwest and eastern parts and a small portion of southern parts
4. Piedmont plains distributed along the middle of the province
5. Sedimentary and alluvial plains along the Gorgan river and Atrak river
6. Lowlands and saline areas at the western part
7. Other areas including small areas of fan shaped colluvium at the upper part of piedmont plain.

(3) Major Soils of the Province

The major soils of the Province according to FAO (1988) classification, the corresponding USDA classification and their main characteristics are as follows.

Major Soils of the Province

FAO Classification	Main Characteristics**	Equivalent USDA Classification
Eutric, Dystric Calcaric, Gleyic, and Humic Cambisol	These are the soils conditioned by their limited age and represent the soils, which were changed of their color, structure and consistency resulting from weathering in situ. They are characterized by slight or moderate weathering of the parent material and by absence of appreciable amount of org. matter, aluminium or iron compounds. These soils may be Eutric (fertile), Dystric (infertile), Humic (rich in organic matter), and Gleyic (excess of water). Cambisols make good agriculture lands depending on the relief and climate.	Eutropepts, Dystropepts, Xerochrepts Eutrochrepts, and Humitropepts
Calcaric and Salic Fluvisols	These soils are conditioned by the relief and are developed in recent fluvial or marine deposits, particularly in periodically flooded places. Most fluvisols are fertile and are on flat lands. It may be Calcaric (accumulation of calcium carbonate) or Salic. Fluvisols are very productive for dryland crops and rice.	Xerofluvents
Mollic Gleysols	These are the soils influenced by groundwater. The formation of gleysols is conditioned by water logging at shallow depth for some time of the year. Gleysols occur in association with Fluvisols and Cambisols. Mollic gley soils represent the soils of good surface structure. Agriculture potential depends on flooding time and drainage.	Calcixerolls / Haploaquolls
Haplic and Gleyic Solonchaks	These are the saline soils conditioned by limited leaching, low rainfall and high evaporation. High salt accumulation limits plant growth to salt tolerant crops, and limits growth because nutrients are less available. These soils can not be used for normal cropping unless the salts are leached. They may be Haplic (soils with simple horizon sequence) or Gleyic (excess of water). The high accumulation limits plant growth to salt tolerant crops.	Torriorthents, Calciorthids

FAO Classification	Main Characteristics**	Equivalent USDA Classification
Haplic and Calcic Kastanozems	These are soils conditioned by a steppe environment in a drier and warmer areas. Downward percolation leaches nutrients from top soil and lime (and sometimes gypsum) accumulates in the subsoil. The main constraint of these soils is the dry climate. They are also susceptible to erosion and sometimes suffer from high sodicity. They may be Haplic (soils with simple, normal horizon sequence) or Calcic (strong accumulation of calcium carbonate). Irrigation is needed to produce arable crops and grazing is an important land use of these soils.	Haplustolls, Calcixerolls
Calcaric and Gypsic Regosols	These are soils of eroding landscape and have a morphology determined by type of parent material and climate. In dry climate, the surface horizon is thin and low in organic matter. They may be Calcaric (strong accumulation of calcium carbonate) or Gypsic (presence of gypsum). Landuse and management depend on climate and the relief. In the warmer areas, these soils can be used for dry farming, but often need supplementary irrigation.	Xerorthents Pssamments
Lithic Leptosols	These are soils of eroding landscape and are characterized by their shallow depth (less than 30cm of soil cover hard rock) or by high gravel content. The limited soil volume makes them subject to drought and water logging. Most of the soils remain under natural vegetation and have a potential for grazing and forestry.	Lithic subgroup
Haplic Calcisols	These are the soils conditioned by limited leaching. The most prominent feature of these soils is the translocation of CaCO3 from the surface horizon to some depth. They are well drained and fertile soils, but high calcium is not favorable for many crop, which also results in iron and zinc deficiency. Calcisols are mainly used for grazing, but may yield well when carefully irrigated for fodder crops, cotton or sunflower, amongst others.	Caciustepts
Chromic Luvisols	Soils conditioned by pronounced movement of clay from surface to some depth. They are in general fertile soils and their physical characteristics are favorable. Luvisols are suitable for agriculture incl. grains, sugarbeet, fodder crops in flat areas. On sloping lands, they are used for orchard.	Haploxeralfs
Calcaric Arenosols	These are the soils developed in sands. Aeronosols are defined by their sandy particle size and by the absence any significant soil profile development. These soils are very permeable and storage of available water is low. Inherent soil fertility is also low, but they are easy to till and tend to form a dry surface quickly, which protects soil moisture from evaporation. In semi-arid climates, dry farming is possible, while high yields are possible with irrigation.	Pssamments

** - (Source: World Soil Resources, FAO 1991; World reference base for Soil Resources, FAO 1998)

2.2.7 Environment

The Golestan provincial directorate of environment is responsible for the protection of national environmental sites in the Golestan province and to carry out the environmental activities including environmental monitoring, and environmental training to its staff and the local population. One of the important natural environment sites in the province is Golestan National Park, which covers an area of about 92,000 ha with a length of 52 km in the east of Albourz mountains. The national park is the largest protected forest in the country, and covers different climatic zones between the Caspian Sea and arid areas.

The Golestan provincial directorate of environment has 8 branch offices at the following locations:

1. Gorgan,
2. Ali-Abad,
3. Bandar-e-Turkman,
4. Kordkuy,
5. Bandar-e-Gaz,
6. Gonbat Kavoos,
7. National Park of Golestan and
8. Minoodasht

In the future, it is planned to open offices in Aghala, Azad Shar, Kalaleh and Ramian. There is also an environmental laboratory in Gorgan.

The provincial directorate is responsible for making the evaluation and approval of Preliminary Environmental Impact Assessment (pre EIA) and detailed EIA. When any industry or factory is set up in the province, permission needs to be obtained from the department of environment based on the regulations of DOE. For eg., when a big industry/factory is to be established, it should be set up in the industrial or commercial areas which are included in the development plans of the city and should be at a considerable distance away from the city as defined by the regulations of the DOE.

Before starting any major factory or industry, an application should be first submitted to the respective branch office of the Golestan provincial directorate of environment. After the first visit by the staff of the branch office, the expert from the provincial directorate will visit the area based on the necessity and the final approval will be given after it is confirmed that all the necessary criteria are satisfied. Besides, the environmental officials will recheck whether all the norms are followed during the construction. When necessary, they also take samples such as drainage water sample and check them at the laboratory in Gorgan.

Chapter 3 Existing Conditions of the Study Area

CHAPTER 3

EXISTING CONDITIONS OF THE STUDY AREA

3.1 Natural Conditions

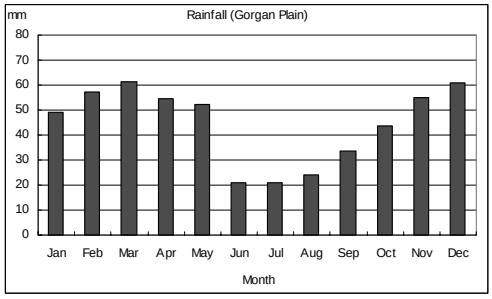
3.1.1 Climate

(1) Gorgan Plain

The Gorgan Plain, where the Study Area is situated, is located in the northern part of the country and eastern side of the Caspian Sea. The Gorgan Plain is situated in a dry to semi-wet region.

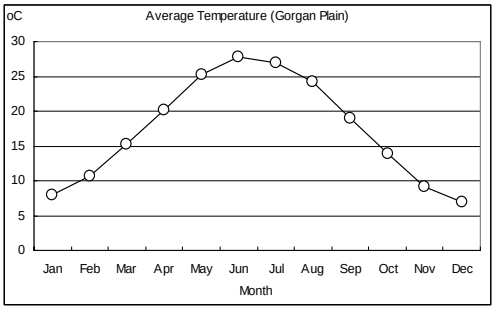
a) Rainfall

The figure on the right shows the variation of average monthly rainfall in the Gorgan Plain. The average annual rainfall in the Gorgan plain varies from 270 mm in Till Abad to 746 mm in Minoodasht.



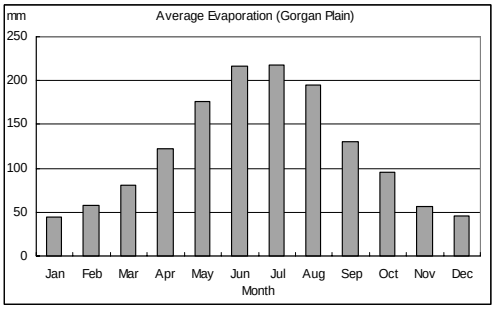
b) Temperature

The average monthly temperature variation in the Gorgan plain is shown on the right figure. The average annual temperature is 17.2 ^{o}C in the Gorgan plain, having the lowest average in Till Abad with 13.7 ^{o}C and 20.5 ^{o}C as the highest average in Aq Qala. The absolute minimum temperature reached –14 ^{o}C, and the absolute maximum is 46 ^{o}C.



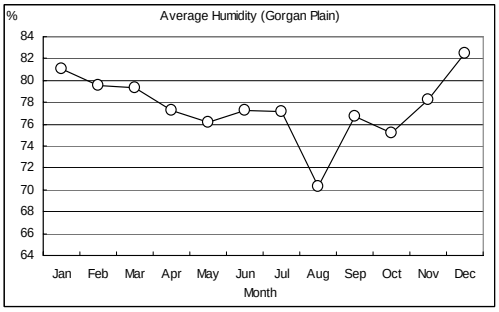
c) Evaporation

The average evaporation is shown on the right side. The average minimum was 46.1 mm in December and the average maximum 217.9 mm in July.



d) Humidity

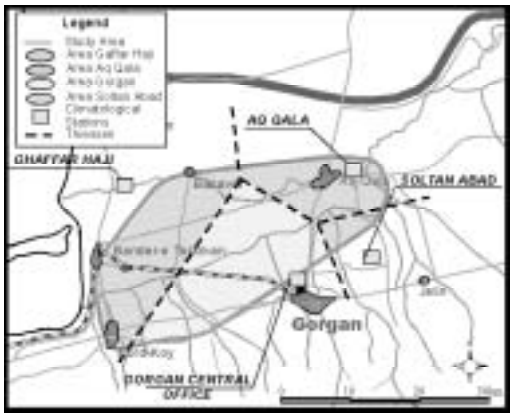
The average monthly humidity is shown in the right figure. The average minimum was 70.3% in August and the average maximum 82.5% in December.



(2) Study Area

There are 4 climatological stations that can be utilized around the Study Area. They are the Ghaffar Haji, Aq Qala, Gorgan Central Office and Soltan Abad stations.

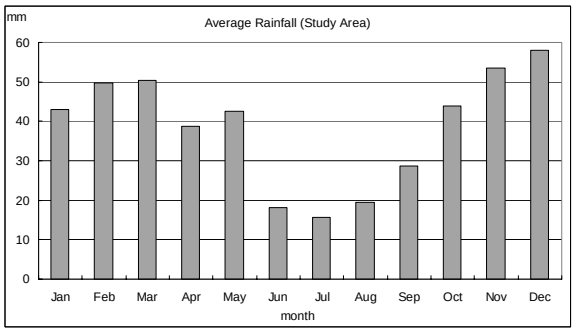
According to the stations position, the study area can be divided in 4 areas, as shown in the figure, by the Thiessen method.

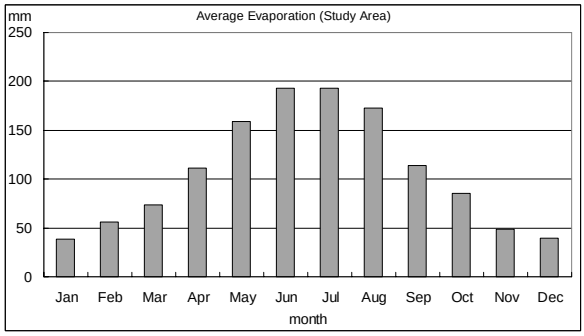


Climatological Station of the Study Area

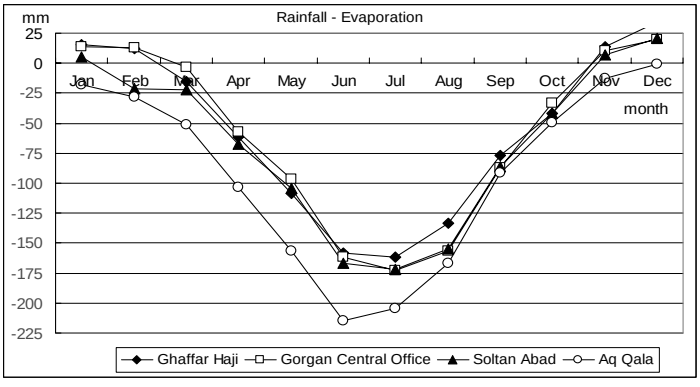
a) Rainfall and Evaporation

The average rainfall and evaporation in the study area varies as shown in the following graphs.





A simple comparison of the rainfall and evaporation shows that each climatological area of the Study Area has the following characteristics.



Ghaffar Haji and Gorgan Central areas have similar characteristics. They have 4 months that the rainfall overcome the evaporation value. In Soltan Abad area, the rainfall is higher than the evaporation for about 3 months. The last one, Aq Qala, has the evaporation rate greater than the rainfall all over the year. The figure shows the variation of the balance between the rainfall and evaporation rates for each station.

Hence, the Study Area can roughly be divided into 3 areas from the rainfall and evaporation characteristics with Ghafar Haji and Gorgan Central presenting better conditions, followed by Soltan Abad and Aq Qala. The last one has the worst condition from the rainfall and evaporation point of view.

b) ETo

The referential evapotranspiration, to be utilized in the calculation of the necessary irrigation water, are as follows.

ETo (mm)

Station	Jan Bah	Feb Esf	Mar Far	Apr Ord	May Kor	Jun Tir	Jul Mor	Aug Sha	Sep Meh	Oct Aba	Nov Aza	Dec Dey	Annual Sum
Ghaffar Haji	16.1	21.8	37.2	61.7	92.8	113.4	117.5	100.2	72.4	55.3	27.0	17.9	733.3
Gorgan Central Off.	20.0	26.3	41.1	69.0	95.9	118.9	124.0	118.6	77.0	55.7	30.7	24.6	801.8
Soltan Abad	26.5	49.7	49.3	69.2	97.5	122.9	122.3	113.2	73.5	54.2	30.1	25.3	833.7
Aq Qala	38.1	47.0	63.5	89.6	127.9	147.8	138.9	116.7	74.4	56.9	39.1	34.7	974.6
Average	25.2	36.2	47.8	72.4	103.5	125.7	125.7	112.2	74.3	55.5	31.7	25.6	835.8

c) Effective Rainfall

The effective rainfall, also for the calculation of the irrigation necessity, was calculated by the empirical formula of AGLW/FAO results in the following values.

Effective Rainfall (mm)

Station	Jan Bah	Feb Esf	Mar Far	Apr Ord	May Kor	Jun Tir	Jul Mor	Aug Sha	Sep Meh	Oct Aba	Nov Aza	Dec Dey	Annual Sum
Ghaffar Haji	14.1	17.5	15.4	9.9	10.5	0.0	1.4	2.4	10.6	15.9	23.2	27.3	148.2
Gorgan Central Off.	16.8	22.2	25.8	19.4	20.4	2.6	0.8	5.5	8.9	21.6	24.8	24.5	193.3
Soltan Abad	17.5	22.9	22.2	13.2	17.2	3.6	0.0	1.5	5.9	14.8	22.2	25.8	166.8
Aq Qala	14.7	16.6	17.6	10.5	14.1	0.0	0.0	0.0	3.6	12.8	18.4	21.6	129.9
AVERAGE	15.8	19.8	20.3	13.3	15.6	1.6	0.6	2.4	7.3	16.3	22.2	24.8	160.0

3.1.2 Water Resources

The main water resources utilized by the irrigation of the agriculture sector, in the study area, can be divided in Groundwater and Surface Water.

The most stable source is the groundwater, which carried to it’s over exploitation. The exploitation of the groundwater is concentrated in the south part of the study area, where the density of wells is very high. It is exploited in the form of qanat and wells.

The surface water has two main sources: Gorgan and Gharasu rivers. The most important one is the Gorgan River. The Gharasu River has serious problem of sedimentation and has a very irregular water flow during the year making its use very difficult.

The Gorgan River is exploited by many farmers and irrigation schemes utilizing pumps due to its deep river bed. The Gharasu River, situated near the mountaineous region, has mainly it’s

tributaries exploited utilizing pumps and diversion structures.

The responsible organization for the water resources management is the Ministry of Energy. This ministry plans the distribution of the water and authorizes it's exploitation.

(1) Groundwater

a) General

The groundwater exploitation in the Gorgan Plain is done in the form of spring, qanat and well. The wells are divided in shallow, deep and artesian. The following table shows the estimation of the groundwater exploitation in the Gorgan Plain.

Groundwater Exploitation in the Gorgan Plain

Item	Well				Spring	Qanat
	Shallow	Deep	Artesian			
			Without Pump	With Pump		
Quantity	9,299	3,516	280	331	65	282
Q (MCM/year)	250	383	13	54	24	69
Average Working Days per Year	92	126	228	260	365	365
Average Q (l/s)	7	19	2	18	12	8

Source: Ministry of Energy (Golestan)

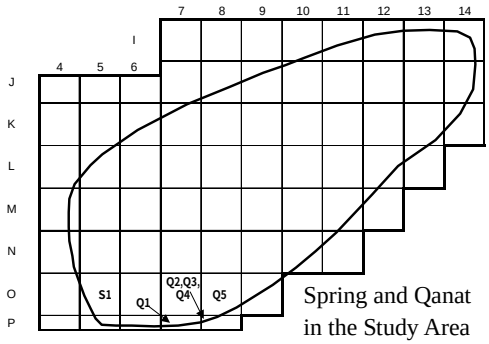
There are 13,426 wells registered in the Gorgan Plain utilizing about 700 MCM/year. The number of springs and qanats are respectively 65 and 282, with a total exploitation of 93 MCM/year. So, the total annual water volume exploited form the groundwater in the Gorgan Plain is 793 MCM/year. The agricultural sector consumes about 690 MCM/year according to the Ministry of Energy estimation.

b) Groundwater in the Study Area

b1) Spring and Qanat

The study area had only one spring in the west part as shown in the right figure (S1). According to the inhabitants, it became out of function 14 years ago.

The number of Qanats (Q in the right figure) in the study area was 5, which one (Q1) became out of function 5 years ago.



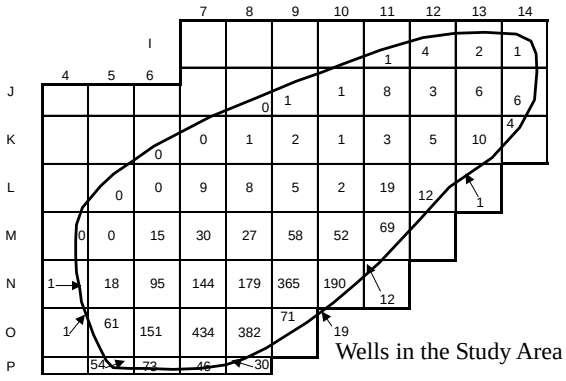
Spring and Qanat in the Study Area

In general the qanats in the study area can not support large agricultural production, being only utilized to supply drinking water or irrigate a very small area.

b2) Well

There are 2,691 wells registered in the study area. Those wells are divided in the following 5 types:

- Shallow (1,584)
- Deep (950)
- Observation (69)
- Artesian (85)
- Piezometric (3)



Wells in the Study Area

The observation, and piezometric wells are special wells to collect the groundwater data. The first is constructed to collect data for the entire groundwater system observation and the second to check individual wells. The exploitation is done from shallow, deep and artesian wells.

The shallow well predominates over the deep one. Both are concentrated in the south part of the study area, mainly in the Gharasu River basin, showing that it is the most important water source in Gharasu basin.

The low density of wells in the north and central part of the study area makes necessary the utilization of the surface water for the irrigation of these areas.

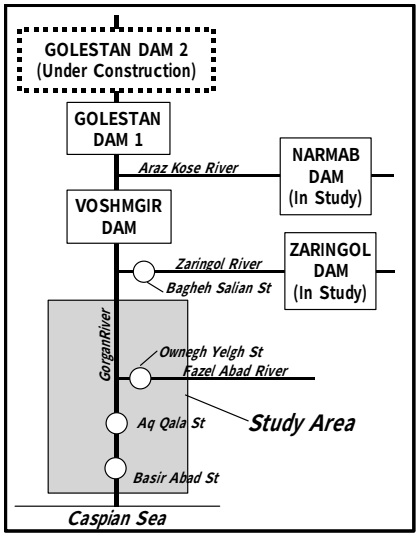
According to the survey, the following fact was found when the well owners were asked about the condition of their wells.

Well Condition According to the Owners

Well Type	Condition		
	Satisfactory	Not Satisfactory	No Answer
Deep	61.1%	8.3%	30.6%
Shallow	25.9%	44.4%	29.6%

(2) Surface Water

The main source of surface water in the study area is, without any doubt, the Gorgan River. It has two important dams, the Voshmgir and Golestan 1 dams, which provides water during the dry season. There is one dam in construction, the Golestan dam 2, situated 30 km upstream of the Golestan 1 dam at the Gorgan River. Another 2 dams are in phase of study: the Narmab and Zaringol dams.



The Voshmgir Dam, constructed 32 years ago, has a serious

problem of sediment accumulation. The initial storage capacity was 95 MCM, but actually this volume has decreased to about 50 MCM. The high quantity of sediments carried by the Gorgan River is one of the problems for the dam and also for the utilization of its water. A 15,000 ha irrigation scheme is linked to the Voshmgir dam utilizing a water volume of 51 MCM annually.

The Golestan Dam 1, constructed 2 years ago, was projected to cover the problems of the Voshmgir dam and to provide water for the irrigation scheme (10,000 ha) linked to it. The irrigation scheme utilizes 96 MCM of water annually. The Golestan Dam 1 has a great importance also in controling floods.

Another dam, the Golestan 2, is under construction, with almost 18% concluded, being projected to assist all this system and provide water for an irrigation scheme of 4,600 ha with an estimated annual water consumption of 40 MCM. The conclusion of this dam is estimated to be after 3 years (2005).

The following table shows the characteristics of the existing dams.

Existing Dams Characterisitics

Dam	River	Storage Volume (MCM)	Catchment Area (km^2)	Situation
Voshmgir	Gorgan	95 (initially)	7,157	Concluded
Golestan 1, 2	Gorgan	116	4,925	Golestan 1: concluded Golestan 2: under construction

Source: Ministry of Energy (Golestan Province)

This system of dams is responsible for major part of the water to be utilized by the irrigation in the agriculture sector of the Study Area.

According to the Ministry of Energy, the following number of pumps are registered in the Gorgan and Gharasu Basins:

Registered Pumps by River

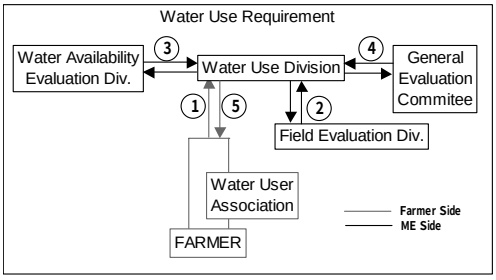
Basin	Pump Quantity	Q (MCM/year)
Gorgan	984	43.6
Gharasu	58	0.5

Source: Ministry of Energy (Golestan)

It shows the high dependency of the Gorgan Basin on the surface water, while the Gharasu Basin is highly dependent on the groundwater.

a) Water Use Requirement Process

The farmers must realize a requirement to be approved by the Ministry of Energy to use the surface



water. The figure shows this process.

The process is as follows:

1. The requirement shall be sent to the Water Use Division in the Ministry of Energy of Golestan province;
2. The Water Use Division sends the requirement data to the Field Evaluation Division to evaluate the conditions of the farm;
3. After the field check, the Water Availability Evaluation Division evaluates the possibility of water use in the total basin:
4. The General Evaluation Committee will realize the final evaluation before the contract;
5. If all conditions are cleared, the contract is made between the Ministry of Energy and the farmer or association.

This process needs about 2 months to be finished and has a fee of Rial 100,000 per requirement. The water use tax paid by the farmer is about 3% of his gross income.

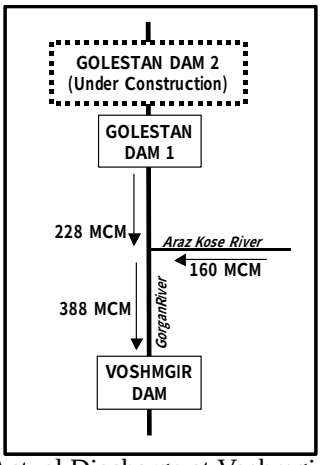
The river water use without permission results in the confiscation of the pump.

b) River Discharge

The whole basin of the Gorgan River can be divided in two by the study point of view: Upstream and Downstream of the Voshmgir Dam.

The Ministry of Energy has being studied the main Gorgan River water availability utilizing 30 years of measurement data.

So, in a rough way, the annual discharge around the Voshmgir dam can be as shown in the right figure. The Golestan Dam with the Araz Kose River provides a water volume of 388 MCM per year.



Actual Discharge at Voshmgir Dam Upstream

c) Authorized Water Use

According to this 30 years data, the Ministry of Energy, responsible for the water resources management, estimated the annual available water volume for the agricultural sector. This water volume is utilized for the water distribution plan in the agriculture sector.

The water use from Gorgan River usually is done by utilizing pumps due to the deep river bed.

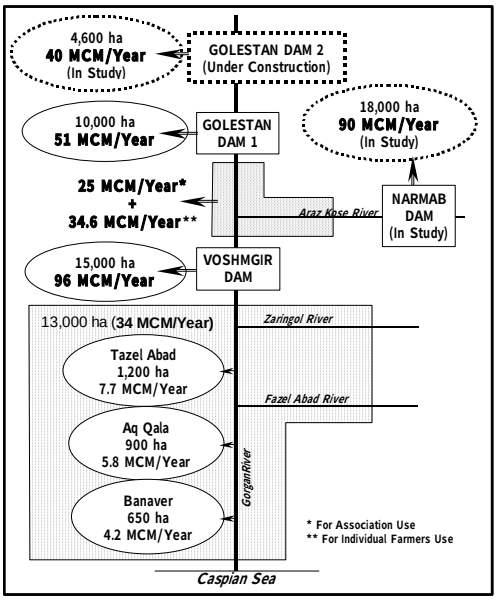
The actual authorized water use is shown dividing the basin in the Voshmgir Dam upstream and downstream. The allowed water volume for agriculture use in all Gorgan River can be

summarized as follows:

Actual Allowed Water Use (Ministry of Energy)

Location	Demand (MCM)
Golestan Dam 1	51
Between Golestan 1 and Gorgan Dam	59.6
Voshmgir Dam	96
Voshimgir Dam Downstream	34
Sub-total	240.6
Golestan Dam 2 (in study)	40
Narmab Dam (in study)	90
TOTAL	370.6

Allowed Water Use



So, the actual water demand for the agriculture sector is 240.6 MCM per year in the whole Gorgan River. This volume shall increase to 370.6 MCM after the conclusion of the Golestan dam 2 and if the Narmab dam will be constructed.

d) Actual Water Use

The water use per hectare can be estimated, in a rough way, using the main schemes demand as follows.

Actual Necessary Water per Hectare

Scheme	ha	MCM/year	Average (m^3/ha/year)
Golestan 2	4,600	40	8,695.7
Golestan 1	10,000	51	5,100.0
Voshmgir	15,000	96	6,400.0
Narmab	18,000	90	5,000.0
Total			6,298.9

This necessary water is for irrigation with an estimated application efficiency of 50%. The average water use for those schemes is 6,300 MCM/ha per year. The values show that the Golestan 1 scheme has the most efficient water use utilizing 5,100 MCM/ha/year.

e) Remaining Exploitable Water

As shown above, the Ministry of Energy has done studies on the water availability for the existing dams. According to those studies, the same ministry stipulates the maximum water available to be utilized for the agriculture sector. As the amount of water coming from the Voshmgir dam is already fixed for the agriculture sector, the only remaining sub-basins of the Gorgan River to be exploited, as a new source in the study area, are the Zaringol and Fazel Abad rivers basins.

The Tank Model was utilized to estimate the runoff of the Zaringol and Fazel Abad Rivers.

This model visualizes the basin as a system of reservoirs. This reservoir is a virtual tank with side and bottom outlets representing the runoff and infiltration respectively. The 'H' represents the storage. A system of several tanks can represent the base runoff, interflow and surface runoff.

The project rainfall, to calculate the available water volume for both basins (Bagheh Salian and Ownegh Yelgh stations), was set for a minimum rainfall of 10 years probability. It is the same probability utilized by the Ministry of Energy for this type of calculation.

The rainfall period was divided in two periods: wet and dry periods. The wet period was set between October to May and the probability analisys was carried for each rainfall as follows:

Minimum Rainfall with 10 Year Probability

BAHALKEH DASHLY

Return Period (T)	Wet Period (mm)	%	Dry Period (mm)	%
200	189.9	100.0	0.0	0.0
100	195.8	99.7	0.6	0.3
50	204.3	98.1	3.9	1.9
40	207.9	97.5	5.3	2.5
30	213.0	96.7	7.3	3.3
20	221.9	95.4	10.8	4.6
10	***242.9***	***92.7***	***19.0***	***7.3***
5	275.2	89.7	31.7	10.3
2	356.2	84.9	63.5	15.1

Obs: Wet Period (Oct-May)
Dry Period (Jun-Sep)

LALEH BAGH

Return Period (T)	Wet Period	%	Dry Period (mm)	%
200	308.1	92.5	25.0	7.5
100	311.8	92.0	27.0	8.0
50	317.2	91.4	30.0	8.6
40	319.4	91.1	31.2	8.9
30	322.7	90.7	33.0	9.3
20	328.3	90.1	36.0	9.9
10	***341.4***	***88.8***	***43.3***	***11.2***
5	361.7	86.9	54.4	13.1
2	412.7	83.4	82.3	16.6

Obs: Wet Period (Oct-May)
Dry Period (Jun-Sep)

RAMIAN

Return Period (T)	Wet Period (mm)	%	Dry Period	%
200	503.9	91.2	48.4	8.8
100	511.0	90.9	51.2	9.1
50	521.3	90.4	55.4	9.6
40	525.5	90.2	57.1	9.8
30	531.8	89.9	59.6	10.1
20	542.5	89.5	63.9	10.5
10	***567.8***	***88.5***	***74.0***	***11.5***
5	606.8	87.1	89.7	12.9
2	704.5	84.5	128.9	15.5

Obs: Wet Period (Oct-May)
Dry Period (Jun-Sep)

FAZEL ABAD

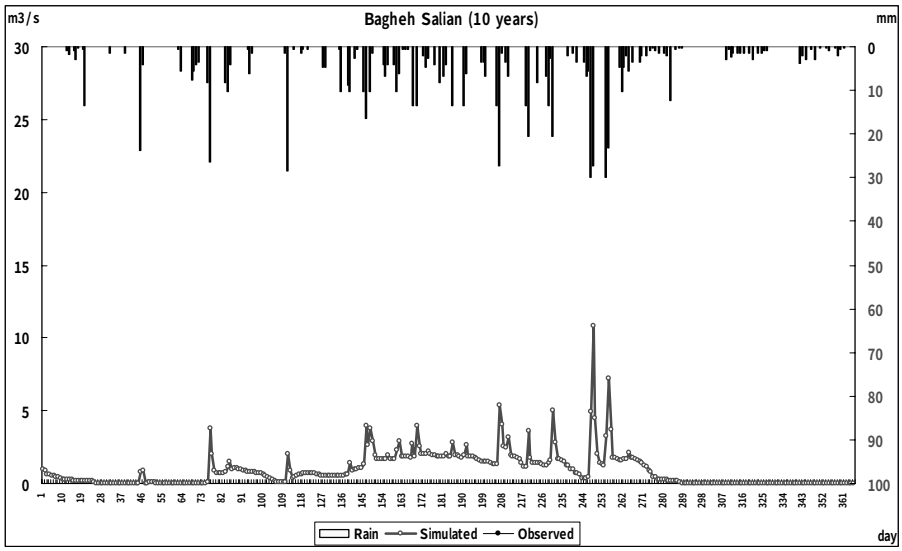
Return Period (T)	Wet Period (mm)	%	Dry Period (mm)	%
200	329.2	87.0	49.3	13.0
100	335.6	86.5	52.2	13.5
50	344.9	85.9	56.4	14.1
40	348.8	85.7	58.2	14.3
30	354.5	85.4	60.7	14.6
20	364.2	84.8	65.1	15.2
10	***387.2***	***83.7***	***75.5***	***16.3***
5	422.6	82.2	91.5	17.8
2	511.3	79.5	131.6	20.5

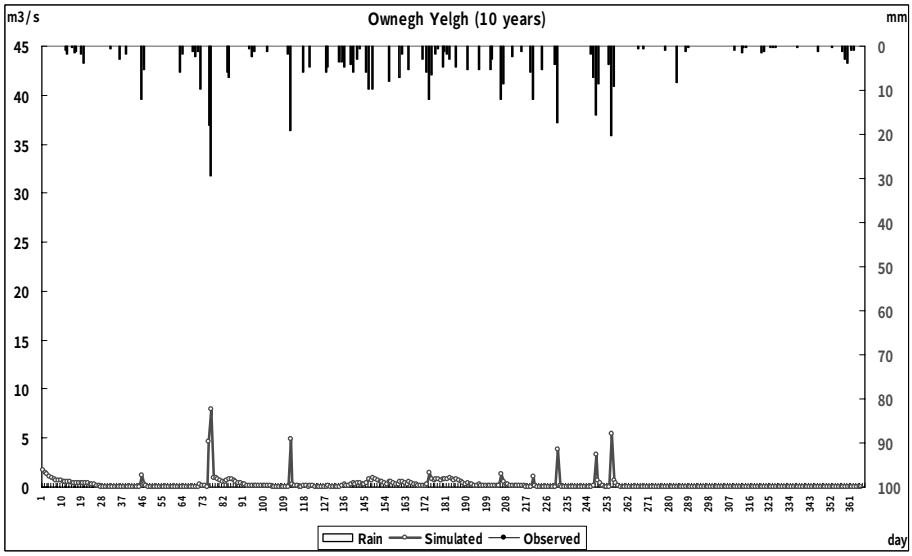
Obs: Wet Period (Oct-May)
Dry Period (Jun-Sep)

According to this result, the original rainfall of 1376 (1997) utilized for the model calibration was used as base rainfall data to generate a minimum rainfall with 10 years probability.

The runoff resulted from this rainfall are as follows:

Discharge for Rain of 10 Years Return Period





The resulted values are shown in the next tables.

Seasonal Discharge Variation at Bagheh Salian (10 Years Probability Rain)

(MCM)

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Monthly Volume (MCM)	0.2	2.3	2.1	4.4	6.8	7.6	5.7	8.2	0.4	0.0	0.0	1.0	38.8
% (month)	1	6	5	11	18	20	15	21	1	0	0	3	100
Season	Autumn			Winter			Spring			Summer			-
Seasonal Volume	4.6			18.9			14.3			1.0			38.8
% (Seasonal)	11.9			48.7			36.9			2.5			100

Seasonal Discharge Variation at Ownegh Yelgh (10 Years Probability Rain)

(MCM)

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Monthly Volume (MCM)	0.2	2.9	0.9	1.2	1.8	1.4	0.7	1.5	0.0	0.0	0.0	0.9	11.6
% (month)	1	8	2	3	5	4	2	4	0	0	0	2	30
Season	Autumn			Winter			Spring			Summer			-
Seasonal Volume	4.1			4.4			2.2			0.9			11.6
% (Seasonal)	35.3			37.8			19.2			7.7			100

So, the available water at the downstream region of Voshmgir Dam can be calculated summing the water from the Voshmgir Dam (34 MCM) and the available water form the Zaringol and Fazel Abad rivers.

(3) Available Water Volume

The available water volume for the study area can be resumed as follows:

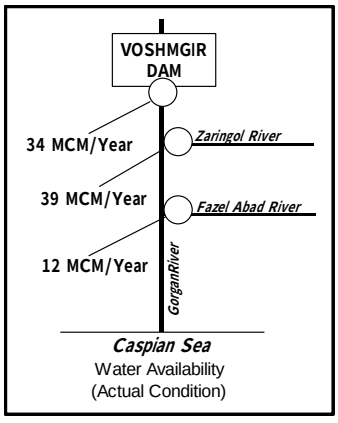
Preliminar Total Available Water Volume (Voshmgir Dam Downstream)

Local	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	TOTAL
Voshmgir Dam	0.8	0.6	0.4	0.4	0.7	2.2	6.0	5.8	3.6	6.4	5.1	2.0	34.0
Bagheh Salian	0.2	2.3	2.1	4.4	6.8	7.6	5.7	8.2	0.4	0.0	0.0	1.0	38.8
Ownegh Yelgh	0.2	2.9	0.9	1.2	1.8	1.4	0.7	1.5	0.0	0.0	0.0	0.9	11.6
Total	1.3	5.8	3.4	6.0	9.3	11.2	12.5	15.5	4.1	6.4	5.1	3.9	84.4

Calculating the total area that can be irrigated by this water volume, if the present average water use rate (6,300 m^3/ha) is used, we reach to an area of 13,397 ha.

The following figure shows these values in each point.

Estimated Total Available Water Volume (Voshmgir Dam Downstream)

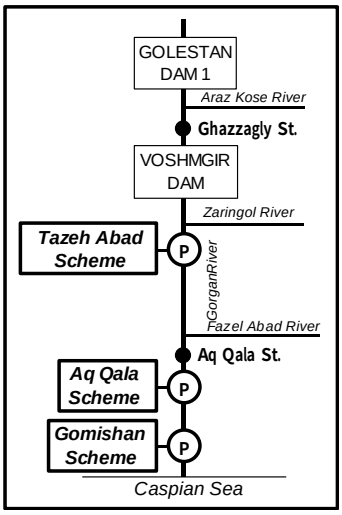


(4) Excess Water From the Voshmgir Dam

The tank model simulation was also utilized to evaluate the relation between the Golestan dam, Voshmgir dam, the tributaries of the Gorgan river with the water availability at the Tazel Abad pump station. The main purpose was to estimate the water discharged by the dams in the form of excess water (the water volume discharged over the dam storage capacity).

First the Golestan dam was analyzed. The Ghazzagly hydrological station's data were utilized to calibrate the model, and the result was applied to simulate the inflow volume variation in the Golestan dam considering the difference between catchment areas.

The right figure shows a schematic map of the main locations utilized in this section.

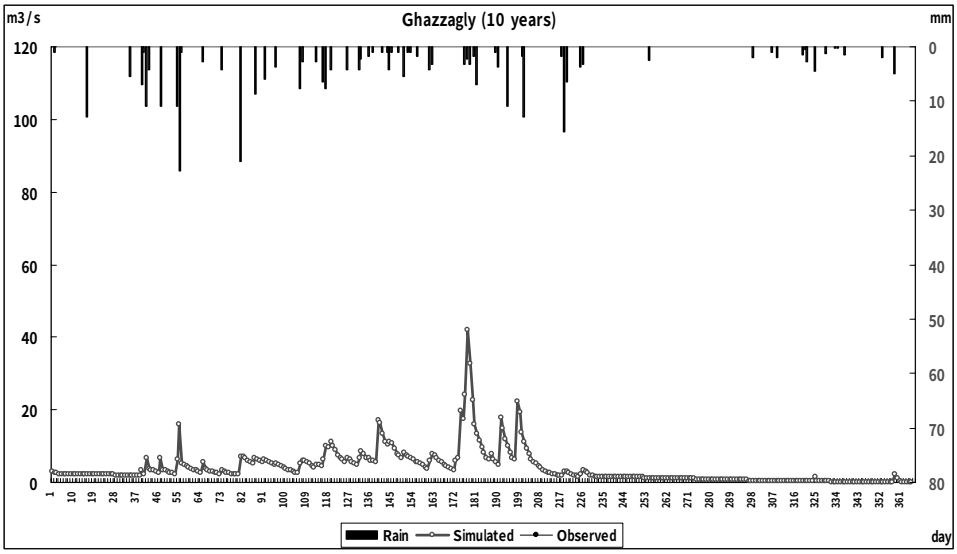


Gorgan River System

1) Discharge

The discharge was calculated for a rainfall of 10 years return period as shown below. The following graph shows the simulation result.

Simulation Result for a Minimum Rainfall of 10 Years Probability



So, the estimation of the discharge in each point is shown in the following table.

Discharge Volume Variation per Month (Rain of 10 Years Return Period)

(MCM)

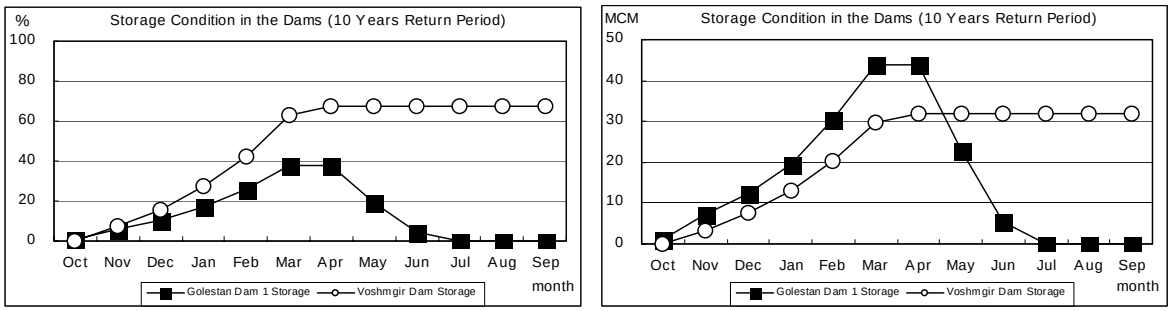
Location		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	TOTAL
1	Ghazzagly St.	5.9	9.8	11.2	14.9	20.0	27.7	21.8	5.3	3.1	1.8	0.8	0.4	122.7
2	Golestan Dam	3.8	6.2	7.1	9.5	12.7	17.6	13.8	3.4	2.0	1.1	0.5	0.2	78.0
3	Araz Kose River	2.2	3.6	4.1	5.4	7.3	10.1	7.9	1.9	1.1	0.7	0.3	0.1	44.8

2) Dam Excess Water

The dams excess water, the water volume flowed over the dam storage capacity, that overflows through the spillway, can be utilized by the farmers apart from the 34 MCM managed by the Ministry of Energy at the Voshmgir dam. This 34 MCM/year depends on the operation of the main gate.

The Ghazzagly St. dischaged volume was utilized to calculate the Golestan 1 dam inflow volume. Considering the water use directly from the Golestan 1 and Voshmgir dam, and that they are initially empty, the storage variation for a rainfall of 10 years return period resulted in the following:

Storage Variation for a 10 Years Return Period Rainfall in Golestan 1 & Voshmgir Dam



As shown in the above graphs, the Golestan 1 dam reaches about 40% of its storage capacity in March and April, but becomes empty during July to October. The Voshmgir dam reaches almost 70% of it's capacity. Both dams storage does not exceed the total capacity, meaning that there is no excess water that overflows through the spillway.

So, it can be concluded that the Golestan 1 and Voshmgir dams do not contribute to the downstream area with excess water for a rainfall of 10 years return period. It can be said that the water coming down from the Voshmgir dam is that originated by the operation of the main gate of the dam. It is the 34 MCM/year that the Ministry of Energy allocates to the downstream agriculture.

3.1.3 Topography

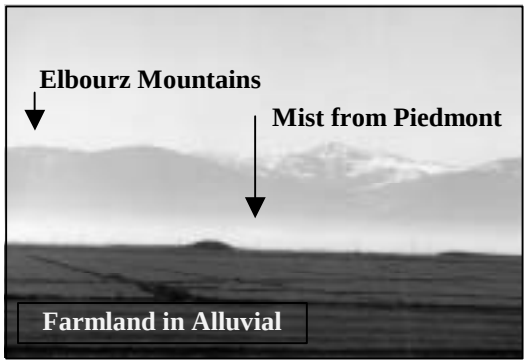
The Study Area is located at the downstream part of the so called Gorgan Plain, which is formed by alluvium deposits of Gorgan river, Gharasu river and their tributaries, which are originated from the valleys of southern side slopes of Elbourz Mountains. Gorgan Region, which includes the Gorgan Plain, is defined as the area bounded by Elbourz Mountains in south and east, by Alexander Wall in north and Caspian Sea in west, with an area of about 14,000km^2.

Gorgan Plain lies at the downstream areas of mainly the Gorgan River and Gharasu River watersheds. Gorgan River starts from peaks of Baba-Shamal Mountains and Narji mountains which is located on 56^{o}00'E and lat. 37^{o}30'N. The river runs from east to west, while gathering many tributaries originated from valleys of Elbourz Mountains and finally flows into Caspian Sea. The total area of the watershed is 11,480 km^2, while Gharasu river watershed occupies 1,720 km^2 of the southern part of the plain between Kordkuy and Taghi-Abad, about 40km along the foothills, which seems like a part of tributaries of Gorgan River. Elbourz Mountains lies in the Northeast – Southwest direction, while guiding the river

streams and defining the south side boundary of the watershed. At the far-east part of the watershed, Kopek Mountain divides Gorgan river from Atrak river, whose watershed covers the northern boundary of Gorgan river watershed. Gharasu river watershed, which is isolated from Gorgan river, forms an independent watershed at the Southwest part of the Gorgan plain. The total area of Gorgan Plain is about 5,330 km^2.

The Study area extends from 54^o06'00" E to 54^o42'00" E (about 45km on East-West direction) and from lat. 36^o47'19" N to lat. 37^o06'08" N (about 35km extends on North-South direction). Southern boundary of the area is defined by the National Road Kordkuy – Ali-Abad Route, which runs along foothill edge of Elbourz Mountains on East-West direction, while the north boundary is to be set as inscribed curve between Bandar-Torkman – Khajeh-Nafas Rout and Alexander Wall in Hemmad. The eastern boundary is defined by Ata-Abad, while the Western boundary of the area is Kordkuy–Gomishan road as which runs along the Caspian Sea coastal line. The figure of the Study area is seemed like a cocoon with an area of about 800 km^2.

The region contains two distinct topographic features; 1) the Plain; a flat area with smooth topographic highs with elevations ranging from –20 to 300m; 2) the Elbourz Mountain range which forms the south and east boundaries and ranges in elevation from 300 to 4,100 m. Alluvial fans which border the mountains on the north have initially steep slopes, interfingering into foothill zone within several kilometers, and connecting to the plain area. The plain has a gentle slope from south to north and east to west.

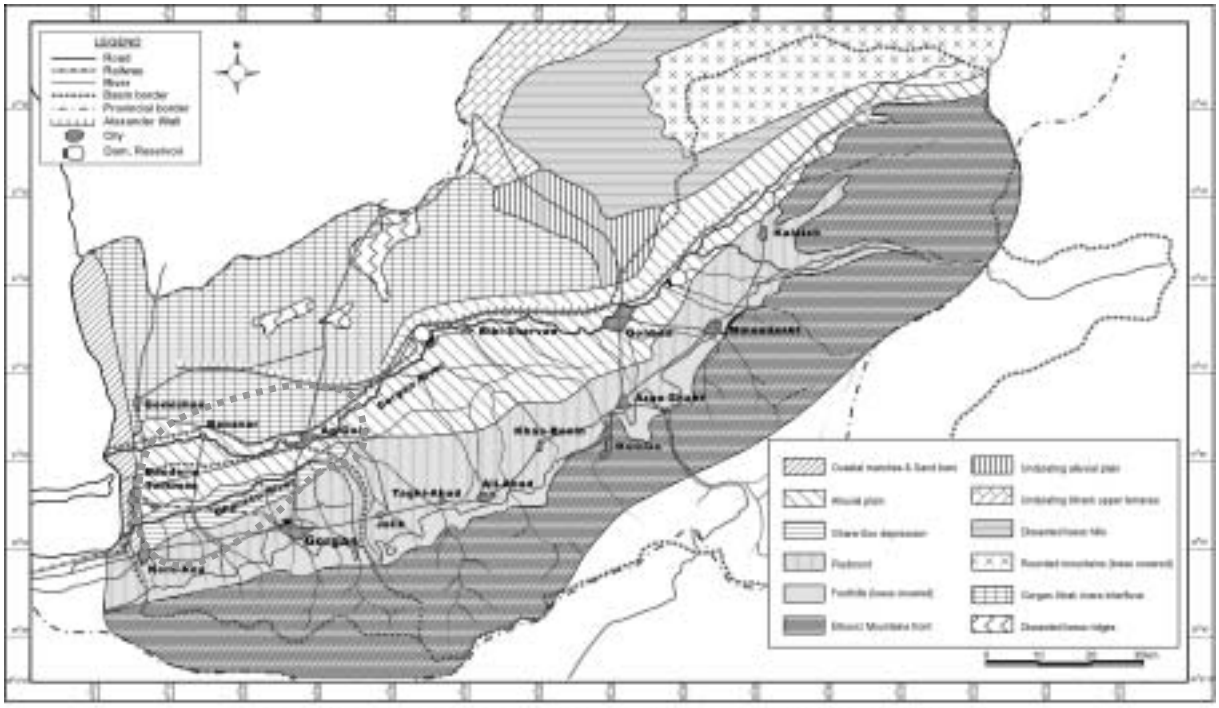


Scene from Farmland in Alluvial Plain to the Mountains

Slope from the high walls of Elbourz Mountains shows a steep decrease from 4,000 m to several hundred meters elevation within a few kilometer at first, and then enters into foothills ranges which are consisted of alluvium fans along the mountain west-east alignment. Major fans are identified as about twelve, which contributed for the historical agro-forestry productions from ancient days. At the edge of those fans Gorgan and Gharasu rivers run from east to west in the plain. Even though the both rivers formulate a concave corridor within some 20 km width, it is hard to distinguish the undulation. Quite gentle slope of 0.15m per 1,000m runs to the north up to Atrak river watershed. On this south to north direction, the Study Area shares the faint concave provided by the two streams.

On the east to west direction, within a distance of some 25 km from Kalaleh area near Gonbad, the slope is about 25m per 1,000m, with elevation decreasing from 100m to 35m. For the next

some 30km westward, the elevation decreases to 17m, with an average slope of 0.7m per 1,000m, at the location of Woshmgir Dam site. The elevation of the plain decreases continuously with a gentle slope and reaches to 13m below sea level during the range from the Dam site to Aq Qala, which is located at 40km in the westward direction. The slope from Aq Qala to the Caspian Sea is about 0.4 m per 1,000m in the 40km distance and the elevation decreases to 28m below sea level. The Gorgan River flows down in those slopes on east to west direction. The Study Area extends in the most downstream side roughly and the elevation is from 10m above sea level to 20m below sea level along the Gorgan River.



Major Physiographic Units of Gorgan Region (Mahler, 1971)

3.1.4 Geology

As stated in the previous section, topological frames of the region consists of Elbourz Mountains in south and east boundary, Atrak River in north and Caspian Sea in west. Entire region might be classified into three regions as 1) mountain region, 2) foothill region and 3) plain area. Based on the geological conditions, the Study Area can be broadly classified into 3 classes as mentioned below;

a. Geological features of mountain areas.
b. Geological features of foothill areas.
c. Geological features of the plain

(1) Mountain regions.

Generally speaking the mountain front forms the southern boundary of the Study area and hydrologic boundary varies between a constant flux recharge boundary (in the lime stone areas) to a zero flux and impervious boundary in the bedrock area.

1) Sedimentary rocks

It was analyzed with evidences that the Gorgan area was inundated several times. Hence sedimentation plays a major role in the geologic events, which led up to the development of present day geologic features. Red colored sandstone noticed in Fazel-Abad and Ali-Abad canyons is said as the oldest rocks and are probably of Paleozoic age (600–250 million years ago).

A black limestone formation (with calcite intercalations) believed to be Devonian (400 – 350 million years ago) or Carboniferous age (350 – 280 million years ago) can be seen in the area. This formation covers a vast area extending from 10km southeast of Gorgan up to Azad-Shahr. Permian sediments in the region are also somewhat calcareous with outcrops located mainly in the southern parts of the mountains east of Gorgan.

During Mesozoic Era (230 – 6.5 million years ago), a large geosyncline covered most of Iran which ultimately resulted in forming the Elbourz and Zagros mountain ranges in early Tertiary period. The fact that no outcrops of Tertiary sediments can be noticed in the highland areas of Gorgan supports this age of mountain forming. Jurassic sediments in the area are mainly calcareous but some sandstones and schists can be found. Cretaceous deposits are also calcareous being generally dark, and interbedded with calcite.

No Tertiary (65.0 – 2.0 million years ago) sediments can be noticed in the mountainous or highland areas in the Gorgan region. Because the Elbourz Mountain range was formed in early Tertiary time as the results of orogenic uplifts. The topographic relief caused by the formation of the mountains forced the existing Seas to regress towards the north and east.

These deposits are of a fluvial and Eolian origin consisting mainly of alluvial fans and wind-blown deposits.

2) Metamorphic rocks

Green-color rocks combining with schist is noticeable in places in the region, which is named “Gorgan Schists”, comprising a major portion of the Elbourz Mountains and extend from the town of Ali-Abad. They are Metamorphic rocks and are believed to be pre-Cambrian in age.

3) Igneous Rocks

Red colored schists can be noticed in various locations of the area. Igneous rocks in the watershed are fairly limited not only in areal extend but also in varieties. The rocks consist mainly of red andesites which can be seen at the south of Fazel-Abad and in an area south of Khan-Bebin. These rocks post-date the metamorphic schists as evidenced by intrusive andesite dikes. They are still however, believed to be pre-Cambrian in age. In the south of Fazel Abad, these andesites were the main source of material, which are formed the red

Cambrian sandstones.

(2) Foothill Region

Foothill region connects Elbourz Mountains and Gorgan Plain in about 10 or 15km range along the Mountains.

Eolian deposits consisting mainly of loess can be seen scattered in various parts of the foothill region as found at south of the city of Gorgan. Cause of the loess is believed that, during early Quaternary time (Pleistocene, about 2 million–11 thousand years ago), the weather in Gorgan had become extremely warm, resulting in melting of much of the perennial snow-fields in the area. This rise in temperature caused a significant decrease in atmospheric pressure. A high-pressure cold front from the Northeast Turkistan Desert invaded the low pressure Gorgan area at this time, carrying a lot of particulate matter consisting of silt, fine sand and clay into the area. Upon contacting the Elbourz range, precipitation was caused by cerographic lifting and the loess deposits now seen in the foothills were gradually formed. Melting of the great masses of ice resulted in heavy floods which transported some of the loess deposits northward depositing them in the northern plain area.

Loess thickness are about 150m in Kalaleh area (lon.55 35’E, lat.37 30’N), 130m to 70m depth and this loess layer deceasing from North to South in Gorgan city area (lon. 54 25’E, lat 36 45’N) and in the vicinity Nahar-Khoran (lon. 54 25’E, lat 36 45’N), the loess is non-existent. These fine grained deposits are semi-pervious and would be in the class of aquicludes rather than aquifers.

(3) Plain Region

The Gorgan Plain is generally quite flat, having a gentle slope originating as a result of regression of the ancestral Caspian Sea.

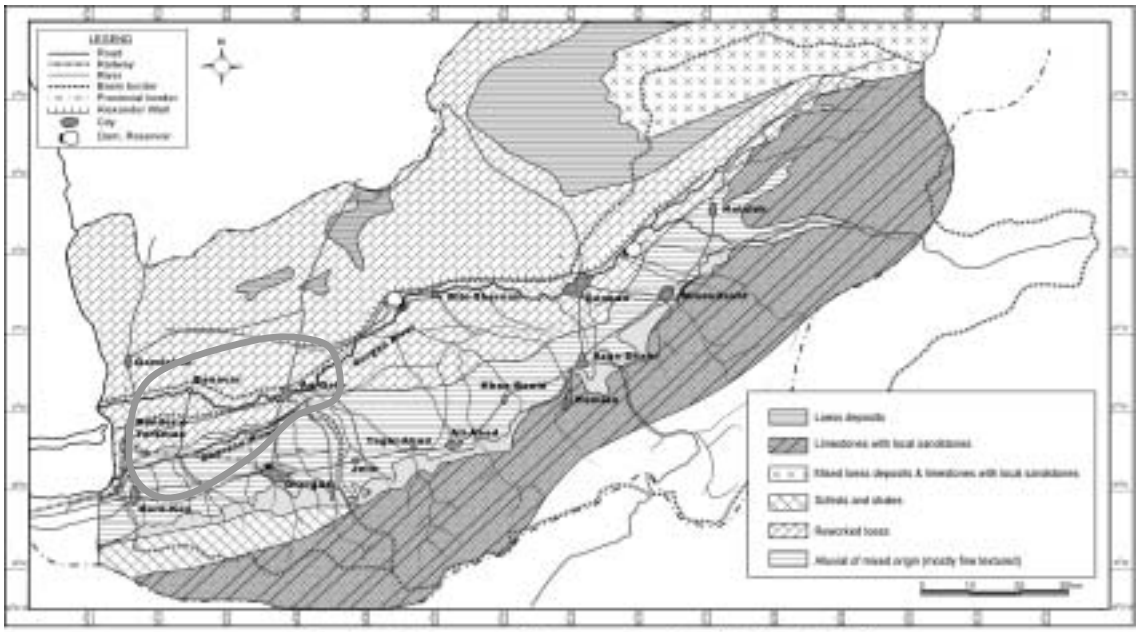
In almost all area in the Plain, a veneer of fine-grained sediments covers the surface. This veneer consists of silt and clay and ranges from zero to 50 m thick. Under this surface layer a layer of marine sediments exists. This layer is composed of mainly of marls and interbedded alluvium and sandstone with various degrees of consolidation. In the upper part of this marly layer, some silt and clay can be found which forms a transition zone; however, this zone does not seem to have any significant thickness. Generally speaking, the marl deposits are fine-grained having been deposited in a quiet marine environment. In most areas, shells can be found in abundance, which were dated as Mio-Pliocene in age.

Similar marine sediments can be noticed along the coast of the sea, which marly layers are not separated from the alluvium and sandstone but are inter-bedded in an inhomogeneous fashion. The alluvium and poorly consolidated sandstones form the main aquifers of the northern Gorgan Plain area: however, the high degree of anisotropy and inhomogeneity existing in the

Plain makes prediction of aquifer depths at any given location very difficult.

The Marls are blue-gray in color and somewhat calcareous. Generally, hydraulic conductivities are quite low in these sediments. It was reported with exploratory boreholes that the marls extend up to the foot of Elbourz range, underlying the alluvial fans in most parts. Geologic logs of exploratory wells drilled within the alluvial fans reveal that alluvial and marine formations also interfinger horizontally in a transition zone which is the result of successive transgression and regression of the ancestral Caspian Sea.

It is said that bedrock in the Gorgan area is composed of the Gorgan Schist. This also correlated with the extrapolation of these outcrops in the southern mountain area, based on previous seismic refraction studies. (The schists extend under the alluvium from south to north with a steep slope with a few east-west trending synclinal and anticlinal structures being noticed. The average depth to these schists ranges from 500 m in the southern foothill region to 800 m in the northern reaches of the plain.)



Surface Geology of Gorgan Region (Mahler, 1971)

(4) Hydrogeology of the Plain

1) Alluvial Fans

Generally, the alluvial fans are very important for exploitation of the groundwater resources and for function of recharging water into ground in hydrological circulation. In the Gorgan area there are twelve alluvial fans deposited by rivers, and all of them overlie marine marls and sandstone formations.

2) Fine-Grained Sediments in the Northern Plain Area

North of the alluvial fans the geology of the fine-grained deposits of the plain can be generally described as consisting of a thin veneer of Eolian deposits overlying marine marls and sandstones which are interbedded with some alluvial sands and gravels. To predict the exact nature of the aquifer system would require knowledge of all past depositional patterns.

In the recent past, the Gorgan area was occupied by an inland sea having several periods of transgressive and regressive overlap. During this time, alluvial deposits were also being formed by the action of mountain streams with their lateral extent directly dependent upon the existing shorelines at any particular time. It is therefore virtually impossible to predict with exact certainty the areal extent, depth and thickness of the aquifer system at any given location in the Plain due to the high degree of inhomogenity and anisotropy developed. However, certain basic facts regarding these aquifers have been clarified through previous drilling and testing, namely:

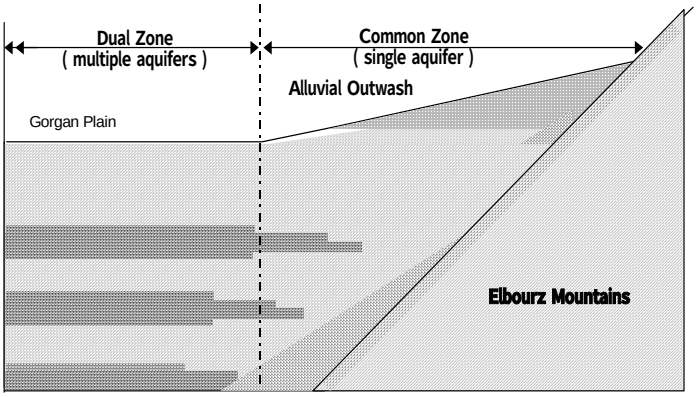
A. Unconfined or near surface aquifer exists in the Gorgan area which seems to be uniform in areal extent and varying in thickness from about 5 to 50 m. Water levels in this aquifer fluctuate due to effective precipitation (precipitation minus evapotranspiration), irrigation return flow and shallow well pumping and qanat extraction.

B. Underlying the unconfined aquifer at varying depths are layers of impervious to semi-pervious fine-rained deposits rich in silt and clay. This layer of silts and clays varies in thickness throughout the Plain and definitely forms a kind of barrier between the shallow (phreatic, unconfined) and deep (artesian) aquifer systems. The most logical concept of the deep aquifer zone is that of a series of confined aquifers consisting of alluvium or weakly consolidated sandstone separated by layers of silty clays or clayey silts. Determination of the exact nature and areal extent of an individual aquifer is quite random due to the lack of necessary data. In other words, on a microscopic scale (i.e. on an individual aquifer basis) the problem is quite undetermined. However, on a macroscopic scale (regional), a dual aquifer system can be visualized. The upper or unconfined aquifer, being one zone, and the sum of all the deep confined and semi-confined aquifers being another zone..

C. Close to the mountains, but at varying distances, the dual-aquifer system concept vanishes. In other words, near the mountains a sudden checking in stream velocities due to a change in topographic slope caused the bed load of the mountain streams to be deposited. This natural geologic process resulted in accumulation of coarse-grained alluvial material near the mountain fronts. Farther down the slope fine-grained deposits accumulated according to the natural law of stream deposition.

The deposits of coarse-grained materials near the head of the alluvial fans forms a zone whereby recharge from infiltration and subsurface inflow is allowed to percolate downward generally uninhibited by confining layers. It is through this coarse-sediment zone where the duel-aquifer system is commonly recharged (thus the name "common zone" has been adopted). The width or the common zone is a direct function of the magnitude of the alleviation processes – being wider in large alluvial fans, and narrower in smaller ones.

Dual Aquifer System Concept



Source : Final Report, Vol. 1 Gorgan Project. 1972

3) Limit of Artesian Aquifers and Pressurized Fine-Sand Formations

The transition between the common and dual aquifer zones is of course not a this line but may vary several hundreds of meters in any given location. The distinction between the common zone (single aquifer with a unconfined water table) and the dual zone (multiple confined and semi-confined aquifers with usually static water levels above the ground surface) was made strictly on the basis of exploratory borings and the study of existing wells and qanats. Boundary between the artesian aquifers (dual zone) and the non-artesian aquifer near the mountain front (common zone) can be defined almost same of alignment of frontline of alluvium fans.

It must be remembered that in the dual zone one may encounter many artesian aquifers, each with a different piezometric surface. This is due strictly to the advanced degree of inhomogeneity of the sediments causing many individual systems to be formed which hydro-dynamically may or may not be connected.

The pressurized sand formations are merely those fine-sand layers, which occur in the dual aquifer zone where artesian pressures may cause problems of well completion due to sand flowing into the well. The limit of these pressurized fine-sand layers for al practical purposes can be considered as the boundary between artesian and non-artesian flow (i.e. the boundary between the duel and common-aquifer zone).

However, the problem of fine sands are more pronounced the further north one goes as the result of more wide spread deposition of fine-grained deposits, and relatively higher artesian pressures on the underlying aquifers as compared to those higher in elevation towards the south (i.e. in a south to north direction, the topographic slope decreases much more rapidly than the slope of the piezometric surface).

3.1.5 Soils

Soils of the Study Area were analyzed using the existing data and information mentioned below:

1) Soil Maps and Reports of Soil surveys carried out by the Soil and Water Research Institute (SWRI) associated with AREEO of the Ministry of Agriculture.
2) Soil analysis data attained through the soil surveys by the Golestan Jihad-e-Agriculture Organization

Apart from these data and information, soil survey was also conducted by the JICA Study Team as mentioned below:

1) Soil profile survey and sampling – 11 locations
2) Soil sampling by auger – 20 locations by grid sampling

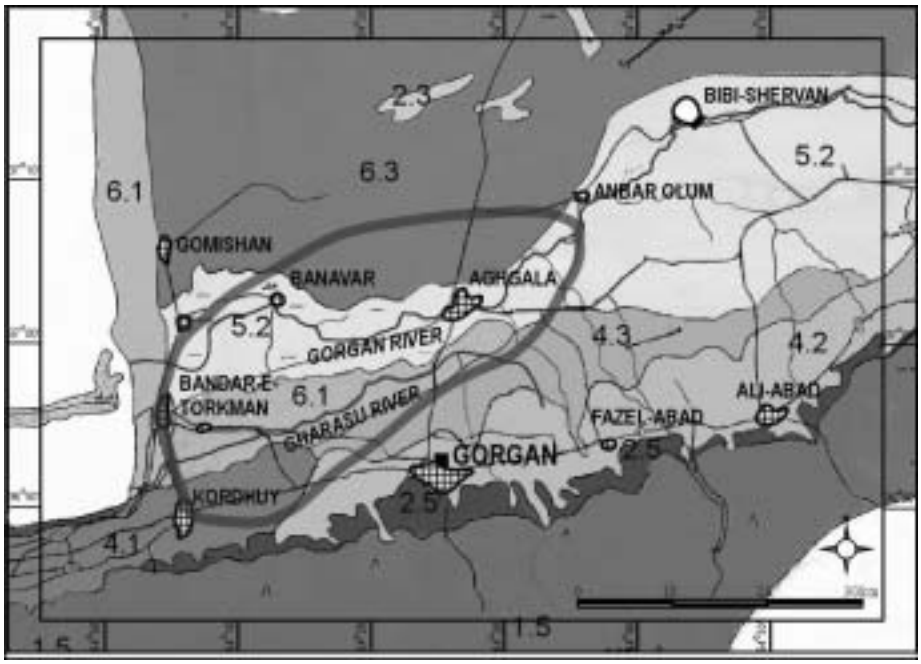
Based on the results of the soil survey, field survey, and the other information collected, the characteristics of the soils of the Study Area are described below.

As shown in Figure 3.1.1, the Study Area can be broadly divided into the 6 land units of 4.1, 4.2, 4.3, 5.2, 6.1 and 6.3 and the characteristics of each land unit is different based on the geology, climate and other factors. The discussion of soil characteristics is made based on these five land units. Soil Texture, Salinity and Alkalinity of the Study Area are shown in Fig.3.1.2 to 4 respectively.

1) Kordkuy land unit (4.1) of Piedmont plains, which occupies about 9.5% of the Study Area is located close to the Caspian Sea, at the foot of the mountainous range. The area is flat with a deep soil cover and a gradient of 1 to 2%. The altitude varies from 20 to 50m above msl.

In accordance with the FAO soil classification, these soils are classified as Calcaric and Eutric Cambisol (USDA: Xerochrepts, Eutropepts) and these are the soils conditioned by their limited age and represent the soils, which were changed of their color, structure and consistency resulting from weathering in situ. They are characterized by slight or moderate weathering of the parent material.

These are deep soils with very heavy to heavy texture and profile development. The results of the soil analysis show that the dominant soil texture in this area is heavy textured silty clay, clay and silty clay loam. Because of the heavy texture, there is poor drainage condition in some areas and are associated with Gleyic Cambisol. This area has a problem of inundation risk.



Legend

4.1 Kordkuy landunit of Piedmont plains

4.2 Gorgan land unit of Piedmont plains

4.3 Torang Tappeh land unit of Piedmont plains

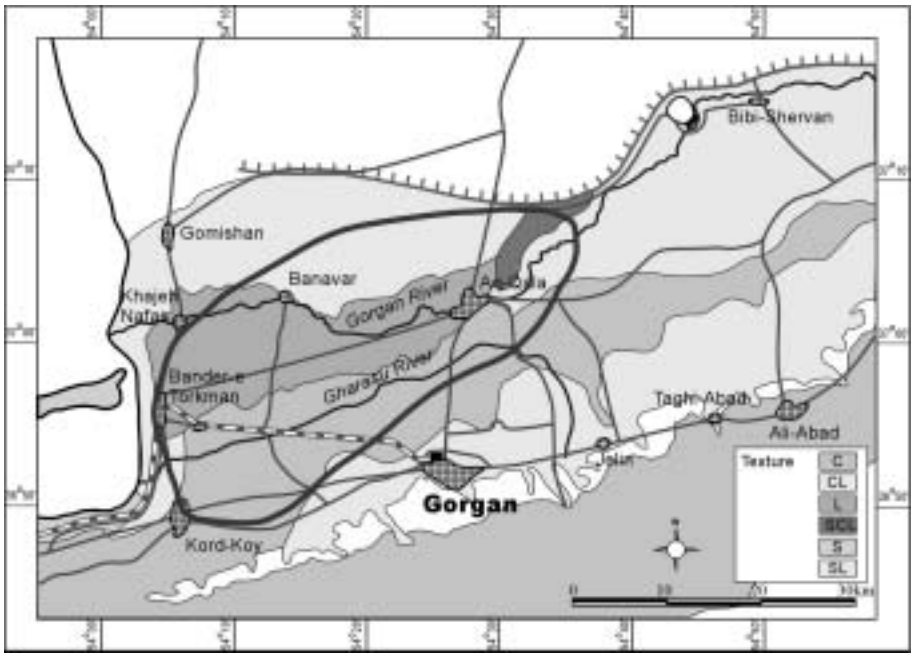
5.2 Sedimentary plains of Gorgan river

6.1 Low lands and Saline Area

6.3 Low lands of Gomishan Area

Fig.3.1.1 Soil Resources and Land Classification of the Study Area

(Source : Map of Soil Resources and Land Classification, AREEO, MOA, 1996)



Legend

C - Clay

CL – Clay Loam

SCL – Sandy Clay Loam

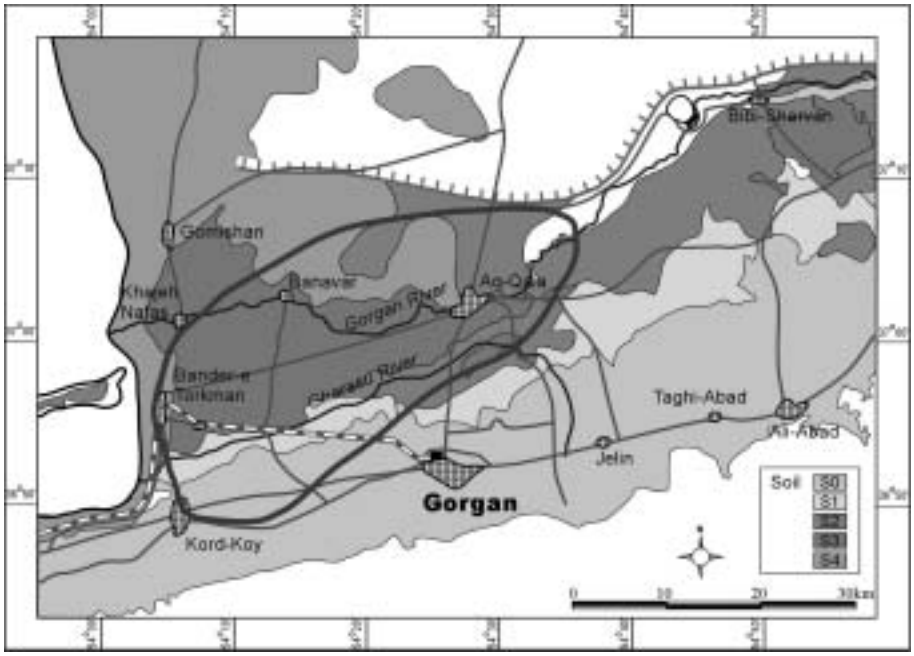
L - Loam

SL- Sandy Loam

S - Sand

Fig. 3.1.2 Soil Texture in the Study Area

(Source : GIS Section, MOA, Golestan Province)



Legend

S0 – EC<4mS/cm (No Salinity)

S1 – EC 4-8 mS/cm (Slight Salinity)

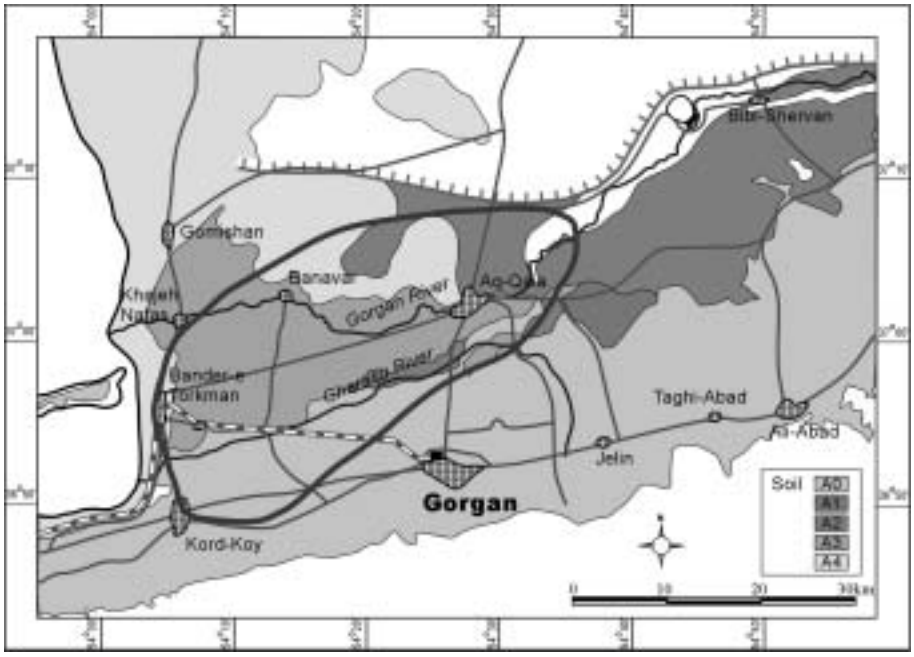
S2 – EC 8-16 mS/cm (Moderate Salinity)

S3 – EC 16-32 mS/cm (Severe Salinity)

S4 – EC >32 mS/cm (Very Severe Salinity)

Fig. 3.1.3 Salinity in the Study Area

(Source : GIS Section, MOA, Golestan Province)



Legend

A0 – SAR<8, pH<8.5 (No Alkalinity)

A1 – 8<SAR<13, pH>8.5 (Slight Alkalinity)

A2 – 13<SAR<30, pH=8.5-9 (Moderate Alkalinity)

A3 – 13<SAR<30, pH=9-9.5 (Severe Alkalinity)

A4–30<SAR>70, pH>9.5 (Very Severe Alkalinity)

Fig. 3.1.4 Alkalinity in the Study Area

(Source : GIS Section, MOA, Golestan Province)

FFrom the soil analysis, it was found that these areas have relatively low salinity with a top layer EC values of 1.6 to 2.8 mS/cm. In this range, the salinity effect can be considered as negligible. Although the EC values increases with root zone depth, it is within reasonable level. The pH value of less than 8 and SAR values of 3.3-6.6 indicates that these areas have low alkalinity. CEC values are comparatively higher in the range of 20-25 meq/100g of soil.

The percentage of organic carbon in this area is moderate to high (above 1%), but it decreases with root zone depth. The soil has a medium level of total N percentage is about 0.1 to .15%. Availability of P is moderate to high level (>20 ppm). Similarly, the availability of K is also high. Micronutrients such as Fe, Mn, Cu and Zn are in the low to moderate level. In general, these soils make good agriculture lands depending on the relief and climate. In order to prevent inundation, drainage and land improvement works are necessary.

2) Gorgan land unit (4.2) of Piedmont plains, which occupies a small area of 1.8% of the Study Area, is located in the southern part of Gharasu river. It has relatively flat alluvials of river, with a slight and regular slope of 2 to 3%. The altitude ranges from 20 to 150m above msl. The Gorgan land unit has a higher elevation because of large alluvial fans, built up by the streams pouring from the mountains into the plains.

In accordance with the FAO soil classification, these soils are classified into Calcic Kastanozems (Calcixerolls), Chromic Luvisols (Haploxeralfs), Eutric Cambisols (Eutropepts), and Calcaric Fluvisol (Xerofluvents). They are normally deep clay soils and in alluvial parts with clay, gravel and loamy soils. The results of the soil analysis in this area show that the soils are primarily heavy textured silty clay loam.

The salinity and alkalinity is also low. The EC of the top layer of the soil sample taken in this area is 1.4 mS/cm (S0) to 6.8 mS/cm and SAR is 3 to 8 (A0). The organic carbon is 1.5 to 1.7% and the fertility level and availability of major and micro nutrients are moderate to high level. CEC values are comparatively higher in the range of 20-25 meq/100g of soil.

The major limitation in this area is inundation and high water table in some areas. These soils have good capability for annual and perennial irrigated cultivation and can be improved further by the prevention of inundation, drainage and improvement of soil texture.

3) Torang Tappeh land unit (4.3) of Piedmont plains with relatively flat alluvials of river, occupies about 5.9% of the Study Area. These areas have slight and regular slope of at most 1% and have an altitude 10 to 60m above msl. This unit occupies a small area at the northern part of the Study Area.

In accordance with the FAO soil classification, these soils are classified as Dystric Cambisols, Gleyic Cambisols, Humic Cambisols (Dystropepts, Eutrochrepts, and Humitropepts) and these soils are conditioned by their limited age. They are characterized by slight or moderate

weathering of the parent material.

They are deep soils with heavy to very heavy texture. The main limitations of this soil are inundation risk and salinity (S1) and alkalinity (A1) in small quantity in some parts. The EC of the top layer of the soil sample taken in this area is 2.0 mS/cm (S1) and SAR is 2.8 (A0). The organic carbon is 1.65% and the quantity of NPK is in the moderate to high level. CEC values are in the range of 20 meq/100g of soil.

These soils have good capability for annual and perennial irrigated cultivation and orchards and they can be improved further through the prevention of inundation, drainage and improvement of soil texture.

4) Middle and downstream sedimentary and alluvial plains of Gorgan river (5.2), which occupies about 38.2% of the Study Area are mostly flat with a gradient of less than 1%. These areas are located at an altitude upto 80m above msl.

According to FAO soil classification, these soils are classified as Haplic and Gleyic solonchaks (Torriorthents, and Calciorthids). These are the saline soils, which are conditioned by limited leaching, low rainfall and high evaporation. High salt accumulation limits plant growth to salt tolerant crops, and limits growth because of less available nutrients. These soils can not be used for normal cropping unless the salts are leached. These are deep soils with moderate to heavy texture. The results of the soil analysis in this area show that the soils are primarily moderate textured silty loam with silty clay loam and clay at some locations.

The soil samples these areas show a wide range of EC values of 10 to 25 mS/cm (S2 to S3) at the top layer and normally the EC values of bottom layers are slightly higher than the top layer. Although the pH value is less than 8, the SAR values of these samples range from 15-35 (A2-A3), which indicates that these areas have moderate to severe alkalinity. These soils are poorly drained with a fluctuating saline groundwater table of 1 to 4m. CEC values ranges widely from 10 to 34, but most of the CEC values are in the lower range of about 10 me/100g of soil.

The percentage of organic carbon in this area is low (less than 1%), and it decreases with root zone depth. The soil has a low to medium level of total N percentage in the range of 0.07 to .10%. Availability of P is low to moderate level (<10 ppm). The availability of K is in the moderate to high level (160-250 ppm). In most cases, these nutrients reduce with depth. Micronutrients such as Fe, Mn, Cu and Zn are in the low to moderate level.

In general, these soils have relatively good capability for annual and perennial irrigated cultivation. Moderate to severe salinity and alkalinity are the major problems in these areas. By land improvement, leaching and construction of drainage system, these areas can be used for irrigated cultivation.

5) Low lands (6.1) of Gharasu depression close to the Caspian Sea and extends over the eastern part of the Study Area covers an area of 23.4% of the Study Area. These areas have an altitude 15 to 25m above msl.

In accordance with the FAO soil classification, these soils are classified as Haplic Solonchaks (Torriorthents), and Calcaric Arenosols (Pssamments). These are saline alluvial soils, which are suitable for salt tolerant species. These are deep soils of medium texture and the texture of the soil samples taken in the Study Area are normally medium textured silty loam, with silty clay loam, and silty clay at some locations.

The salinity varies widely from low level (S1) to very severe level (S4) based on their locations. For e.g., the soil samples taken close to the Caspian sea show a salinity values of as high as 38.2 mS/cm at the root zone depth although the salinity level decreases with respect to depth. The salinity levels at the inner part of the Study Area shows a salinity value of only 4.0 mS/cm. Similarly, the alkalinity also ranges from 4.2 (A0) to 40 (A4) depending on the location. CEC values are comparatively in the lower range of about 10 me/100g of soil.

The percentage of organic carbon in this area is low (less than 1%), which decreases further with root zone depth. The soil has a low level of total N percentage in the range of 0.06%. Availability of P and K are in the moderate level of 8 and 190 ppm respectively. Micronutrients such as Fe, Mn, Cu and Zn are in the low to moderate level.

In general, rainfed wheat and cotton are cultivated in these area. The major problems in this area are swampy state because of poor conditions of drainage and high salinity. Drainage and land improvement are necessary in these areas.

6) Coastal low lands (6.3) of Atrak river basin, the areas around Gomishan and inter-valley flood water plains of nearly flat and sometimes with a gradient of 0.5% occupies an area of 21.2% of the Study Area.

In accordance with the FAO soil classification, these soils are classified as Gleyic Solonchaks (Torriorthents), Mollic Gleysols (Calcixerolls / Haploaquolls) and Salic Fluvisols (Xerofluvents). These soils are poorly drained and with a high salinity and very saline groundwater. These are deep soils with medium to heavy texture The texture of the soil samples taken in the Study Area are mostly medium textured silty loam and heavy textured silty clay loam.

The salinity varies from severe (S3) to very severe (S4). The soil samples taken in this area show a salinity values of as high as 16 - 36 mS/cm at the root zone depth and the salinity level also increases with respect to depth. Similarly, the alkalinity is also very severe with SAR values ranging from 21.5 (A3) to 40 (A4). CEC values are about 15 me/100g of soil.

The percentage of organic carbon in this area is moderate to high (higher than 1%), and it decreases with root zone depth. The soil has a moderate level of total N percentage in the range of 0.14 to .17%. Availability of P is in the moderate to high level of 8.5 and 12 ppm and

the availability of K is in the higher level of 250 ppm. Micronutrients such as Fe, Mn, Cu and Zn are in the moderate level.

There are swampy areas in some parts, and these areas are used for rainfed cultivation. Relatively a lot of improvement operations are carried out in some of these areas. The major problems in these areas are salinity and poor condition of drainage. These areas have medium capability for agriculture. With enough irrigation, these areas can be used for irrigated cultivation.

A brief summary of the soil characteristics based on the main land units is given below in the following Table:

Major Characteristics of the Soils of the Study Area

Land Unit	Area (%)	Main Soil Characteristics
Piedmont Plain (4.1,4.2 and 4.3)	17.2	These are deep soils with very heavy to heavy texture (silty clay, clay and silty clay loam). The salinity and alkalinity problems are at a much lower level. The fertility status is usually at a moderate to high level. The major limitations of the soils are very heavy texture in some areas, and inundation due to poor drainage condition.
Sedimentary and Alluvial Plains of Gorgan River (5.2)	38.2%	These are deep soils with medium to heavy texture (silt loam and silty clay loam). They are poorly drained soils with fluctuating saline groundwater table. The salinity and alkalinity problems are at moderate (S2A2) to severe level (S3A3). The fertility status is usually low to moderate level. Salinity, alkalinity, and poor drainage are the major limitations of the soils.
Low lands of Gharasu depression (6.1)	23.4%	These are deep soils with medium to heavy texture (silt loam and silty clay loam). The salinity and alkalinity problems vary widely from low (S1A1) to severe level (S4A4) depending on the drainage and the proximity to Caspian sea. The fertility status is usually low to moderate level. Salinity, alkalinity, and poor drainage are the major limitations of the soils.
Lowland and Saline Areas of Atrak river basin around Gomishan (6.3)	21.2%	These are deep soils with medium texture (silt loam). The salinity and alkalinity problems are severe (S3A3) to very severe level (S4A4). The fertility status is usually moderate level. Salinity, alkalinity, and poor drainage are the major limitations of the soils.

In regard to the physical characteristics, the bulk density is within the range of 1.40 to 1.70 g/cc, which is the normal range for silty loam, silty clay loam and loam soils. The infiltration rate and the hydraulic conductivity of the soils in the Study Area range between slow to moderate levels and these soils are considered to be suitable for surface irrigation.

3.1.6 Existing Environmental Problems of the Study Area

(1) Water Pollution in Gorgan and Gharasu Rivers

The water pollution in Gorgan and Gharasu rivers is considered to be the major environmental problem in the Study Area. Water pollution is caused by three ways:

i) By farming practices: All the agricultural pollutants including pesticides, fertilizers and salts are drained into the river through the drainage water causing pollution.
ii) Some industrial wasters from Aq Qala and other nearby towns are also discharged into the Gorgan river causing pollution.
iii) There are 100 villages located near the rivers and the wastes from houses living closer to the river are also thrown into the rivers causing pollution.

In order to analyze the water quality of Gorgan and Gharasu rivers, well water and drainage water, water samples were taken during the 1st and 2nd field survey The results of the water quality analysis of the first field survey are presented in Table 3.1.1.

According to USDA classification, the water of Gorgan and Gharasu rivers is in the range of C3S1 to C4S2, and the salinity of water is in the high level. This condition was noted both during the first and the second field surveys. Therefore, the irrigation water may cause serious salinity problems, if the soils are not properly drained. However, the sodium is at a slight (S1) to medium level (S2). The wells in the Mehtar Kalate (Cheldin project area) have relatively good quality water with a low salinity. Since the irrigation in this project area is carried out with this water, the salinity, alkalinity problem in this Cheldin project area is low.

The water quality analysis made by environmental research center also shows higher values in spring and summer. During this period, the water in the Gorgan river and Gharasu river is mostly drainage water from the fields and therefore the salinity of water is very high, since the soils also have high salinity and alkalinity.

As shown in Table 3.1.1, the water quality in the winter season does not vary significantly at different locations, whereas the water quality during the spring and summer season (dry period) varies significantly based on the location. The water quality at the Vosmigr dam and the nearby Army farm canal are much better than the down stream sides and the salinity level of Gorgan river water increases by almost 10 times at the Aq Qala and Banavar project areas.

According to the FAO guidelines for water quality, the chloride is at a higher level for surface and sprinkler irrigation. Therefore, salt tolerant crops should be used. However, nitrate nitrogen is at a lower level and bicarbonate is at a moderate level. The other elements such as Cu, Zn, Mn and Fe are at a much lower level.

Table 3.1.1 Results of Water Quality Survey in the Study Area (1st Field Survey, January 2002)

Sample No.	Source	pH	EC mS/cm	SAR	SSP	Classification (**)	Cations and Anions, milliequivalents per liter								Nutrients/Elements, Parts Per Million (P.P.M)						Sol. K	TDS	TSS
							Na^{+}	Mg^{++}	Ca^{++}	Sum Cations	Cl^{-}	$SO4^{--}$	$HCO3^{-}$	Sum Anions	$NO3^{-}$ - N	$NH4^{+}$-N	Cu	Zn	Mn	Fe	meq/l	mg/l	mg/l
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	Upstream of Gorgan River	7.8	2.000	3.9	39.0%	C3S1	12.0	11.4	7.4	30.8	12.0	15.2	3.8	31.0	1.75	0.07	0.01	0.00	0.02	0.12	0.22	1,200	1,110
2	Middlestream of Gorgan River	7.8	1.990	4.0	40.3%	C3S1	12.0	10.8	7.0	29.8	12.4	13.4	4.2	30.0	1.47	0.14	0.02	0.00	0.02	0.76	0.19	1,190	780
3	Downstream of Gorgan River	7.8	2.340	4.8	43.9%	C4S2	15.0	11.0	8.2	34.2	14.0	15.7	4.3	34.0	1.75	0.14	0.03	0.00	0.01	0.70	0.23	1,500	40
4	Upstream of Gharasu River	7.9	1.430	3.0	36.2%	C3S1	7.7	3.8	9.8	21.3	5.2	9.6	6.2	21.0	0.00	0.00	0.01	0.00	0.02	0.09	0.37	1,000	10
5	Middlestream of Gharasu	7.9	1.550	3.9	44.2%	C3S1	9.5	4.6	7.4	21.5	10.0	5.6	5.9	21.5	0.00	0.00	0.00	0.00	0.01	0.07	0.24	1,200	10
6	Downstream of Gharasu River	7.5	1.570	3.3	38.5%	C3S1	8.5	5.2	8.4	22.1	6.8	9.1	6.2	22.1	0.00	0.35	0.00	0.00	0.01	0.10	0.30	1,230	10
7	Well Sample 1	7.5	0.982	1.5	25.0%	C3S1	3.2	3.6	6.0	12.8	5.2	0.4	7.2	12.8	0.00	0.00	0.00	0.00	0.01	0.04	0.04	550	10
8	Well Sample 2	7.7	1.457	5.4	57.2%	C3S2	10.7	4.0	4.0	18.7	11.2	2.1	7.4	20.7	0.35	0.07	0.01	0.01	0.01	0.09	0.10	1,000	0
9	Drainage Sample 1	8.1	47.600	62.5	76.8%	C4S4	590.0	131.0	47.0	768.0	570.0	196.5	3.5	770.0	0.07	0.00	0.05	0.00	0.09	0.28	0.41	50,500	190
10	Drainage Sample 2	8.1	16.110	16.5	51.2%	C4S4	130.0	96.0	28.0	254.0	176.0	76.0	2.0	254.0	0.00	0.00	0.03	0.00	0.05	0.09	0.41	14,000	60
11	Drainage Sample 3	8.1	8.380	16.4	64.1%	C4S4	75.0	33.0	9.0	117.0	84.0	27.3	5.7	117.0	0.00	0.07	0.02	0.00	0.03	0.07	0.37	5,500	20
12	Profile Water table Sample	7.1	38.800	48.8	72.6%	C4S4	450.0	100.0	70.0	620.0	444.0	171.9	4.1	620.0	0.70	0.07	0.04	0.00	0.08	0.36	0.15	38,500	8,980

Note : The Sampling was carried out in January, 2002

(**) USDA Classification of Irrigation water salinity

C1 - Low Salinity Water (EC<0.25 mS/cm)
C2 - Medium Salinity Water (EC = 0.25-0.75 mS/cm)
C3 - High Salinity Water (EC = 0.75 - 2.25 mS/cm)
C4 - Very High Salinity Water (EC>2.25 mS/cm)

S1 - Low Sodium Water (SAR<10)
S2 - Medium Sodium Water (SAR10-18)
S3 - High Sodium Water (SAR18-26)
S4 - Very High Sodium Water (SAR>26)

As shown in Table 3.1.1, the drainage water has a very high EC ranging from 8 mS/cm to 47 mS/cm, which has very severe salinity and alkalinity problems. This extremely saline-sodium drainage water is drained into Gorgan river and the Caspian Sea. Although the water of the Caspian sea is less saline (EC = 18 mS/cm or TDS = 12 mg/l) when comparing with the sea water, which is about 3 times than the Caspian sea, the higher amount of salty water and chemicals draining into Caspian sea also has a potential impact on the fishes in the downstream side of the study area.

(2) Other Environmental Problems in the Region

1) Atmospheric Pollution

It is a common practice in the areas such as Cheldin project area to burn the fields immediately after harvesting of wheat so that the fields will be ready sooner for the next spring crop such as rice or soybean. Heavy smoke causing air pollution were observed during the field survey in the Cheldin project area.

Field Burning in Cheldin Area after Harvest (June 2002)

In stead of burning of the fields, it might be better if the wheat straw are ploughed into the soil so as to increase the organic matter of the soil. However, the farmers choose to burn the fields, since it is much easier and faster. Research and extension of proper tillage methods are necessary so that the farmers will avoid burning of fields. Regular monitoring of atmospheric pollution and adoption of proper farm management practices are necessary.

2) Health and Sanitation

During the field survey, it was reported that the house wastes and garbages are mostly thrown into the nearby canals or river. One of the most important problems existing in the study area is the location of many villages at both sides of the Gorgan river. In this case, the human sewage and also the agricultural drainage including agro chemicals cause the pollution of Gorgan river and cause diseases on fishes. As a result, the people who consume those fishes may be infected with the water borne diseases such as skin diseases or stomach ailments etc. Also, the children are infected with some diseases because of swimming in Gorgan river. Monitoring of regulations of waste disposals and provision of waste disposal measures are

necessary.

3) Social problems in project execution

In general, people of Turkmen Origin live in and around the Study Area, except for a small area in the western part of the Study Area, where people of Mazandaran and Sistan province live. The irrigation and drainage projects are executed based on the request from the farmers and the cooperatives and therefore, there is very little disagreement among people. However, when a storage reservoir or a desilting pond needs to be constructed, the cooperative needs to make arrangement for purchasing the lands from the concerned farmers. Some times, when new irrigation and drainage projects are executed by the government, it might be difficult to get the agreement of the farmers, if the proposed irrigation and drainage system disturbs the land allocation of the farmers. It was reported that the introducing of drainage system in the Cheldin project area has been postponed mainly because of the disagreement of the farmers.

3.2 Socioeconomic Conditions of the Study Area

3.2.1 General

(1) Administration

The Study Area includes 4 Districts (*Shahrestan*) and 6 Sub-Districts (*Bakhsh)* in the Golestan Province. The names of Districts and Sub-Districts are shown in the following table.

Districts (*Shahrestan*)	Sub-Districts (*Bakhsh)*
Kordkuy	Central Kordkuy
Bandar-e-Torkman	Central Bandar-e-Torkman
Aq Qala*	Central Aq Qala, Anbor Olman
Gorgan	Central Gorgan

*Aq Qala District use to be Aq Qala Sub-District in Gonbat District until 2 years ago.

(2) Population

The population of 4 Districts occupies 40% of that of Golestan Province. The ratio of the rural population is about 70%, except Gorgan. They are mainly 4 different races: Turkmen, Mazandarani, Baluchi and Sistani (Zaboli).

Among economically active population, agriculture sector dominates the share of employment by industrial origin, except Gorgan. Service sector and industry sector follow the agriculture sector. Thus, it can be concluded agriculture is the important sector of the area from the viewpoint of the employment.

(3) Social Infrastructure

1) Road

Almost all of the roads connecting to the major cities in the study area are asphalt paved; dual lane type roads with 8.0m ROW, while feeder roads from those inter-city connecting roads are earth graded 6.0m ROW. All of the farm roads are 6.0m ROW or 3.0m ROW and easily turned into muddy and slippery conditions by rainfall.

2) Electricity, Water Supply, and Communication (Telephone Line)

Alternating current electricity with 220 voltages is supplied to areas along the inter-city connecting roads and to important rural facilities such as pump stations. But the electricity is not supplied to most of the farm areas. Potable water supply is available only in major cities. Almost all of the people in rural areas obtain drinking water from rainwater of storage tanks, individual, or community wells. Rural administrations are delivering drinking water by truck-amount tanker in dry seasons. Telephone facilities are available only in cities such as Gorgan, Aq Qala, and Bandar-e-Torkman. Only some of the government officers and people use mobile phones for their communication. Majority of the people in the villages use "*telephone hane*" (telephone office) for their telecommunication.

3) Education

The number of schools and students of each District are shown in following table.

Number of School and Students as of 1999

	Aq Qala	Torkman	Gorgan	Kordkuy
Primary school				
Number of schools	N.A.	211	323	63
Number of classes	N.A.	656	2,230	353
Number of students	N.A.	17,057	59,276	8,439
Junior high school				
Number of schools	N.A.	60	203	36
Number of classes	N.A.	327	1,213	209
Number of students	N.A.	9,424	37,631	6,416
High school				
Number of schools	N.A.	36	153	35
Number of classes	N.A.	212	1,183	205
Number of students	N.A.	6,648	34,266	5,395

Source: Provincial Educational Organization, MPO of Golestan Province, 2000

4) Health and Medical Care

The medical personnel and facilities are centralized in Gorgan City. Four out of six Dehs surveyed have a public health center for vaccinating children, taking care of pregnant women and expanding a family planning. A public clinic exists in relatively large Deh and city.

3.2.2 Rural Social Structure/ Deh

The difference of the administrative structure of Deh is not so noticeable according to race in the Study Area although that is remarkably appeared in their customs and activities, especially of rural women. The representatives of Dehs are the members of Rural Council, elders, and mullahs. The society consists of landed farmers, tenant farmers, agricultural labors, animal breeders and sometimes, public servants, small storekeepers, *ab-ban mirab* (a traditional water manager), *dasht-ban* (a traditional farmland watcher), and *hammam-ban* (a traditional public bath caretaker). In other words, main income sources of Deh settlers are agriculture and animal husbandry. Among the representatives, Rural Council plays a big role in the recent Deh society.

3.2.3 Rural Associations

There are some public and private associations and groups: (Public) Rural Council, RPCs (Rural Production Cooperatives), RCO (Rural Cooperative Organization), *Basiji*, Coupon Distribution Organization, Islamic Assembly, :(Private) mosque management groups, women religious groups, milk collecting and transport organization, and *Qalz-al-Hassanah* (Lending gently). More details about Rural Council, RPCs (Rural Production Cooperatives), RCO (Rural Cooperative Organization), and *Qalz-al-Hassanah* are described below.

(1) Rural Council

Rural Council, the smallest unit of the administrative organization, is relatively new. There are always Rural Councils in Dehs where more than 20 households live. Rural Councils were established first through Rural Council election in February 1999. Although they were selected by the election, the status of the members is a volunteer and they can get no reward.

Rural Council does not include *Dehdar* (Head of Deh). *Dehdar* is a governmental officer and supervises about 5-6 Dehs together. Rural Council consists of President, Vice President, and Secretary if they are 3, and adding Accountant and one more Secretary, if they are 5. The term of their service is 4 years. So as to be a member of the Council, candidates need to register their names at the department under Ministry of Interior in *Bakhsh* (Sub-District) government, and be screened whether he/she is eligible for the members of Rural Council. The candidates should be older than 21 year-old Iranian men and women (after serving in the army, if men), and are required of finishing a lower secondary school, and not committing crimes in the past. After the screening, the eligible persons are announced and then the election is implemented.

A part of the governmental budget is allocated to Rural Council. The Council covers the all fields and activities concerning improvement of the living standard of the Dehs such as installation of rural and agricultural infrastructure.

All of the members are very active and enthusiastic about solving the problems and improving the living standard of their Dehs. But in case of that population of the Deh is small such as Deh Tazeh Abad (mainly consisting of Baluchi), the members of the Rural Council have to face a serious budget problem. This is because people have to share the cost of all public works such as construction of a school and a health center and it is hard for a small Deh to collect the huge amount of share from the settlers.

(2) Rural Production Cooperatives (RPCs)

1) General

RPCs (Rural Production Cooperatives) is a public organization established for effective agricultural water use through well-managed irrigation facilities such as pumping stations and irrigation and drainage canals. There are 27 RPCs in Golestan Province as a whole and there are 8 RPCs in the Study Area. 6 out of 8 RPCs are located in 4 Priority Areas. General information of each RPCs in the Priority Areas is shown in the following table.

General Information of RPCs

Name (No. of Priority Area)	Prefecture	Year	No. of Covered Deh	Covered land area (ha) (With irrigation)	Membership (persons) (Men:Women)	Main Race	Average holding area (ha) (Maximum/ Minimum)
Pavand (Priority Area 1)	Aq Qala	1997	7	3,500 (2,000)	430 (425:5)	Turkmen, Baluchi	8 (2/ 100)
Hemat (Priority Area 2)	Aq Qala	1998	3	1,962 (1,025)	185 (175:10)	Turkmen	10 (1/ 60)
Shadi Mehr (Priority Area 2)	Aq Qala	1996	3	1,172 (0)	379 (368:11)	Turkmen	2-4 (Plan)
Partov-e-Bonavar (Priority Area 3)	Torkman*	1995	3	1,500 (600)	158 (157:1)	Turkmen	6 (1/ 40)
Gomishan Kesht (Priority Area 3)	Torkman	1997	6	4,800 (0)	291 (287:4)	Turkmen	5 (2/ 130)
Rooyesh-e-Mehtar Kalateh (Priority Area 4)	Kordkuy	1997	2	1,558 (1,200)	450 (440:10)	Mazandarani, Sistani	1-3 (0.25/ 15)

*Torkman = Bandar-e-Torkman
Source: Hearing from the RPCs mentioned above (June, 2002)

The eligible persons to be a member of RPCs are those who hold farmland in the covered area (Dehs) by RPCs. The entrance fee or the share is a little different from one by one.

2) Organizational Structure

The RPCs comprises of a RPCs President, an accountant, agricultural technicians usually dispatched from Jihad-e-Agricultural Organization and an executive board selected among the members. The executive board comprises of 5 persons: President, Vice President, Secretary, and two non-positioned persons. They cannot get any rewards from RPCs and are farmers, the members of RPCs. The election among all the members is conducted every 3-year. And 2 inspectors, who supervise the management of RPCs 3-4 times a year, are also selected

at that time. Their term of service is 1 year. RPCs is a government-led organization. Commonly, at the initial stage of setting up RPCs, an official of Jihad -e- Agricultural Organization goes to a Deh and explains about RPCs. Then, farmers organize the promoters' group although it is ideal that RPCs are established based on farmers' spontaneous intention.

3) Activities of RPCs

The activities of the RPCs are mainly 1) construction of agricultural infrastructure, 2) water distribution, 3) selling agricultural inputs, 4) lending or selling agricultural machinery, 5) collecting and shipping of agricultural products and 6) giving technical instruction and advice through supervision (technical extension).

4) Available Finance for RPCs

When RPCs carry out their activities such as installation of agricultural infrastructure, they can obtain the credit from Agricultural Bank in the different conditions from individual farmers. The differences are described in the table below.

Type of Debtor	Condition
Individual farmer	- Required of the reserving fixed time deposit at the bank which he/she wants to borrow money determined by types of activities
RPCs/ the member of RPCs	- Not required of the reserving - The interest rate is discounted at 50% except "*Qalz-al-Hassanah*"

There are three types of finance related to or through RPCs: 1) RPCs borrows money from the Bank for purchasing agricultural machinery and inputs, then RPCs pays back money to the Bank, 2) RPCs borrows money from the Bank for implementing projects related to soil and water such as leveling for the individual land of the members, and then the landowners pay back money to the Bank through RPCs, and 3) RPCs members can obtain the credit for the individual use in the same conditions with the RPCs among the allotment of each RPCs with the inquiry letter from the Organization. The conditions for each activity are shown in the table below.

Conditions of the Credit (2002)

Purpose of the credit	Interest rate (commission) /year	Among the total	Repayment term
Purchasing of agricultural input	4% (*Qalz-al-Hassana**) 14% (other facilities)	25% 75%	1 year
Purchasing of agricultural machinery	16%	100%	5 year
Implementation of the projects related to water and soil	12-14% (depending on activities)	100%	5 year

Source: Hearing from the counterpart (June, 2002)

* *Qalz-al-Hassanah* is a name of Islamic contract type's facilities without interest (actually low commission)

(3) Rural Cooperative Organization (RCO)

1) Organizational Structure

Rural Cooperative Organization (RCO) is a public organization established for improving rural settlers' living standard through providing living necessaries, agricultural inputs, and collecting and shipping of agricultural products. The Head Quarter of RCO is located in Tehran. Central Organization for Rural Cooperative of Iran is a competent authority of RCO. RCO Union Golestan Province was established in 1999 under the supervision of Organization for Rural Cooperative of Iran Golestan Province. Nevertheless, the history of RCO in Golestan Province is long and the first RCO at Prefecture level was established in Gorgan Prefecture in 1963. Under RCO Union, there are 9 prefecture level's RCOs and each of them has *Dehestan* or large Deh level RCOs. Moreover, these levels' RCOs have some RCO shops in Dehs, which sell living necessaries including sugar (with coupons) and agricultural inputs. Most of the RCOs' management goes well and about 98% of them are in black.

2) Eligibility and Privileges of the Members

The members of RCO are 85,000 households in Golestan Province as a whole. The eligible persons to be a member of RCO is those who engage in agricultural related works such as farming, animal husbandry, rent-a-tractor, and agricultural industries. They also have to live in *Dehestans* covered by RCOs. At least about 60% of Deh settlers are the members of RCO. The members buy at least one share at Rls.1,000. Those who are not members of RCO can use RCO shops but the members have two privileges: 1) obtaining credits for agricultural production and 2) gaining dividends if the RCO has benefit.

3) Activities of RCO

Main activities of RCO are four: 1) selling living necessaries, 2) selling agricultural inputs (seeds, agricultural chemicals, and etc.), 3) distributing the products such as petroleum and sugar in exchange for coupons, and 4) collecting (at guaranteed prices) and shipping of agricultural products especially which have some problems on marketing.

4) Strengths, Problems, and Future Plans of RCOs

Organization for Rural Cooperative of Iran Golestan Province believes that it provides necessary services for farmers and rural people and contributes to improving of their lives. On the other hand, one of the problems is that too much milk production brings about huge buying cost. Organization for Rural Cooperative of Iran Golestan Province knows the requirement of a milk-processing factory but it is not affordable for now. Moreover, the members of RCOs do not consider that RCO is their organization and do not make much effort to improve them. A future plan of the Department is to construct a slaughterhouse.

(4) *Qalz-al-Hassanah* (Lending gently)

Qalz-al-Hassanah (Lending gently) is an informal money lending organization mainly for those who cannot borrow money from banks. It is not related to the same name service of Agricultural Bank. This organization lends money without interest (commission) and collateral. *Qalz-al-Hassanah* is popular mainly among Mazandarani Dehs.

3.2.4 Rural Women

As a part of the Deh survey, the condition of rural women was examined through group interview with women being between the late 20s and 50s by race. The difference among races was remarkably revealed from the life style of women. Women's condition by race is summarized in the table below.

	Turkmen	Mazandarani	Baluchi	Sistani
Appearance	A flower printed one-piece dress with a long sleeve and a long length and a flower printed scarf	A black Islamic cloak (*chador*) and a scarf	Ditto	Ditto
Av. martial age	17-20 (at oldst 30)	15-20	15	15-20
Av. no. of children	3-5	2-5	2-5	3
Main activities	-Weaving carpets -Making short-napped coarse carpets, -Housekeeping -Taking care of domestic animals -Making dairy products	-Farming -Raising chickens and ducks for self-consumption, -Making dairy products from the milk -Sewing, -Handicrafts -Housekeeping.	-Farming with their husbands -Animal husbandry -Weaving -Housekeeping, -Needlework -Making yogurt	-Farming -Taking care of domestic animals -Making dairy products -Housekeeping
Sphere of women	Everywhere, if their husband permit	Ditto	Neighboring cities without husbands' permission	Neighboring cities, usually with husbands (or need to get permission from them)
Education	In the past, many women could not go to school At present, almost all women go to school by the level of a lower secondary school	Most of the women go to school by the level of upper secondary school	Normally, by the level of primary school	Normally, by the level of primary school
Voting right	Both men and women have voting right from 16 years old by law	Ditto	Ditto	Ditto
Voice of women	Women do not hesitate to speak up in front of men, but decision makers are men	Not big and all matters are decided by men	Women can consult with men but decision makers are men	Ditto
Access/Control on resources (water, land, farmland, domestic animals)	Can access and control on all the resources mentioned	Ditto	Ditto	Ditto
Problems	-Less profitable weaving carpet	-Unemployment of both men and women	-Lost of income sources and	-Landless -Not enough

	Turkmen	Mazandarani	Baluchi	Sistani
	-Limited working place	especially graduating from an upper secondary school -Hard for girls to continue study if there is no higher educational institutes in their Dehs	nothing to do -Hard for girls to continue study	income generating works
Future desire	-Continuing/ restarting weaving carpets -Improving rural social infrastructure	-Income sources besides farming	-Income sources -Girls receive higher education	-Learning technique such as weaving carpets and sewing

3.2.5 Assistance from the Government and Finance for Farmers

(1) Present Assistance from the Government

1) General

Governmental assistance programs for farmers and rural areas are now provided by Ministry of Jihad-e-Agriculture, Ministry of Industries and Mining, Ministry of Housing and Urbanization, Ministry of Education, Ministry of Health and Medical Treatment, and Islamic Revolution Housing Foundation. Besides these programs provided through Ministries, Agricultural Products Insurance Fund contributes much to securing agriculture and farmers' lives.

2) Problems with the present assistances from the government for farmers

The problems of the present assistances from the government for farmers are summarized as follows: 1) the programs cannot cover all farmers who need the assistance (about only 1/3 of the farmers under the coverage of the programs), 2) the subsidy is not enough, especially for infrastructure, 3) the approval of the development plan and its subsidy is not timely enough (the second half of the year), 4) the private sector is not interested in investing in the study and the project implementation for farmers, 5) the budget of the assistance for farmers is scattered in too many small projects, and 6) Land (Use) Bank* is not active in Golestan Province.

*Land (Use) Bank is a subordinate bank of Agricultural Bank. It lends the land after land preparation and installation of irrigation and drainage networks to farmers and horticultural companies, and food-processing industries.

(2) Available Finance

1) General

Agricultural Bank or Bank Keshavarzi distributes about 65% of the total credit facilities extended to the agricultural sector as well as 10% of the total credit in Iran. The rest 35% is provided by the other national banks such as Bank Melli, Saderat, Mellat, and Tejarat, and Sepah. Besides them, RPCs (Rural Production Cooperatives) and RCO (Rural Cooperation Organization) have a credit scheme for their members. Moreover, *Qalz-al Hassanah*, an informal money lending organization in this case, is popular among Mazandarani Dehs.

2) Problems with Agricultural Finance and Countermeasures

Iranian government and farmers have not been invested enough in the agricultural field so far. The main reason for farmers cannot invest in agricultural infrastructure and agricultural inputs is lack of own capital due to recent drought, shortage of water, and subdivision of farmland. Moreover, it is very hard for them to borrow money from Agricultural Bank due to lack of collateral and so on. Therefore, farmers, if they are the members of RPCs, expect to borrow money through RPCs. However, RPCs also face many difficulties when they intend to obtain loans from Agricultural Bank. First, the Bank imposes the hard conditionalities to be fulfilled. Putting them concretely, 1) RPCs need a co-signer, 2) The members of the executive board and the ordinal members did not overdue once they borrowed money from Agricultural Bank, and 3) Landownership of the members should be very clear. In other words, all of the RPCs members cannot always fulfill the conditionalities mentioned above, for example, there are some members who have overdue repayment. Additionally, some of the farmers who hold the farmland that were distributed after the Islamic Revolution or inherited do not have a land register. Second, even if the RPCs found a co-signer and obtain credit from Agricultural Bank, some new difficulties come up. The co-signer cannot obtain credit from the bank individually and cannot leave Iran until the RPCs pays off its debt. Under this situation, some traders make benefit through lending money with high commission (interest), instead of banks. Moreover, the existing banks are all national and there are no private banks that can be a competitor of national banks. (Note: Private banks have been established recently, but they do not competitive power against national banks yet.)

Finally, the ways out of this situation are as follows:

a) To promote the private banks that have competitive power against national banks,
b) To establish “Association Bank” which can provide loans with more simple conditionalities,
c) To simplify the conditionalities and
d) To put more stress on agriculture (banks).

3.3 Agricultural Conditions in the Study Area

3.3.1 Agriculture in the Study Area

(1) General

The agricultural conditions of the four districts related to the Study Area are discussed in this section. Based on the agricultural conditions, the Study Area is divided into three regions as mentioned below:

1) Southern region of Gharasu River has good conditions for agriculture. The agriculture is mainly irrigated, but there is also rain-fed farming in this region. The farmers do not worry about irrigation because the rainfall is relativelly abundant at the base of the Elbourz Mountains. The soil has medium texture, except the site No.4, in Mehtar Kalate village, where it is heavy. The salinity problem is not severe and it is possible to have two to three harvests in a year. On the other hand, the farm scale in this area is very small, reaching less than 1.0 ha. In this region, the main crops are paddy rice with vegetables during the summer, such as cabbage, squash, cotton, soybeans and fruit trees.
2) The zones of both banks of the Gorgan River have very good conditions for agriculture and high yield. The soil texture is silty loam and the groundwater level is low. The rainfall is about 400mm per year. The main crops are wheat, barley, cotton, etc.
3) The areas out of the Gorgan River have the worse agricultural conditions and lower productivity. Especially, the northern region of the study area has problems for agriculture. The soil has high salinity and alkalization problem. The rainfall is low, about 250mm per year, and evaporation and temperature become very high during the summer. The farming scale is larger than other regions. The main crops are barley and rapeseed in rain-fed fields, and wheat, cotton, paddy rice and maize in irrigated fields. The problems of farming are related to the poor drainage from January to April, salt damage and lack of water.

(2) Farm Households

In the Study Area, 90% of the population are Torkman, who has settled down from ancient time. Balchi and Sistani also live in this region, who moved to Golestan as laborer of harvesting cotton from Baluchistan and Sistan about 40 years ago. Besides, Mazandarani of Persian has been settled in Mehtar Kalate of Kordkuy district.

Most of the Balchi and Sistani became land owners after the land reforms of the white revolution and the Islamic revolution in 1979. Their farm scales are very small, 2 or 3 ha per farm, due to the high number of the laborers. The next table shows the number of farms of land owners, tenant farmers and laborers by district of the study area.

Number of farm Households in Each district of the Study Area (2000-2001)

District	Number of Farms		
	Owner-farming	Tenant farming/Laborer	Sum
Aq Qala	12,938	1,518	14,456
Bandar-e-Torkaman	7,496	0	7,496
Kordkuy	7,104	3,838	10,942
Gorgan	14,648	7,410	22,058
Total	42,186	12,766	54,952

There are many farmers in the Study Area engaged in the agriculture sector with no land. These farmers are divided into two types: the tenant farmer and the employer (laborer). In the case of tenant farmers, the whole farming activities are charged on the tenant farmer, and the tenant farmer gets one third of the products. In the case of the laborer, the farmer is a daily laborer. Over 80% of the laborers are women, whose working hour is short (commonly six-hour per day) than that of the men (with eight-hours per day). In general, the farm works of women are light works, such as weeding, transplanting of paddy rice seedlings. However, in the cotton harvesting, women and men work together with no difference of wage. The wage of women is US$2.0 /day for light work, and that of men is US$6.0 to 7.0 /day for heavy work, such as harvesting of paddy rice.

It seems that the high rate of rural population in Golestan province, 46% in both of women and men, is caused by the existence of many small farms created by the land reforms after the revolution. In addition, the equalized inheritance of land by the Iranian law increases the number of small lands.

(3) Farm scale

The number of farms and cultivated area by class of farm scale are shown in the following table. The average of farm scale in the whole Golestan province is 6.7 ha.

Farm Scale in Golestan Province (1996, Census)

Classification of farm scale	Farmers		Cultivated Land	
	Number	%	ha	%
< 1 ha	4,408	5.2	2,438	0.4
1 ~ 2 ha	13,844	16.3	18,966	3.1
2 ~ 3 ha	13,686	16.1	31,791	5.3
3 ~ 5 ha	17,374	20.4	63,498	10.5
5 ~ 7 ha	11,297	13.3	65,671	10.9
7 ~ 10 ha	7,435	8.7	57,978	9.6
10 ~ 15 ha	8,188	9.6	96,268	16.0
15 ~ 20 ha	2,947	3.5	50,060	8.3
20 ~ 25 ha	1,962	2.3	43,434	7.2
25 ~ 30 ha	1,163	1.4	31,941	5.3
30 ~ 35 ha	845	1.0	27,218	4.5
35 ~ 50 ha	1,034	1.2	41,730	6.9

Classification of farm scale	Farmers		Cultivated Land	
	Number	%	ha	%
50 ~ 70 ha	498	0.6	29,069	4.8
70 ~ 100 ha	262	0.3	22,341	3.7
.> 100 ha	116	0.1	21,103	3.5
Total	85,059	100.0	603,505	100.0

Note: 1) Land of Dashly Boroon and border areas are not included.
2) Source: Golestan Jihad-Agriculture Organization

In Golestan province, the small scale farms (less than 10 ha) account for 80% of the whole number of farms, and the sum of the area of the small scale farms accounts for about 40% of the total area. The average of the farm scale is 3.5 ha in Kordkuy, 5.9 ha in Gorgan, 6.5 ha in Minoodasht, 7.2 ha in Ali Abad, 7.4 ha in Gonbad and 11.9 ha in Bandar-e-Torkaman.

(4) Agricultural production

The cultivated area and yields of main annual crops in four districts are shown in the following table.

Agricultural Production in 4 Districts Related to Study area

Main annual crops (1999-2000)

District	Crop	Cultivated land (ha)			Yield (ton/ha)	
		Irrigated land	Rain-fed land	Sum	Irrigated land	Rain-fed land
Gorgan	Wheat	33,605.0	17,486.0	51,091.0	3,450.4	1,512.4
	Barley	2,999.0	16,866.0	19,865.0	2,590.0	1,000.0
	Soybean	8,464.0	795.0	9,259.0	1,550.2	727.0
	Cotton	19,576.0	1,451.0	21,027.0	1,500.0	1,107.0
Total of District		85,950.0	42,109.0	128,059.0		
Bandar-e-Torkaman	Wheat	3,147.0	14,250.0	17,397.0	3,320.9	2,308.0
	Barley		32,610.0	32,610.0		1,340.0
	Soybean	14.0		14.0	1,071.4	
	Cotton	4,157.0	3,735.0	7,892.0	1,983.0	880.1
Total of District		8,232.0	55,237.0	63,469.0		
Kordkuy	Wheat	5,045.0	1,126.0	6,171.0	3,841.0	2,948.5
	Barley	11.0	85.0	96.0	1,730.0	1,690.0
	Soybean	2,291.0	2,748.0	5,039.0	1,748.6	1,384.3
	Cotton	7,346.0	3,086.0	10,432.0	1,926.0	1,520.1
Total of District		21,410.0	10,518.0	31,928.0		

Source: Golestan Jihad-e-Agriculture Organization
Note: Data of Aq Qala district are pigeonholing in the Golestan Jihad-e-Agriculture Organization.

The cultivation of wheat and cotton takes priority in irrigated lands of all districts, and the yields are between 3.3~3.8 tons/ha for wheat and 1.5~1.9 tons/ha for the cotton. On the other hand, in rain-fed land, the cultivation of wheat and barley takes priority, except for Kordkuy. In Kordkuy, there is less difference between the irrigated crops and rain-fed crops due to the relatively rich supply of water.

The yields of rain-fed lands are clearly different from the irrigated lands, except that of Kordkuy district. In Kordkuy, there is no big difference between the irrigated crops and rain-fed crops. According to the central extension service center of Aq Qala, the Agricultural

conditions in the jurisdiction of the center are as follows:

1. The cultivated area under the center control is about 40,000 ha. The area of grains, such as wheat and barley, is about 37,000 ha. The main crops are wheat, barley in rain-fed land, cotton, and vegetables.
2. The irrigation of wheat has two kinds of sources: well and river. The wells (100~150 in the controlled area) can irrigate and supply water to 5,000 ha of wheat. On the other hand, the irrigation by pumping up from river is insecure, and the river's water supplies is up to about 3,000 ha of wheat.
3. The agriculture in this area is changing from traditional farming to mechanized farming.
4. The improved varieties of wheat and barley are spreading to farmers. Especially, the improved barley is for rain-fed farming and the yield of variety is about 4 tons/ha.
5. The tendency of yields of crops during 10 years has been decreasing in cotton, increasing in wheat, barley, melon, water melon, pea, rape, soybean, etc.
6. Low precipitation and hot temperature occurred during the summer in the last years.

The cultivated area and yields of main fruit trees in four districts are shown in the following table.

Agricultural Production in 4 Districts Related to Study area (1999-2000)

District	Fruit Trees	Cultivated land (ha)			Yield
		Sapling	Fertile trees	Sum	kg/ha
Aq Qala	Peach	0.1	6.5	6.6	11,969.2
	Egg-plum (Yellow plum)	0.4	12.3	12.7	11,959.3
	Orange	2.2	35.0	37.2	13,000.0
	Olive	1,160.0	8.0	1,168.0	600.0
	Walnut		0.1	0.1	5,000.0
Total of District		1,172.3	136.1	1,308.4	-
Gorgan	Peach		168.0	168.0	4,154.4
	Egg-plum (Yellow plum)		638.0	638.0	8,650.0
	Orange	23.7	226.0	249.7	10,340.7
	Olive	713.0	11.0	724.0	650.0
	Walnut	69.3	12.8	82.1	2,514.8
Total of District		810.5	1,233.9	2,044.4	-
Bandar-e-Torkaman	Peach				
	Egg-plum (Yellow plum)				
	Orange				
	Olive	11.0		11.0	
	Walnut				
Total of District		11.0		11.0	-
Kordkuy	Peach				
	Egg-plum (Yellow plum)		44.0	44.0	8,918.2
	Orange	29.0	642.0	671.0	8,002.5
	Olive	260.0	40.0	300.0	675.0
	Walnut		182.2	182.2	5,500.0
Total of District		335.5	1,797.1	2,132.6	-

Source: Golestan Jihad-e-Agriculture Organization

The table shows the cultivated area of the main crops as the sum of irrigated and rain-fed land, and the yields are also shown as the total horticulture land. Since Kordkuy and Gorgan districts have good farming conditions, there are few differences between rain-fed and irrigated land. On the other hand, Aq Qala and Bandar-e-Torkaman districts are under relatively bad farming conditions, and most of the horticultural lands are irrigated, because fruit trees can not grow without irrigation. Especially, there are few fruit trees in Bandar-e-Torkaman.

(5) Agriculture Corresponding to 5 Dehestan Extension Service Centers in the Study Area

Most part of the Study Area is covered by the following Extension Service Centers in regard to the area of jurisdiction of Dehestan Extension Service Center: from the north, Anbar Olum and Central Extension Service Centers in Aq Qala, Banavar and in Bandar-e-Torkman Prefecture, and Garji Mahaneh Extension Service Center in Kordkuy Prefecture.

The characteristics of each area of jurisdiction of Dehestan Extension Service Center in the actual situation of agriculture are as follows:

1) Area of jurisdiction of the Anbar Olum Extension Service Center

The area is located in the north-easternmost and nearest to the Gorgan Dam in the Survey Area. The area borders on the Gorgan River on the south. The army farm and the Peivand RPC (rural production cooperative, site 1) are in the area.

The annual precipitation in this area is the least in the Survey Area. Therefore, the main crops' yields in the last several years, which were drought years, were less than 30% of the yields in the normal years.

The irrigation water comes 70% from the Gorgan Dam, 10% from the Gorgan River and 20% from wells. Recently, 80% of the total irrigated area suffered damage from the lack of irrigation water because of the sedimentation of the Gorgan dam and shortage of Gorgan River's water. The wells in the area concentrate in Chin Civili, which is the big Deh and has 95% of the total wells in the area. 75 are deep wells and 9 are shallow wells.

The farm scale class with the largest number is 3 to 5 ha in the irrigated farming and 5 to 10 ha in the dry-land farming, respectively. In every farm scale class, wheat, barley, cotton and vegetables as succeeding crop of wheat and barley are cultivated.

With regard to the change in the yields of main crops during the last ten years, the yield of irrigated wheat has increased compared with 10 years before, because of modernization of farming. The modernization of farming in the area has reached the highest standard in the

Golestan province due to extension activities of the Extension Service Center, such as use of improved seeds, seed disinfection, sub-soiling, application of chemicals and chemical fertilizer with optimal methods, irrigation in time for growth, soil analysis and fertilization with micro-elements (mainly 250 tons Zn and S in 2001) in 500 ha every year. On the other hand, the irrigated cotton yield not changed during the last 10 years, because the seeds of the variety “sahel”, which was introduced 15 years ago, have been self reproduced. Therefore, the new variety “ Saiukura” has being introduced now.

The yield of barley under dry farming has increased compared with 10 years before, because of extension of new varieties tolerant to salinity of soil. However, the barley of dry farming suffered severe damages of drought during the last several years.

The rate of insured farmers for the total farmers with the accident insurance of the Agricultural Bank in the area is also the highest in the Golestan Province. 70% of cultivated wheat and 95% of cultivated cotton in the area are insured by the accident insurance.

2) Area of jurisdiction of the Aq Qala Central Extension Service Center

The area borders on the Gorgan River on the north and Ghalas River on the south. Aq Qala city and the Hermat RPC (site 2) are in the area.

Annual precipitation in this area is the least in the Survey Area as same as Anbar Olum. Therefore, the main crops’ yields in the last several years, which were drought years, were 30 to 50% in the northern part and more 50% of the yields in the normal years.

In the zone between the Gorgan River and the Ghalas River, there are many deep wells, about 200 wells, and about 900 ha is irrigated by wells. In Aq Qala city and northward, there is no well, therefore, the northern part of the area is dry-land farm. Both banks of the Gorgan River and the Ghalas River are also irrigated by pumping up of rivers’ water. The damages of drought during the last several years arose severely in the irrigated farms by pumping up of the Gorgan River’s water and the dry farms.

The farm scale class with the largest number is more 20 ha in the irrigated farming and 10 ha in the dry-land farming, respectively. In every farm scale class, wheat, barley, cotton and vegetables as succeeding crop of wheat and barley are cultivated.

With regard to the change in the yields of main crops during the last ten years, the yield of wheat and cotton have decreased during the last 4 years due to drought, especially in dry land and in irrigated land by pumping up of rivers’ water. Extension rate to farmers of improved seeds and chemical fertilizer are nearly 100%, but almost farmers do not still fertilize the micro-nutrients. Awareness of farmers on modernization of farming is not high and the meeting of technical transfer by the Extension Service Center has been poorly attended.

3) Area of jurisdiction of the Banavar Extension Service Center

The area is divided into two parts by the Gorgan River. Banavar city, the Shadi Mehr RPC and Partove Banavar RPC (site 3) are in the area.

Annual precipitation in this area is about 450mm in the normal year, but 230mm in the drought year, 2001. Therefore, the main crops' yields in the last several years, which were drought years, were 30 to 50% of the yields in the normal years.

The irrigated land is about 21% of the total cultivated land. About 1,700 ha are irrigated by 117 wells, which are mainly located in the southern part of the area. In the northern part of the Gorgan River, the numbers of wells are only 9. Main irrigated crops are wheat, barley and rape as winter crops, and cotton, rice and vegetables as summer crops.

Both banks of the Gorgan River are also irrigated by pumping up of river's water. That is, 1,450 ha of the Partove Banavar RPC, 1,500 ha of Shadi Mehr RPC and 1,500 ha of Arekhe Bozorg RPC (in the planning) are irrigated by use of the Gorgan River's water. However, in the last several years, crops suffered severe damage due to shortage of river's water and difficult taking of the river's water at the lower reaches of the stream. Therefore, in the Partove Banavar RPC and the Shadi Mehr RPC, the reservoirs are under construction or in the planning stage. The farm scale class with the largest number is 10 to 20 ha.

With regard to the change in the yields of main crops during the last ten years, the yield of irrigated wheat has increased compared with 10 years before, because of modernization of farming due to extension activities of the Extension Service Center, and subsidies for well construction and pumps for taking of river's water.

The yield of cotton has been unstable during the last 10 years. Diseases and the lower international marketing price of cotton cause the decrease of the cotton production. The new variety " Saiukura" is introducing now.

4) Area of jurisdiction of the Torkman Central Extension Service Center

The area borders on the Gorgan River on the north, Ghalas River on the south and the Caspian Sea on the west. Bandar-e-Torkman city is in the area.

Annual precipitation in this area is about 430mm in the normal year, but 290mm in the drought year, 2001. Therefore, the main crops' yields in the last several years, which were drought years, were more 50% of the yields in the normal years in the northern part of the area. On the other hand, in the southern part of the area, crops did not nearly suffer the drought damages.

The area is divided into three agricultural zones, that is, the low productivity belt along the seaside of the Caspian Sea, the high productivity belt along the Ghalas River and the medium

productivity zone of central part.

The irrigated land is about 19% (3,825 ha) of the total cultivated land. About 3,632 ha are irrigated by 283 wells, which are mainly located in the southern part of the area, and consist of 154 of deep wells, 127 of shallow wells and others. The quantity of water and the depth of wells are less and deeper in proportion to distance from the Ghalas River, and the water levels of wells are lower in the drought years, especially in summer use of irrigation water. There are reservoirs of 20 to 60 ha in total, in which fish culture is carried out.

Cereals of 1,787 ha are cultivated with sprinkler irrigation by use of wells' water, and cotton of 1,847 ha is cultivated with furrow irrigation by use of wells' water. The irrigated farms by pumping up of river's water are only 5% of the total irrigated farms. River's water is high salinity and cannot be commonly used as irrigation water. Only in seasons of low salinity, river's water is used as irrigation water for cereals cultivation with sprinkler.

Main crops cultivated in the area are wheat, cotton, rice, rape, which introduced several years ago, and vegetables, such as "harvoze", water melon, melon, etc. The farm scale class with the largest number is 5 to 20 ha.

With regard to the change in the yields of main crops during the last ten years, the yield of irrigated wheat has not changed during 10 years. The yield of barley in dry land has decreased during 10 years, because of increase of salinity in soil. The local varieties tolerant to salinity have to cultivate. The yield of cotton has been unstable during the last 10 years, because of increase of salinity in soil.

5) Area of jurisdiction of the Kordkuy Garji Mahaneh Extension Service Center

The area borders on the Ghalas River on the north, the foot of the Elbourz Mountains on the south and near the Caspian Sea on the west. The Rooyesh-e-Mehtar Kalateh RPC (site 4) is in the area.

Annual precipitation is about 700mm in the normal years, and 600mm in the drought year, 2001. The area is rich in irrigation water, such as more rainfall, rich groundwater from the Elbourz Mountains, compared to other four areas. However, the area has also suffered the damage of drought since 1993. That is, the yield of soybean decreased from 2.2 tons/ha to 1.6 tons/ha, and that of cotton also decreased to 65% of the yield in the normal years. There is no damage of drought in wheat. The reasons of these yield decrease were considered that it did not rain at time of need and it rained at time of needless, which caused diseases of crops, such as fusarium.

The soil of the area has low salinity problem, except the northern part of the area, but has problem of heavy textured soil, which is difficult to till. To solve the problem, the organization of extension and research carries out to transfer the techniques of tillage to cover

every soil condition.

The area is divided into three agricultural zones as follows;

1. The northern zone between the Gharasu River and the national main road; There are many low land and crops cannot cultivate in autumn due to inundation. Therefore, seeding of winter crops is delayed. Cotton, wheat and rice are cultivated. Vegetables cannot cultivate in this zone. Rice is cultivated if irrigation water is enough. Soybean cannot cultivate due to high salinity in some parts of the zone.
2. Middle zone between two main roads: This zone has suitable soil and high productivity. Besides of cotton, wheat and rice, vegetables, especially leafy vegetables, are cultivated in autumn, and water melon, tomato, radish and cucumber are cultivated in spring.
3. The foot of the Elbourz Mountains; it is more rain than other zones. Cotton, wheat and rice are cultivated.

Main crops in this area are soybean, cotton and rice, and wheat cultivation is few. Soybean is cultivated in two cropping seasons, spring cropping, which soybean is sowed in May and period of vegetation is about 110 to 130 days, and summer cropping which soybean is sowed in mid-June. Soybeans of both cropping season can rotate with wheat.

Rotation of crops in the area is considered as follows; wheat - soybean of summer cropping - green peas (November to April) - cotton (May to December) – wheat, barley or rape. However, in the area, farmers have not stable crop rotation. This is the most important problem in the Survey Area. Farmers turn a deaf ear to advice of the organization of extension or the Golestan Government and produce the profitable crops under themselves discretion, and then fail in farm economy. For example, the price of cotton fell sharply due to the overproduction in more than 200 ha in the area. Besides, farmers produced sugar beat in 1,000 ha in spite of the Government advice and also failed in farm economy. Although the Government advises to stop rice cultivation by wells' water, farmers reject it. That is, farmers carry out the gambling farming.

(6) Farm Management in Dry Land Farming

According to the Dry Land Agricultural Research Institute (Maragheh), there are 4 million ha of dry lands in Iran. The average yield of wheat is 840 kg/ha, and Golestan Province has the highest yield in Iran, 2.2 tons/ha, in 10 years average. Golestan Province is considered as the best dry land farming region of Iran.

Water availability is the main criteria rather than any other parameters including soil, mechanization etc. Besides, the timing of rainfall is more important than the total amount of rainfall. Wheat is also cultivated in Western Azerbayjan Province, which has only 197mm of

annual precipitation.

The principle of dry land farming is to keep the soil moisture as possible. As the surrounding areas of the Institute is a plateau area and the secluded places in the mountains, the keeping of soil moisture is carried out with the following methods;

① Semi-irrigation
② The ridges in crop cultivation should make at right angle to slop.
③ Minimum tillage
④ Increase of soil fertility by crop rotation: common rotation is “wheat – chick pea – fallow” in the area.

On the other hand, Golestan Province is completely different from this area in natural conditions, except the low rainfall, such as high salinity of soil, high groundwater table, poor drainage due to low land, etc. Referring to the opinion of the Institute, the measures of development of the sustainable dry land agriculture in the Survey Area are as follows;

1) Construction of reservoirs, which store the irrigation water in winter for the minimum irrigation at time of intolerable drought.
2) Minimum tillage: Minimum tillage using chisel plough is needed to preserve soil moisture in dry land. Weeds are removed with sweeper plough.
3) Increase of soil fertility by crop rotation: Common rotation is “wheat or barley – rape or safflower” in the Survey Area. Besides, it is desirable to rotate with pasture plants, which have a lot of roots, to increase the organic matter in soil.
4) In order to carry out the desalinization of soil by rainfall in the dry land, drainage system, including from drains in field to main drain, should be established in the Survey Area.

3.3.2 Animal Husbandry in the Study Area

(1) Number of Animals in the Study Area

In the study area, sheep, cattle and poultry are common for meat, milk and egg production. The number of livestock in the study area is as follows:

	Gorgan	Aq Qala	Torkman	Kordkuy	Total
Sheep	165,741	248,612	235,294	52,941	702,588
Goat	16,470	24,706	4,118	2,353	47,647
Cattle	35,027	35,026	24,166	31,195	125,414
Pure Milk Cow	10,352	4,437	5,380	1,507	21,676
Hybrid Cow	23,044	28,957	12,887	28,957	93,845
Native Cow	1,631	1,632	5,899	731	9,893
Buffalo	22	64	97	627	810
Poultry	1,148,440	382,000	267,860	770,600	2,568,900

Source: Jihad-e- Agriculture Organization, 2001; Note: Pure milk cow means Holstein species

As shown above, most part of the animals (sheep, poultry and cattle) are raised in the Study Area (about 30 % of the total number in Golestan Province).

(2) Sheep Farming

Most of sheep are raised by the farmers in the village for meat production with the traditional method. Few farmers raise sheep under extensive method in the area. A farmer purchases a lamb with 15-20kg/head and raises for 3.5months. After the certain period sheep gains 45kg/head for sale. Male lambs are fattened for meat production purpose. Most of these lambs are exported to other cities especially to Tehran. Female lambs are sold in markets or slaughters.

The species of sheep in the area is native or endemic as mostly Zeland and Dalagh. The feed for sheep is natural pasture, straw of wheat, rice and barley. Red meat production and consumption of each district are shown in following table.

	Production (ton)	Consumption in District	Surplus or Deficiency
Gorgan	2,171	4,162	1,991
Aq Qala	2,678	1,287	1,393
Torkman	3,132	2,132	1,433
Kordkuy	672	839	167

Source: Jihad-e-agriculture Organization, 2002

(3) Cattle Farming

Most of Cattle in this area is for milk production and raised in the farmers as a sideline for self-consumption and sale. 1 to 5 heads of cow are raised in a farm. There are few intensive dairy farmers in the area. Farming management system of intensive dairy farmers is quite different from that of the small scale farmers, as most of intensive dairy farmers, have improved variety of pasture as well as machinery equipment. They also perform self-production of replacement heifers, AI, and silage production.

There is no beef breeder in the area. Male calves are dealt to the beef breeders in Mazandaran and Tehran. In recent years, due to the low milk productivity of native cows, Holstein species has been imported from Denmark, Holland, Germany and Canada. After introduction of Holstein, Hybrid cow is bred by crossing Holstein and native cow. The native cow has resistance for diseases and adapted to climatic conditions of the area, however, the raised number are decreasing due to low milk productivity. The hybrid cows are raised in the farmers in the village.

Preservation and breeding of cattle are performed either in intensive dairy or traditional way. In intensive dairy, Holstein cows are kept in well sanitary condition with proper feeding with

purpose of getting high quality products. There are 50 technicians working on artificial insemination (AI) in animal husbandry in Golestan province.

Annual milk productions of Holstein, Hybrid and Native cows are 2,500 to 5,500 kg, 1,800kg and 800kg, respectively. Average milk production in different livestock and its consumption in Golestan Province are summarized in the following table.

Unit: kg

Kind of livestock	Yearly Product	Lamb & Calves Consumption	To Market
Pure cow (Holstein)	5,650.00	400.00	5,250.00
Hybrid cow	1,816.00	300.00	1,516.00
Native cow	605.00	200.00	405.00
Buffalo	1,122.00	300.00	822.00
Small cow	30.00	10.00	20.00
Goat	40.00	10.00	30.00

Source: Jihad-e-Agriculture Organization

Milk production and its consumption of each district are shown in the following table.

Unit: ton

	Total Production	Self Consumption	Dairy Product	To Other cities
Gorgan	44,749	2,493	4,548	42,256
Aq Qala	35,599	8,884	226	26,715
Torkman	26,129	9,474	575	16,555
Kordkuy	10,819	5,649	295	5,170

Source: Jihad-e-Agriculture Organization, 2001

There are 11 milk plants in Gorgan district having 50 ton/day processing capacity. In Aq Qala, 4 units are processing milk with 33ton daily capacity, and in Bandar-e-Torkman, there are 6 plants having daily processing capacity of 27ton. In Kordkuy, 3 milk plants are producing 16ton/day.

(4) Buffaloes Farming

Only few farms of buffaloes are seen in the area for milk production. Buffaloes have recently attracted attention since their meat contains low cholesterol and calories and also high contents of fat in buffalo milk.

Buffaloes are known as; it is possible to raise them in natural pastureland that a cattle does not eat well. It is especially advantages in the study area, where utilization of farmland is limited.

In average, milk yield is 1,100kg to 1,500kg per year. River type dominant species crossed with swamp type are seen in the area.

(5) Poultry Farming

Productions of poultry meat and eggs are made in traditional and systematical industrial ways. In industrial chicken meat breeding, day-old chick is raised for 45 to 50 days gaining 2.3 kg weight, and then delivered to slaughterhouse. After slaughtering the meat are sent straight to market. There are 3 kinds of industrial poultry in the area.

- Roof covered poultry house with controlled windows and ventilation system on both sides.
- Roof covered poultry house without window, height of wall is 1.5 m.
- Tunnel system without windows on sides, from one end air comes through and at the other end ventilation system is installed.

Since the tunnel system has more efficiency than another systems, most of the chicken are employed with this system. The species of the industrial chicken meat is mostly Arian and for eggs is Hiline. In the village farmers raise chicken, duck, goose and turkey in traditional way, and they are fed with left over foods or dry bread or grazing in the fields. The production of eggs and chickens are made surrounding their houses.

The production cost of 1 kg chicken meat in the industrial units is Rls.5,842 when the shipping weight is 2.2 kg. There is a probability of lower cost of production by doing a better management. The production cost for 1 kg eggs in industrial unit is Rls.4,932 while one-day chick is Rls.4,200.

Due to lack of a well-equipped slaughterhouse to produce frozen chicken with the world standard level, and to trace non-permitted chemical materials in chicken’s meat, and some diseases, there is no possibility of exporting poultry meat and eggs under the present conditions. It is required to introduce the modern and progressed facilities.

About 60 % of poultries in Golestan have identification card which their period have been expired, and their facilities and instruments are not proper for producing chicken meat and egg, and they are location close to urban areas and don’t regard proper quarantine rules and sanitary matters. Due to low knowledge of poultries owners, do not utilize technician’s advises, improper production are prevailed.

In some cities of province, because of proper climatic condition some poultries produce more chicks. It is sometimes 2 times more than the market need for poultry meat and eggs. Sometimes the productions of poultry meat and eggs are very low as the improper climatic condition, buying power of people increases to resist such climatic condition so that meat and eggs consumption increases also. At present, slaughterhouses of province do not have freezing facilities and facilities for packing and instruments to clean up inside chickens.

(6) Price of Livestock Products

Consumer retail price of each livestock products in the Study Area is as follows:

Retail price of Livestock products

Items	Price (Rls./kg)
Sheep meat	26,000
Beef (boneless)	22,000
Chicken meat (broiler, frozen)	11,500
Egg (1 kg)	4,000
Long Life milk (1 liter)	1,500

Source: Data from the field survey by JICA Study Team, June 2002.

The present price of day-old chick is Rls.4,200/unit and the live chicken in free market is Rls.7,500 to 9,000 per kg. It means dealers buy Rls.7,500 to 9,000 per kg and treat for meat with 30% benefit; they sell it to consumer for Rls.11,500/kg. The poultry liver is sold Rls.3,500/kg while the 1 kg poultry meat is Rls.11,500 at the market to consumers. The price of 1 kg poultry meat depends on price of day-old chick, management, cost of feed and medicine.

In some critical conditions, dealer sells poultry meat and eggs to consumers. And in some cases price is controlled by inspection office. And some time price of production keep changing up and down, it is because of climate, especially in hot season and celebrations and holidays.

Produced milk in the intensive dairy farms are carried with the especial tankers and sold to factories for Rls.0000 per litter which price is determined by the government. In villages, dealers purchase produced milk from farmers in cheap price and then carried it to the factories. Factories pay Rls.82 to 100 per kg, and if the distance of buying factories is far from the produced dealer will buy it for Rls.95 to 1,100 per kg.

(7) Forage for Livestock

Hays of wheat, barley and rice, wetland pastures and dry land pasture is common livestock forage in the study area. However, it is clear that all districts except Kordkuy in the study area are not sufficient in the forage production.

Prices of the forage per kilogram are wheat hay; Rls.410, sugar beat waste; Rls.850, wheat bran sold by Government; Rls.485, cottonseed concentration; Rls.1,410, wheat bran in free market;Rls.808 and dry Alfalfa;Rls.1,240.

1kg of sugar beet waste in the free Market is Rls.100, barley; Rls.905, maize for silage; Rls.250 and Molasses; Rls.550. The prices of barley and bran are distributed by Government they have constant price, but other forages are depending on the market flows.

3.3.3 Farm Management

(1) Purpose of Farm Households' Survey

The farm households' survey is conducted for understanding actual situation (production, farm economy, livelihood, and awareness and desire of farmers) of farm households in the Study Area. The result of this survey becomes the data for concreting the objective of agricultural development.

(2) Methods of Farm Households' Survey

① There are about 160 Dehs in the Study Area, were culture, customs, and the way of thinking are different depending on Dehs. It was selected 15% of the 160 Dehs.
② Selection of farm households depends on the type of farmers: The number of selected farm households was determined in portion as the number of farm households by farm scale in the prefectures as much as possible.
③ The members of RPCs (Rural Production Cooperatives) were included in the selected farm households in taking account to the share of them in total number of the farm households.
④ The farm households were selected through random sampling.

Considering all items mentioned above, the questionnaire survey (farm households' survey) through interview including about 100 questions were conducted for 18 households in Kordkuy Prefecture, 54 households in Aq Qala Prefecture, 38 households in Bandar-e-Torkman Prefecture, and 18 households in Gorgan Prefecture under cooperation with provincial extension department.

(3) Farming of Individual Farm Households

1) Problems on farming by prefecture in the Study Area

The problems on farming are classified according to the natural / social conditions and problems on the farming. Gorgan and Kordkuy Prefecture has plenty of rainfall and groundwater compared with the other 2 prefectures. The location is also good because it is close to Gorgan City. So, the problems are relatively less compared with the other 2 prefectures. Common problems of four prefectures are shortage of irrigation water as natural condition, and small benefit due to unbalance between unstable and low producer's price and steep rise of agricultural inputs as social condition. Farmers are lacked with the financing for production. As the problems of farming, because agricultural inputs are not provided timely (it is not clear whether there are not agricultural inputs or they cannot afford it), farmers miss appropriate time for irrigation, machine operation, fertilizing, weeding, and protection of pests. These cause low production.

Adding to these problems, Aq Qala and Bandar-e-Torkman Prefectures have operation problems due to salinity, and alkalinity as natural condition, and not well maintained roads for conveying the products and hindrance of agricultural investment and decreasing of productivity because of segmentation of farmland owing to equal inheritance of property system. And they also have the problems of farming such as shortage of machinery, lack of irrigation and drainage facilities, and low technical level (there are not varieties which are appropriate for climate and soil texture, machinery is not improved, and organic matters in soil are small).

The problems mentioned above can be seen in the intention of farmers. Many of farmers' farm scale is small but in Gorgan and Kordkuy Prefecture which has relative advantage in natural and social conditions have the problem of introducing technique besides those of finance and production cost. In addition to these problems, the other two prefectures have the problems of salinity and supply of irrigation water.

Considering these results mentioned above comprehensively,

① It is necessary to phase in (short, middle and long terms) construction of irrigation and drainage facilities for solving shortage of irrigation water as natural condition.

② As social condition, it is necessary to phase in planning and execution of following projects: improvement of infrastructure such as roads and processing factories, establishment of the system for timely providing of agricultural inputs and machinery, solving the problem of farmland segmentation through legislative approach, and improvement of financial supply system for production.

③ As for improvement of farming, first of all, reformation of farmers' awareness is required. Although Agricultural Extension Service Centers extend technique and market information, farmers do not follow them. The farmers intend to gambling agriculture. Sustainable farming contrasts with gambling agriculture. The crop rotation for increasing organic matters in soil should be established soon. After this, technical modernization is introduced. High level of technique means operating each technique timely and securely. Mere use of agricultural chemicals and pesticide costs much. Production can be stable and improved through making each farm work the most effective. Justification of the considerations above is referred to in the following paragraphs.

2) Level of cultivation technique and production of main crops

In the farm households' survey, operation of 8 items: organic manure, chemical fertilizer, lime, inspected or certified seed, irrigation, herbicide, insecticide and fungicide was examined in order to know the level of farmers' technique. Here, the farmers who apply these items much are defined as the farmers whose level of technique is high.

Commonly, the production of wheat and barley is small and rare respectively in Gorgan and Kordkuy Prefecture. Nevertheless, the production of wheat and cotton is relatively high even though the level is low. In the other two prefectures, it is required to apply 4 technique on wheat, 5 technique on cotton, and 3 technique on barley in order to produce at least more than 2t/ha.

Moreover, there are some farmers whose production is relatively high although their level of technique is low. The reason of low production although high level of technique can be assumed that technical operation was not done timely. In addition, this is the data in the year severely suffered from drought. Therefore, one of the other reasons can be that the technique of irrigation did not make effect. The damages of drought are caused by the interval between rainfalls besides absolute shortage of precipitation. It can be seen in *Veranico* phenomenon (the drought caused by a long interval of rainfalls in rainy season) feared in Brazil. The interval of rainfalls suffered the damage by drought has subtle locality. This should be also considered as one of the reasons.

3) Irrigation and yields of main crops

Even in dry land, the production of wheat is 2-3t/ha in Aq Qala and Bandar-e-Torkman Prefecture. Furthermore, the production of wheat can be 2.5-3t/ha with 1-2 times of irrigation. This is also the data in the year severely suffered from drought.

In case of barley, production is larger in dry land rather than that in irrigated land. In conclusion, as the first stage of improvement, it can be estimated that wheat needs total 2 times of irrigation: once for leaching in fall and once in spring, and barley needs once of irrigation for leaching in fall to produce more than 2t/ha stably. As for summer cotton, it is hard to increase production in dry land even in Kordkuy Prefecture which condition is relatively better. In the other two prefectures, it requires at least three times of irrigation to produce more than 1.5t/ha.

4) Farm Economy Based on the Results of the Farm Households' Survey

Basically, the benefit should cover the production cost for the next year besides production cost and living expenses in this year. If not, farmers could not reproduce. The results of this survey show that the farmers of any farm scales and in any prefectures do not have the surplus for reproduction in the next year. It should be considered that the survey examines the data in the year of drought. The results of the farm households' survey are described below.

① As comparing annual gross income of the farmers belonging to the same farm scale in three prefectures, those of Gorgan and Kordkuy Prefecture is the largest. Specially, the farmers whose faming scale is 3-10 ha highly depend on agriculture and also gain much gross income from agriculture, compared with the other two prefectures.

② Gross income becomes higher as the faming scale becomes larger.
③ As for composition of farmers' gross income, the portion except of agriculture and animal husbandry becomes larger as the farm scale becomes smaller, except 1-3 ha of farm scale of Gorgan Prefecture.
④ Animal husbandry is introduced and composes a certain part of gross income without the relation to farm scale in Aq Qala and Bandar-e-Torkman Prefectures.
⑤ All farm scales' farmers are in black if only concerning on the production of agriculture and animal husbandry. Nevertheless, the farmers whose farm scale is more than 5ha in Gorgan and Kordkuy Prefecture and is more than 10ha in Bandar-e-Torkman Prefecture are in black even after reduction of living expenses. The others are in red.
⑥ In comparison with Bandar-e-Torkman and Aq Qala Prefectures, the surplus of farm economy as a whole including living expenses of the farmers whose farm scale is more than 10ha is small, and they are in red in Aq Qala Prefecture. The reasons are that the production cost of two farmers whose farm scale is more than 20ha in Aq Qala Prefecture increased owing to something and the living expenses are higher than those in Bandar-e-Torkman Prefecture. This is not because of big difference of the production.
⑦ Living expenses are not related to prefecture and farm scale and are around Rls. 15 million to Rls.20 million (US$ 1,900-2,500/year, US$ 160-208/month).

5) Debt

The results of the farm households' survey are described below.

① Generally, there are many farmers who have debts in four prefectures. The portions of them are 100% in Gorgan and Kordkuy Prefecture, 23-50% in Bandar-e-Torkman Prefecture depending on farm scale, and 34-45% in Aq Qala Prefecture depending on farm scale, respectively.
② Creditors are banks, cooperatives, wholesalers, consignment loan lenders, relatives, and money lenders.
③ Each prefecture has characteristics. Main creditors are banks, cooperatives, and money lenders in Gorgan and Kordkuy Prefecture. It is remarkable that the debt from banks is very large. In case of the farmers whose farm scale is small, they borrow supplemental money from relatives and money lenders in all of the prefectures.
④ In both of Bandar-e-Torkman and Aq Qala Prefectures, the farmers have the debt from consignment loan lenders besides from cooperatives, relatives, and money lenders as well as Kordkuy Prefecture. The farmers whose farm scale is less than 10ha has debt except from banks.
⑤ Repayment situation of debt is summarized later, but if the repayment situation is

classified into 4 stages: normal, reschedule, overdue and requiring of legal instance, the repayment situations of all farmers to banks are overdue or requiring of legal instance. This means the debt is not paid off and they are in severe condition. The repayment situations of overwhelming majority of farmers to cooperatives, consignment loan lenders, and money lenders are also overdue and requiring of legal instance.

3.3.4 Agricultural Extension

Organizational structures, activities and problems of 5 Dehestan Extension Service Centers are described by Center.

(1) Anbar Olum Extension Service Center in Aq Qala Prefecture

The Center consists of 11 technical staffs: 4 of them are graduated from university and 7 are technicians. Adding to them, there are three more staffs totalizing 14. One extension worker is in charge of 1,625ha/ person as for cotton and 4,300ha/ person as for wheat.

The number of extension workers is enough. The Center has three cars but one of them is out of order. The budget is not enough.

(2) Central Extension Service Center in Aq Qala Prefecture

According to the standard of Ministry, appropriate area of farmland which is covered by one extension worker is 1,500ha but that is 10 times of the standard, 15,000 ha in the Center.

The Center consists of 11 technical staffs including the Head of the Center (4 graduated from university, 4 graduated from high school with 2-years training, and 3 are technicians graduated from high school) and one office clerk. The center has sections for extension, cotton, plant protection (agricultural chemicals, damage of pest, and weed), farming and fruits trees, statistics, mechanization and clerical work. Technical staffs also do office work, so they do not have time to extend.

The Center has three cars and one motor bike (out of order). The staffs are busy due to approving farmers' purchasing of subsidized agricultural chemicals. The Center recommend farmers to use agricultural chemicals and farmers can buy them at cooperatives and shops at low price. So, the farmers rush to the Center and the staffs are very busy with this. In the near future, this work will be transferred to private sector. Moreover, extension is inefficient (many farmers do not come). And a number of extension workers and experts is not enough although the area in charge is large.

(3) Banavar Extension Service Center in Bandar-e-Torkman Prefecture

The Center consists of totally 4 technical staffs: 2 graduated from university and 2 are

technicians. Adding to them, there are four office clerks. So, the grand total is 8.

One of the staffs from Jihad and a regular staff but the others are contracted workers on a one-year contract and unstable. The Center does not have opportunities to train the staff. Budget is not enough. The number of staff is small. The Center has three cars but they are old.

(4) Central Extension Service Center in Bandar-e-Torkman Prefecture

Because of merger of Ministries of Jihad and Agriculture, the organization structure is not fixed yet. The Center consists of totally 6 technical staffs: 3 of them are graduated from university, 1 of them is graduated from high school and took 2-year training, and the other 1 of them is cotton technician. Adding to them, there are three office clerks and two drivers. So, the grand total is 11.

Head of the Center is from Jihad and one is regular staff. Two experts are contracted only for one-year being an unstable job. The Center has two cars but old. They have opportunities to train staff (10-20 weeks). The number of staff is enough. The high number of illiterate farmers makes difficult the extension services.

(5) Garji Mahaneh Dehestan Extension Service Center in Kordkuy Prefecture

The Center consists of totally 51 technical staffs including Head of the Center. Sections are extension, cotton cultivation, plant protection (agricultural chemicals, damage of pest, and weed), crop cultivation except cotton, statistics, mechanization and clerical work. Technical staffs also do office work, so they do not have time to extend.

A number of cars is not enough. And a number of extension workers and experts are not enough although the area in charge is large. Office is small. They do not have a copy and fax machines and even telephone.

3.3.5 Distribution of Agricultural Products and Marketing

This section examines the distribution of agricultural products and marketing through the situation of wholesalers, middlemen, and retailers in 4 Prefectures in the Study Area: Gorgan, Aq Qala, Bandar-e-Torkman, and Kordkuy.

(1) Products from Dehs and Outer Markets

1) Crop Production

From the viewpoint of production variety, Kordkuy produces the most varied agricultural products. On the other hand, that of Bandar-e-Torkman is not much verified. The products of these prefectures are differed because the climatic condition and soil quality are quite different from the northern to the middle parts of the Province. Aq Qala and Bandar-e-Torkman Prefectures are located in the northern part of the Province and produce

small varieties of products compared to Korkuy and Gorgan Prefectures located in the middle part of the Province. Korkuy and Gorgan Prefectures mainly produce vegetables, summer patch products (water melon and melon), and orchard products. On the other hand, the main products of Aq Qala and Bandar-e-Torkman Prefectures are wheat, barely, cotton and sometimes patch products.

2) Stock Farm Products

Major stock farm products in the Study Area are sheep, cattle, poultry, and dairy products. The number of livestock has been raising and it shares about 30% of total number of livestock in Golestan Province. In Aq Qala and Bandar-e-Torkman, sheep is in the majority of the livestock. Red meat, dairy products, and white meat (chicken) occupy about 29%, 36% and 50% respectively of the total in Golestan Province.

(2) Rural Supporting Industries

1) Agricultural processing products

According to the result of the statistical survey for agricultural processing industry, the number of factories and workers for agricultural processing industry is relatively small, compared to the other provinces in Iran. Its share remains around 1% of national total at present.

Considering the capacity of agriculture in Golestan Province, it can be a center of agricultural processing industry in Iran in the future. The production of oil seeds and cotton takes the first and of wheat and rice takes the fourth and the fifth places respectively in Iran. Nevertheless, it is difficult to be realized due to the problem on the credit for agricultural processing industry. Moreover, the capacity of 4 Prefectures in the Study Area is now under the study conducted by government.

2) Stock farm processing products

Stock farm processing industries are described in the table below.

Processing Industries Related to Stock Farm Products in Golestan Province (2000-2001)

Items	No.	Capacity unit	Nominal capacity	Remarks
1. Feed processing plant	5	tons /year	271,500	4 units in operation
2. Dairy factories	13	N.A.	6,900	3 units under construction
3. Leather and fur	3	pieces /year	657,336	-
4. Wool spinning factories	1	tons /year	160	-
5. Meat processing factories	4	tons /year	9,350	3 units under construction
6. Complementary nutrients factories	4	tons /year	19,000	1 units under construction
7. Industrial slaughterhouse for poultry	3	tons /year	N.A.	-
8. Honey packing	1	N.A.	N.A.	Under construction
Total	72	-	-	-

Source: Jihad-e-Agriculture Organization, 2002

(3) Mechanism from Deh to Markets

1) Agricultural Products

With regard to market condition of agricultural products, there is one big wholesale market in the easily accessible part of Gorgan City. There are about 150 wholesalers dealing in distribution of agricultural products. This market plays a role of the central market for 4 prefectures and takes part in trading a great portion of their products.

The mechanisms of trading agricultural products in 4 Prefectures are similar. But marketing channels are different by product. The price of the products is commonly determined by market mechanism, demand and supply, except wheat, soybeans, sunflower, rapeseeds, and sometimes cotton and rice. In the wholesale market in Gorgan City, the prices of the products are determined by wholesalers. They decide the prices through seeing the volume of arrived products (the number of trucks) every morning. There is not auction and sorting systems for setting the prices. Moreover, it is not enough but information of the market price can be taken through radio and TV.

2) Stock farm products

All of the stock farm products are dealt at free market prices. However, RCO buys milk at the guaranteed price when it is oversupplied.

(4) Problems and Constraints on Marketing

The problems and constraints on agricultural marketing are listed as follows:

a) Most of the middlemen who deal with agricultural products are illiterate or remain at low educational level,
b) The middlemen's knowledge on their business is low and so their activities are limited,
c) Transportation means are too short to transport the products due to large production in the Province,
d) Shipping cost is high,
e) Storage facilities are not enough, especially for selling the products at the highest price,
f) Pricing is difficult due to the lack of the standards for agricultural products,
g) The number of cooperatives which deal in agricultural marketing is not enough for creating job opportunities for unemployed persons,
h) There is not training on modern management and sales for wholesalers,
i) There is not insurance for damages and robbery of the agricultural products dealt by wholesalers,
j) The budget of those who deal in agricultural distribution business is low and it causes

the limitation of their activities,

k) Domestic and international market information are not sufficient,

l) The number of a large market is too small to support farmers in the meaning of obtaining markets, and

m) Quality of some products is low due to not setting proper price because of lack of classification process.

3.4 Irrigation and Drainage Conditions

3.4.1 Existing Irrigation and Drainage Schemes in the Study Area

(1) Existing Irrigation Scheme in the Study Area

1) Number of Irrigation Scheme and Irrigated Area

There are 6 irrigation schemes in the Study Area. The Provincial Government provided primary facilities for 5 of them. The remaining Cheldin area has been developed by the farmers themselves from old days.

The irrigation schemes provided by the Government's initiative are quite new approaches and might be called "extraneous farming" due to their shallow history (less than 10 years) and small area, comparing with the entire Study Area. Also, none of those 6 schemes irrigated completely their area since their establishment. So, the "irrigation farming" called by the Government seems to be "a measure to supplying supplemental water" to the dray farming in the actual condition.

2) Project Area and Irrigation Area

The meaning of the "Project Area" here is not "irrigation benefited area", but area covered by an open drainage system which was provided as preparatory works about 10 years ago. At that time the local Government recognized the importance to provide such open channel drainage system to protect the land from the salinization. So, those systems were constructed during the initial stage of the water resources study to secure the introduction of irrigation practice in the Area.

The lack of storage facilities in the irrigation system carried to a variation of the irrigable area from year to year. The irrigation area was affected by the river discharge changes.

Comparing the planned irrigable area and actual irrigated area, no irrigation scheme has ever completed whole irrigation through the irrigation system.

(2) Classification of Irrigation Schemes By Water Sources

1) Water Source for Irrigation Schemes Provided by the Government

5 irrigation schemes, excluding Cheldin Area, depends on Gorgan River as irrigation water source. Almost half or more than half of the area still depends on the rainfall. The

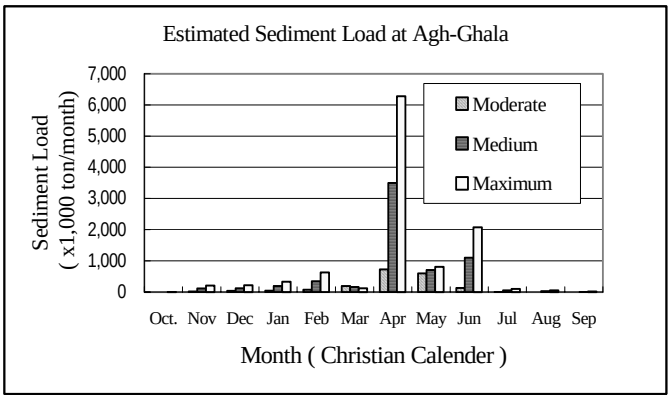
most utilized irrigation method is the "Basin Irrigation". They are utilizing water from streams of the piedmonts and groundwater individually in Cheldin area.

2) Private Irrigation Scheme Along the Gorgan River

About 13,000 ha along the Gorgan river is under cultivation utilizing water from the Gorgan River by private pumps. Those pumped river water is used as supplement to the dry land farming.

3) Private Groundwater Irrigation Scheme

Many wells are concentrated in the downstream of the area bounded by Gorgan River and Gharasu River, which are utilized as irrigation source for private farms.



Estimated Sediment Load at Agh-Ghala

unit : x1,000 ton / month

	Oct.	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Moderate	1.3	21.1	37.0	45.2	78.8	196.9	722.9	602.5	131.7	5.2	2.8	1.9
Medium	2.7	115.8	127.9	192.1	355.3	161.0	3,504	707.2	1,103	52.9	27.9	11.7
Max.	4.2	210.4	218.7	339.0	631.7	125.1	6,284	811.9	2,074	100.6	53.1	21.4

Source : Location of Study Field Areas and Topography of Watershed of Gorgan and Ghareh-Sou Rivers, W.O., Golestan, MOE

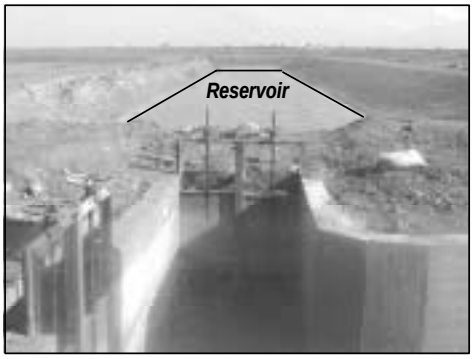
(2) Intake

All of existing schemes, excluding Cheldin Scheme, are taking water from Gorgan River. The pump capacity varies from 250 lit/sec to 300 lit/sec, with total head of about 25 m. They are obtaining design requirement with adjusting the number of pumps by each scheme.

The pump stations have no de-silting facility on the suction side. Instead of it, the suction pipes are set 50cm above the riverbed and has the inlet capped with silt screens.

One outlet chamber is provided at outlet side of the station. The water is discharged with overflowing from the crest of the chamber to the conveyance canal after rectification of turbulence flow.

The pump station design utilizes a basic standard developed by the central government. The pumps are operated by a fulltime operator. Records of pump operation and intake amount have never been kept.



Scene of Diversion Gates to Sediment Depositing Reservoir At Tazeh-Abad Scheme

(4) Distribution Rule of the Irrigation Water Among Farm Plots

The rule of irrigation water distribution is decided by the cooperative board every year. The allocation schedule and allocation amount is based on the scale of the farm (Tazeh Abad Scheme). There is no records

about the real water distribuiton condition carried in the scheme. In other schemes they have no rule of water allocation and are adapting an way to supply water each time when the farmers request the water. At that time farmers should pay the operation cost to the cooperative each time. Hence their present manner is like a water vending system. So if a farmer has no enough money at that time, he should bear the thirsty.

(5) De-Silting Pond

A de-silting pond is provided only in the Tazeh-Abad Scheme, with an area of 4.0ha and 2.5 m depth, just after the pump station. The total capacity of the pond is about 100,000 CM. It is explained that all of the water from the pump is stored in this pond before distributing irrigation water through the main canal. The completion of the pond construction was at the end of 2001.

At the other irrigation schemes without de-silting ponds, the water from the pumps is conveyed to the main canal directly without de-siltation. Hence the canals are often filled up with sediment.

(6) Irrigation canal

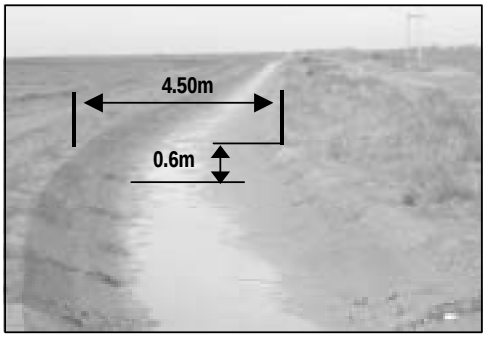
Commonly the irrigation canal system consists of 1) Main canal, 2) Secondary canal and 3) Tertiary canal in an I&D scheme. Main canal is structured with concrete lining commonly with same slope of side wall as 1:1.5. The bottom widths vary from 0.55m to 0.76m and the depth from 0.8m to 1.25m. Longitudinal gradient is 1/2,000 or 3/10,000.

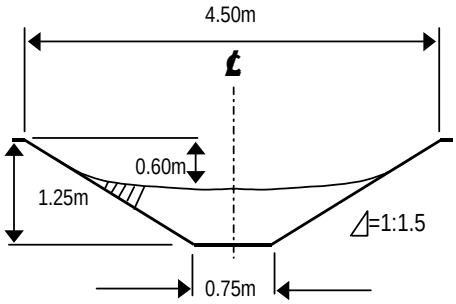
Secondary canal is constructed as earth lining structure basically and partially adopting concrete lining, depending on the budget. The ordinary dimension is 0.2 or 0.3 m for the bottom width, 0.4 or 0.6 m for the canal depth with a side slope of 1:1.5. Longitudinal gradient varies from 1/2,500 to 6/10,000 aiming to obtain conveyance capacity of a range from 70 lit/sec to 120 lit/sec.

Tertiary canal is constructed in earth, with dimension of 0.2 or 0.3 m for the bottom width, 0.4 or 0.6 m for the depth with side slope of 1:1.5.

(7) Silting Condition in the Canals

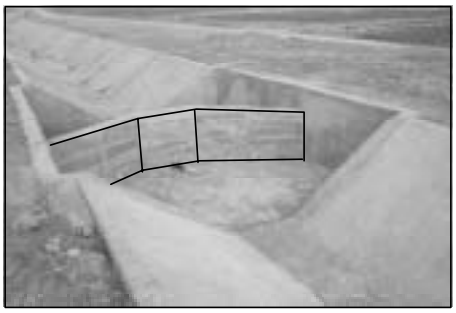
The irrigation water distributed through the irrigation canal networks contains thick silts and it shares as one of constraints on irrigation practices.





Scene of Main Canal Filled with Sediment in Tazeh-Abad Scheme

Almost all irrigation and drainage schemes are affected with sediment silting. The above picture shows the silting condition of the main canal in *Tarzer-Abad* I&D Scheme. About half of the canal sectional area is buried with silt and silting makes blockage along the canal.



Desilting Basin Along Canal

Desilting Basins, as shown in the right photo picture, are provided at some locations along the canal.They explained that farmers' cooperative has to excavate twice or thrice a year.

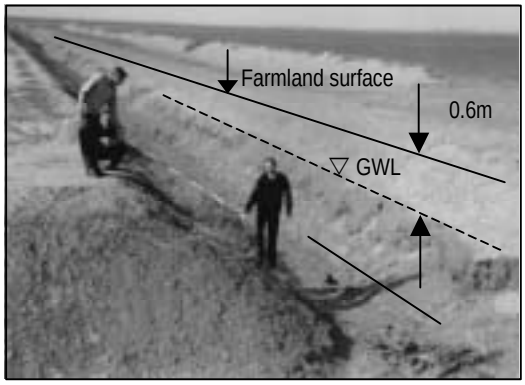
7) Drainage Canal.

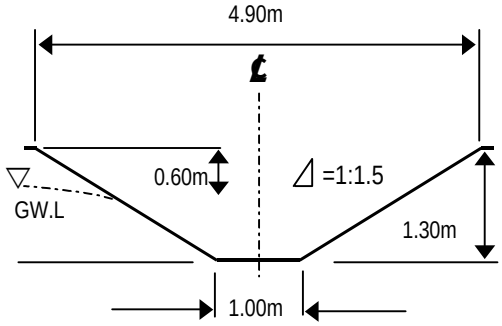
Drain system consists of main and secondary drainage canal in all schemes commonly. The original task of the drainage canal was to drain inundated water of seasonal rainfalls and was excavated before stating irrigation development by the Government.

Main canal is structured with earth lining. Its sectional dimension is bottom width: 1.0 or 1.5 m, side slope gradient: 1:1.5 and canal depth: 2.0 or 2.5 m. Longitudinal gradient is set as 1/2,000 or 1/10,000, little bit different by scheme. Secondary canal is structured with earth lining. Its sectional dimension is bottom width: 0.5 or 1.0 m, side slope gradient: 1:1.5 and canal depth: 0.8 or 1.25 m. Longitudinal gradient is set as 1/2,000 or 3/10,000, slightly different by scheme.

Those drain system, provided in ahead before introduction of irrigation system, has obviously contributed to down the groundwater level in the farm field. According to the officer in charge of Banaver Scheme, the groundwater level was at about 1.0 m below the ground surface when the excavation was started (1994). It was noticed at about – 2.0m in 1998. And the level was not found during the first field survey of this Study (January 2002). With those evidences, it might be said that the groundwater level is already below the canal bottom level, which is 2.5m below the ground surface. But it is required to investigate and examine more whether

the present groundwater level at midway between two drainage canals is so or not, which interval is 300m or 400m. Continuous monitoring has never been conducted even though already been recognized the importance of groundwater management and setting measures against salinity.





Secondary Drainage Canal in Banavar I&D Scheme

(9) Irrigation Method

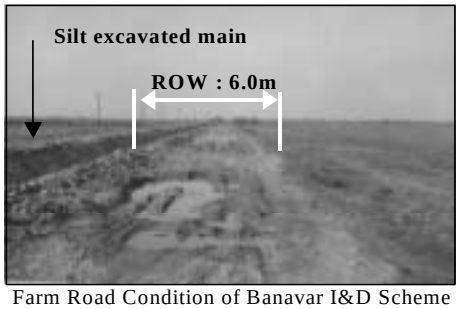
Border irrigation method is applied widely in the Study Area. Farmers are taking irrigation water by blocking the tertiary canal connected with an off-take gate provided along secondary canal, applying rotational irrigation by canal unit. They explained that the duration of the water intake for one block or proper water amount has not being measured exactly. Farmers have tendencies to intake water more than requirement because the yield of wheat can be increased by more water inputs.

Other different irrigation methods are noticed like linear mobil system, self-tractive rain gun system and fixed sprinkler system, but they only work in a very limited condition in the Study Area. Those systems are available only for the area which can use desilted water at dams or reservoirs. Hence tentatively those systems are not going to be considered in the Study Area.

Size of Borders and Stream Size for Different Soil Type and Land Slope

Soil type	Slope (%)	Width (m)	Length (m)	Average flow (lit / sec.)
Sand	0.2 - 0.4	12 - 30	60 - 90	10 - 15
	0.4 - 0.6	9 - 12	60 - 90	8 - 10
	0.6 - 1.0	6 - 9	75	5 - 8
Loamy sand	0.2 - 0.4	12 - 30	75 - 150	7 - 10
	0.4 - 0.6	9 - 12	75 - 150	5 - 8
	0.6 - 1.0	6 - 9	75	3 - 6
Sandy loam	0.2 - 0.4	12 - 30	90 - 250	5 - 7
	0.4 - 0.6	6 - 12	90 - 180	4 - 6
	0.6 - 1.0	6	90	2 - 4
Clay loam	0.2 - 0.4	12 - 30	180 - 300	3 - 4
	0.4 - 0.6	6 - 12	90 - 180	2 - 3
	0.6 - 1.0	6	90	1 - 2
Clay	0.2 - 0.3	12 - 30	350+	2 - 4

Source : FAO Irrigation and Drainage Paper No.24



Farm Road Condition of Banavar I&D Scheme

(10) Farmland Block

Generally the farmland block adopted in the Study Area is rectangular with about 400 m of

width and 1,500 m of length, divided by tertiary drainage canals. Individual farmers are diving the block furthermore with some 60cm height levees. 1/2,000 slope is adopted for farmland surface gradient.

The size of farm blocks might be within acceptable from the viewpoint of proper irrigation practice.

(11) Appurtenant Facilities

1) Farm Road

Farm roads (earth graded type) are provided along both of irrigation and drainage canal network, with 4.0m or 6.0m R.O.W for trunk road, 3.0 or 4.0m R.O.W for lateral road. Arrangement of route system is generally lattice type consisting of trunk and lateral roads.

The surface condition of the farm roads during the first field survey was little bit muddy, showing a very difficult traffic condition. It seems to be caused by the soil type of the farmland, roughly classified as clay loam or clay. Even though, the comment is superficial without direct interviews to farmers, some modification might be required like gravel pavement.

Road bridges connected with farm road are only for roads crossing over main and secondary canals, which adopts RC board with 4.0 m width or applying RC box culvert.

2) Division Works

All of secondary canals are taking irrigation water through simple sluice-gate type intakes. The tertiary canals also takes water through same type but in a smaller size, as shown in the pictures. Farmers conduct irrigation water from tertiary canal, sometimes being classified as quaternary and just a man-excavate ditch, with blocking the flow with clod.

Although the canals in the pictures are lined with concrete, most of secondary and tertiary canals are unlined actually.

Division Work for 2ndary Canal .

Divisin Work for Tertiary Canal

General Information of Existing Irrigation Schemes in the Study Area

Common Name in S/W			Tazeh-Abad	Agghala		Banaver		Cheldin
Number			No.1	No.2	No.3	No.4	No.5	No.6
Name of Irrigation Project			Tazeh-Abad	Aghghalla (Aghghabar)	Shadi Mehr	Gomishan	Gomishan	Mehtar Kola
Name of Cooperative			Peivand	Hemmat	Shadi Mehr	Banaver	Gomishan Kesht	Rooyesh-e-Mehtar
Name of District			Agghala	Agghala, Torkaman	Agghala	Bandar-e-Torkaman	Bandar-e-Torkaman	Kord Kuy
Name of Dehstan			Aghdakesh, Tazeh	Sahneh sofia, Delije	Delije Kashakheh	Banaver	BasirAbad- Camlar	Mehtar Kalate
Name of Deh			Tazeh Abad	Sahneh	Delije	Banaver, Gharghi, Katoelk	Gharghi Nardanly	Mehtar Kalate
Number of Farms			464	163	40	279	700	605
Number of Cooperative members			341	170	379	157	280	450
Project In-Charge Agency			JeAO	JeAO	JeAO	JeAO	Jihad > JeAO	JeAO
Water Sources			Gorgan River	Gorgan River	Gorgan River	Gorgan River	Gorgan River	Groundwater
Pump capacity			9 pumps @ 300 lit./sec	5 pumps @ 300 lit./sec	3 pumps @ 250lit./sec	5 pumps @ 300 lit./sec	5 pumps @ 160 lit./sec 5 pumps @ 240 lit./sec	individual pumps & streams
Project Area			3,500 ha	1,250 ha	1,170 ha	1,780 ha	4,800 ha	1,588.5 ha
Latitude			N37-05'-00" > 37-07'-	N36-58 > 37-1	N37-2-30	N36-59>37-1	N37-2	N36-50>36-51
Longitude			E54-28'-00" > 54-36'-	E54-21>54-26	E54-24-30	E54-11>54-12	E54-12	E54-11>54-13
Design irrigable area.			2,000.0 ha	900.0 ha	0.0 ha	1,450.0 ha	2,000.0 ha	1,400.0 ha
Present irrigated area.			1,200.0 ha	650.0 ha	0.0 ha	650.0 ha		1,400.0 ha
Main crops			Cotton, Wheat, Barley.	Cotton, Wheat, Barley	Cotton, Wheat, Barley	Cotton, Wheat, Barley	Cotton, Wheat, Barley	Cotton, Wheat, Barley,
Expected yield	Wheat		4,000.0 kg/ha	3,500.0 kg/ha	3,000.0 kg/ha	4,000.0 kg/ha	4,000.0 kg/ha	5,000.0 kg/ha
	Barley		3,000.0 kg/ha	3,000.0 kg/ha	2,000.0 kg/ha	3,000.0 kg/ha	3,000.0 kg/ha	4,000.0 kg/ha
	Cotton		2,500.0 kg/ha	2,500.0 kg/ha	2,000.0 kg/ha	3,000.0 kg/ha	3,000.0 kg/ha	4,000.0 kg/ha
	Sunflower		2,000.0 kg/ha	1,800.0 kg/ha	- - - - - -	2,000.0 kg/ha	2,000.0 kg/ha	2,500.0 kg/ha
	Way of the above estimation		Field experience	Field experience	Field experience	Field experience	Field experience	Field experience
Landuse	Farm		3,259.0 ha	1,182.0 ha	1,000.0 ha	1,450.0 ha	4,728.0 ha	
	Farm road		42.0 ha	22.0 ha	7.0 ha	19.4 ha	21.4 ha	
	Residential area		2.0 ha	1.0 ha	1.5 ha	1.0 ha	1.0 ha	
	Pond		150.0 ha	14.0 ha	80.0 ha	0.3 ha	0.0 ha	50.0 ha
	Canal		47.0 ha	31.0 ha	22.5 ha	30.5 ha	49.6 ha	
Soil Sampling Results *	EC	Top layer (mS/cm)	7.9 7.5	13.9	13.1	23.2 11.6		1.6
		Middle layer (mS/cm)	9.7 12.3	22.9	23.4	21.0 12.9		1.4
		Bottom layer (mS/cm)	12.1 9.6	24.4	28.8	10.7 14.2		1.4
	pH	Top layer	8.0 8.0	7.9	8.0	7.7 7.7		7.9
		Middle layer	8.0 7.9	7.7	8.1	7.7 7.8		8.3
		Bottom layer	8.1 8.1	8.1	8.2	7.9 7.9		8.3
	Texture	Top (Sand-Silt-Clay)	12-62-26 10-50-40	8-48-44	16-64-20	16-62-22 10-70-20		6-54-40
		Middle (Sand-Silt-Clay)	10-74-16 8-44-48	22-54-24	18-68-14	18-72-10 6-76-18		4-54-42
		Bottom (Sand-Silt-Clay)	8-64-28 6-46-48	50-44-6	18-70-12	66-30- 4 34-60-6		6-54-40
		Classification	Si-L Si-CL Si-L	Si-L	Si-L	Si-L Si-L		Si-C Si-CL
Electricity availability			Available	Available	Available	Available	Available	Available
Development History	Year : Planning		1993 - 1997	1992 - 1993	1997	1993	1998	1996
	Year : Drain started		1998	1994	1999	1994	1999	--
	Year : Pump station provided		1998	1994	2001	1994	2000	--
	Year : Watering started		1999	1996		1996	2002	99
	Year : Cooperative set		1997	1996	1998	1995	1997	1997
	Phase-1	Construction period	1998 - 2000	1994 - 1999	1997 - 2001	1994 - 1999	1998 - 2002	1996 - 1998
		Area developed	2,000.0 ha	900.0 ha	1,000.0 ha	650.0 ha	2,000.0 ha	400.0 ha
		Cost Disbursed	1,200.0 Million Rials	450.0 Million Rials	1,000.0 Million Rials	350.0 Million Rials	750.0 Million Rials	
	Phase-2	Construction period	2002 - 2004	2003 - 2005	2002 - 2004	2003 - 2006	2002 - 2006	1999 - 2004
		Area developed	1,200.0 ha	600.0 ha	0.0 ha	850.0 ha	2,800.0 ha	1,200.0 ha
		Cost Estimated						

* Note Results are referred from 1st Field Survey
Top : 0 - 20, Middle : 20 - 40/50, Bottom : 40/50 - 100

Source : Golestan Province JAO, Soil & Water

Irrigation Canals of Existing Irrigation Schemes in the Study Area

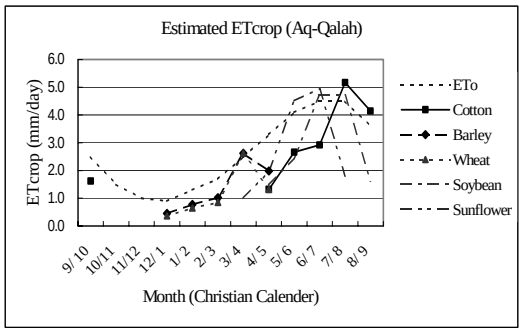
Number		No.1	No.2	No.3	No.4	No.5	No.6
Name of Irrigation Project		Tazeh-Abad	Aghghalla (Aghghabar)	Shadi Mehr	Gomishan	Gomishan	Cheldin
Name of Cooperative		Peivand	Hemmat	Shadi Mehr	Partov	Gomishan Kesht	Rooyesh-e-Mehtar
Irrigation Canal : Main	Canal flow capability	2,400 lit./sec	1,250 lit./sec		1,250 lit./sec	800 lit./sec	
	Canal bottom width	0.70 m	0.76 m		0.60 m	0.55 m	
	Canal depth	1.25 m	0.95 m		1.10 m	0.80 m	
	Canal free board						
	Canal long-gradient	1 / 2,000	1 / 2,000		3 / 10,000	3 / 10,000	
	Canal side slope	1 : 1.5	1 : 1.5		1 : 1.5	1 : 1.5	
	Canal structure	Concrete lining	Concrete lining		Concrete lining	Concrete lining	
	Total length	0.50 Km	4.00 Km		0.70 Km	4.00 Km	
Irrigation Canal : Main (1dgre	Canal flow capability	1,200 lit./sec			870 lit./sec		
	Canal bottom width	0.50 m			0.60 m		
	Canal depth	0.90 m			0.90 m		
	Canal free board						
	Canal long-gradient	1 / 2,000			3 / 10,000		
	Canal side slope	1 : 1.5			1 : 1.5		
	Canal structure	Concrete lining			Concrete lining		
	Total length	5.00 Km			1.15 Km		
Irrigation Canal : Main (2dgre	Canal flow capability				330 lit./sec		
	Canal bottom width				0.30 m		
	Canal depth				0.75 m		
	Canal free board						
	Canal long-gradient				3 / 10,000		
	Canal side slope				1 : 1.5		
	Canal structure				C.L:1.6km. E.L:4.6km		
	Total length				6.20 Km		
Irrigation Canal : Main (2dgre	Canal flow capability				550 lit./sec		
	Canal bottom width				0.30 m		
	Canal depth				0.75 m		
	Canal free board						
	Canal long-gradient				3 / 10,000		
	Canal side slope				1 : 1.5		
	Canal structure				C.L:1.0km. E.L:5.0km		
	Total length				6.00 Km		
Irrigation Canal : Secondary	Canal flow capability	2,400 lit./sec	120 lit./sec		70 - 100 lit./sec	1,000 lit./sec	
	Canal bottom width	1.50 m	0.30 m		0.20 m	0.55 m	
	Canal depth	1.50 m	0.60 m		0.40 m	0.95 m	
	Canal free board						
	Canal long-gradient	1 / 2,500	6 / 10,000		1 / 2,500	3 / 10,000	
	Canal side slope	1 : 1.5	1 : 1.5		1 : 1.5	1 : 1.5	
	Canal structure	Earth lining	Earth lining		C.L:1.5km. E.L:8.5km		
	Total length	8.70 Km			10.00 Km	2.00 Km	
Drainage Canal : Main	Canal flow capability	- - -	- - -		- - -	- - -	
	Canal bottom width	1.00 m	6.00 m	1.40 m	3.00 m	5.50 m	
	Canal depth	2.00 m	2.50 m	2.00 m	2.50 m	1.40 m	
	Canal free board						
	Canal long-gradient	1 / 2,000	1 / 2,000	6 / 10,000	3 / 10,000	3 / 10,000	
	Canal side slope	1 : 1.5	1 : 1.5	1 : 1.5	1 : 1.5	1 : 1.5	
	Canal structure	Earth lining	Earth lining		Earth lining	Earth lining	
	Total length	11.50 Km	4.00 Km	7.00km+5.00km	8.80 Km	26.00 Km	
Drainage Canal : Secondary	Canal flow capability	- - -	- - -		- - -	- - -	
	Canal bottom width	0.50 m	1.00 m	1.00 m	1.50 m	1.00 m	
	Canal depth	1.50 m	1.50 m	1.40 m	1.50 m	1.30 m	
	Canal free board						
	Canal long-gradient	1 / 2,000	1 / 2,000	6 / 10,000	3 / 10,000	3 / 10,000	
	Canal side slope	1 : 1.5	1 : 1.5	1 : 1.5	1 : 1.5	1 : 1.5	
	Canal structure	Earth lining	Earth lining		Earth lining	Earth lining	
	Total length	34.00 Km	4.00 Km	26.50 Km	26.00 Km	45.00 Km	

Source : Golestan Province JAO, Soil & Water

(12) Estimation of Irrigation Water Requirement

1) Crop Water Requirement

CROPWAT is well adopted for estimation of crop water requirement in the region widely, and Soil and Water Management of I&D section, J.A.O, Golestan had already provided summary of ETcrops of various locations in the province. Among those estimates, *Aq Qala* is to be applied tentatively because of its location in the Study Area as the right table, which is quoted from results of estimation prepared by Mr. Mohsen Zamani, Soil and Water Management Section.



Estimated Crop Water Requirement

Location : Aq-Qalah unit : mm/day

Iranian Calendar	7	8	9	10	11	12	1	2	3	4	5	6
Christian Calendar	9/10	10/11	11/12	12/1	1/2	2/3	3/4	4/5	5/6	6/7	7/8	8/9
ETo	2.5	1.5	1	0.9	1.3	1.7	2.5	3.3	4.1	4.5	4.5	3.6
Cotton	1.62							1.32	2.66	2.92	5.17	4.14
Barley				0.45	0.78	1.02	2.62	1.98				
Wheat				0.36	0.65	0.85	2.62	1.32				
Soybean								1.48	2.46	4.72	4.72	1.62
Sunflower							1.0	1.98	4.51	4.95	1.8	

Source : Summary of Etcrop in Various Locations in Golestan Province, Mr. Mohsen Zamani, I&D, JAO, Golestan.

2) On-farm Water Balance and Demands for Irrigation

a) Crop Selection and Crop Calendar

The crops and its cropping pattern are shown in the following table.

b) Irrigation Practice and Efficiency

Border irrigation with the irrigation efficiency of 0.48 is to be adopted, multiplying 0.80 of canal conveyance efficiency with 0.6 of field application rate.

c) Leaching Requirement

Electrical conductivity as reference point of irrigation water quality is referred to observed values at *Aq Qala* by MOE. Requirement for leaching, indicating percentage against irrigation water requirement, varies from 1% in June/July to 50% in July/August and August/September, reflecting the fluctuation of EC value of river water.

Estimation of Monthly Irrigation Demand and Pond Capacity Requirement

Solar Calendar		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Iranian Calendar		10	11	12	1	2	3	4	5	6	7	8	9
		Bahm	Esfa	Farv	Ordi	Kord	Tur	Mord	Shah	Mehr	Aban	Azar	Dey
Monthly Rainfall (mm/month)		56	25	81	41	40	0	8	26	28	14	11	10
Wet / Dry Season		wet	wet	wet	dry	dry	dry	dry	dry	dry	dry	wet	wet
Major Crops & Cropping Calendar in the Area	Wheat												
	Barley												
	Paddy Spring												
	Paddy Summer												
	Cotton												
	Rape												
	Soybean Spring												
	Soybean Summer												
	Cabbage												
Cropping calendar : Cotton													
Cropping calendar : Wheat													
ET: Cotton mm/day						1.32	2.66	2.92	5.17	4.14	1.62		
ET: Wheat mm/day		0.36	0.65	0.85	2.62	1.32	0						
Total ET for farmblock		0.36	0.65	0.85	2.62	1.32	2.66	2.92	5.17	4.14	1.62	0	0
EC of Water (mS/cm)		2.6	2	3.6	1.8	0.9	0.8	0.7	12	12	2.6	2.9	2.7
Actual water vol. Cotton		0	0	0	0	1.35	2.71	2.96	7.76	6.21	1.72	0	0
Actual water vol. Wheat		0.39	0.69	0.95	2.76	1.35	0	0	0	0	0	0	0
Total Actual water inc. leach'g		0.01	0.04	0.08	1.45	0.36	0.72	0.86	4.01	2.57	0.28	0	0
Ratio : AW/ET		0.03	0.06	0.09	0.55	0.27	0.27	0.29	0.78	0.62	0.17	0	0
Demand for source (only irri.)		0.75	1.35	1.77	5.46	2.75	5.54	6.08	10.77	8.63	3.38	0	0
Leach'g coverage by loss		Cov'd	Cov'd	Cov'd	Cov'd	Cov'd	Cov'd	Cov'd	Cov'd	Cov'd	Cov'd	Need	Need
Effective rainfall mm/mon.		21.6	14.7	16.6	17.7	10.5	14.1	0	0	0	3.6	12.8	18.4
W.demand for 1000ha I&D		0.02	0.23	0.38	1.46	0.75	1.52	1.88	3.34	2.59	1.01	0.00	0.00

Annual water requirement for developing 1,000ha I&D scheme ; 13.18 MCM / year / 1,000ha (In case of everyday irrigation practice)

Crop selection and calender
- Cotton : from 4/5 to 9/10 (Solar Calender)
- Wheat : from 11/12 to 4/5 (Solar Calender)

Irrigation efficiency

Conveyance efficiency	Ec	0.80
Field application efficiency	Ea	0.60
Irrigation efficiency	Ei	0.48

W.demand for 1000ha I&D	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(As recommended by Govt)	0.0165	0.231	0.3827	0.3144	0.1425	0.3576	0.5472	0.9693	0.7767	0.2682	0	0

Annual water requirement for developing 1,000ha I&D scheme ;	4.01	MCM / year / 1,000ha
Reuired Pond Capacity / 1,000ha for Dry Season from Apr. to Dec.)	3.38	MCM / 1,000ha
Required Pump capacity	883.00	lit / sec/1,000ha (60 days 18hr operation in Wet Season.)
Required number of pump of 300 lit / sec capacity for the above	2.94	Nos/set/1,000ha area. To fill farm pond with 60days 18 hrs operation in Wet Season

Adapted irrigation practice for the above estimation is 3-time irrigation in a month during dry season.

Required capacity of reservoir by irrigation scheme ;

Tazeh-Abad	3,300	ha	11.10	MCM	say	11.00	MCM	10	Nos pump required / Present ;	9	Nos
Hemmat	1,200	ha	4.10	MCM	say	4.00	MCM	4	Nos pump required / Present ;	5	Nos
Shadi Mehr	1,000	ha	3.40	MCM	say	3.50	MCM	3	Nos pump required / Present ;	5	Nos
Banaver	1,450	ha	4.90	MCM	say	5.00	MCM	4	Nos pump required / Present ;	5	Nos
Gomishan Kesht	4,700	ha	15.90	MCM	say	15.50	MCM	14	Nos pump required / Present ;	5	Nos

Legend of Marks in Crop Calendar

○	Tillage	△	Irrigation	◇	Pesticide
◎	Sowing	×	Harvesting		
●	Transplanting	■	Fungicide		
▲	Fertilization	□	Herbicide		

3.4.2 Improvements Needed in the Present I & D Schemes

(1) Problems and Constraints Recognized by Farmers and the Government

1) Problems and Constraints Recognized by the Farmers

a) Stable supply of irrigation water is not obtained.
b) River is not flowing sufficient amount of water.
c) Hardly to buy irrigation water from the station due to debt.
d) Never received irrigation water after completion of pump station construction. (Mainly in the downstream area in an irrigation scheme)
e) Not available to convey water through secondary canals due to obstacle of slope slides.
f) Not available to get water due to the lack of tertiary and quarterly canals.
g) Hope to increase / provide more drains to increase crop yield.
h) Soil salinity causes low yield.
i) Improper land leveling causes imbalanced irrigation in a plot.
j) Number of agricultural machinery is not sufficient.
k) Muddy farm road avoids smooth farm works.
l) Hardly to accept to sell farm land for pond construction.

2) Problems and Constraints Recognized by the Government

a) Stable supply of irrigation water is not obtained.
b) River is not flowing sufficient amount of water.
c) Hardly to obtain sufficient water when they need water.
d) Farmers hardly accept water saving irrigation and continue to use the basin irrigation method.
e) Budget shortage of the Government causes delay of canal concrete lining.
f) Budget shortage of the Government makes hardly to increase drains.
g) Farmers are not conducting proper canal maintenance.
h) Ponds are necessary to keep sufficient water for dry season irrigation.
i) Budget shortage of the Government makes delay of project completion.
j) Non-lining canal caused water leakages.
k) Improper land leveling causes imbalanced irrigation in a plot.
l) Farmers have never become familiar with irrigation framing due to short experiences for it.
m) Basin irrigation has function to leach salt as preparatory practice before introducing furrow irrigation.
n) Present drainage canal interval ; 300m or 350m seems to be sufficient.

(2) Improvements Needed in the Present I & D Schemes

1) No Stable Water Intakes for Irrigation

Scarcity of irrigation water is the first thing at any irrigation schemes, during the interviews. The farmers well knew that wheat was the high sensitive crop for water when they were cultivating under dry farming practice. The present situation / achievements of wheat yield is far from the expected level or from the level explained for the farmers by the Government before adapting the irrigation farming. Present procedure of water delivery is direct supply to canal from the pump station, after pumping water of the river. Farmers are introducing the

irrigation practice, but they are complaining that the river discharge decreases rapidly at the time when they need water for irrigation.

2) Hardly to Covey Water Through Irrigation Canals

Farmers raise opinion as above, hardly to convey water through irrigation canals. Two are the main problems, where one is “Obstruction of canal section by sedimentation“ and “Obstruction by falls and deformation of earth canal section”.

3) Drainage System to Avoid Salt Hazard

Request of provision of drain is raised from farmers commonly during the interviews. Reasons of their request come from “ lower yield “ which is doubted from “ salt hazard “ and “ high groundwater table “. It is difficult to define the exact causes of their low yield whether from salinization only, draught condition of recent several years, lack of farming technology or others. But the present drain system is hardly to cause vertical water movement in the soil, which functions for salt leaching due to low density of the drain, as the Provincial J.A.O’s recognition.

Provision of additional open drain canal, pipe drain and mole drain are seemed as possible countermeasures. Some farmers object for the open drain because of decreasing of farm land. Applying the pipe darn system is doubted for the implementation due to the cost, which is expected as permanent countermeasure. Mole drain system is seemed applicable, with imagination of low cost because of non-material utilization. But concrete research results are not found in the Study Area or under similar condition. Also the clay content rate of the soil is about 30 % or so, not more than 45%, which is reported as suitable condition for the mole drain. It seems that some trials of those alternatives are conducted urgently to gain references of adaptability.

4) Provision of Farm Pond / Water Storages to Alleviate Water Scarcity

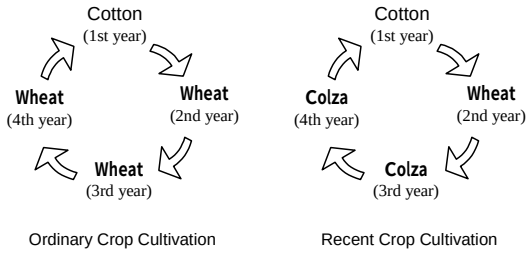
Discharges of Gorgan river in the dry season is not sufficient to supply water to the demand. For fulfilling to the demand, especially for the dry season, it is necessary to store the discharge of the rainy season or to convey the water from other outer basin. Most realistic measure is to construct farm pond by each irrigation scheme, which can store river water of the rainy season through existing pump station and utilize it in the dry season. Even though the Provincial J.A.O recognizing as the most important subject, both of budget shortage and land acquisition prevent the progress by now. And farmers are still under the lower yield.

3.4.3 Appraisal Procedures of Irrigation and Drainage Schemes

Appraising procedure of irrigation and drainage schemes in Iran are to be explained in this sub-chapter to understand stakeholders and task allocation of irrigation and drainage projects.

(1) Necessity of Enhancing Irrigation and Drainage Schemes

As already been stated in previous chapters, the Government aims to increase the food self-sufficiency against heavy burden of staple food import. About 40% of domestic demand depends in the importation from foreign countries. The Government set measures to increasing the food production, mainly for wheat production. The *Gorgan* region, including to the Study Area, was nominated as potential area due to the wide extent for I&D scheme introduction and perennial rivers represented by *Gorgan* river system.

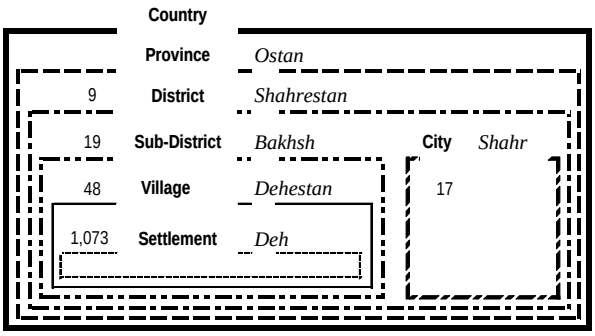


Recent Change of Cropping Pattern in the Study Area

On the other hand, even the farmers are accepting the government policy as an assistance source to improve their productivity, little bit different recognitions are noticeable among farmers. Their main intention is to improve their living standards securing a stable and sufficient income, not insisting in wheat production. They prefer to cultivate higher value crops than wheat like colza in recent few years.

(2) Appraising Procedure of Irrigation and Drainage Schemes

Administrative Hierarchical Unit in Iran



Note ; Nubers besides of administrative unit name ; Number in Golestan Province

All I&D projects starts from the requests of the farmers or farmers' cooperatives to the government, according to the explanation of the local government. First, the request from farmers of a certain area is reported to a local Agriculture Office, which was provided by the Government to assist farmers for any agriculture-related constraints. Basically an Agriculture Office is set in each *Shahrestan* (District) and branch offices are provided at every Dehestan (Village). The I&D project is classified into three categories, based on fund sources, in *Shahrestan* (District) project, Ostan (Province) project or Central Government project. Quite minor matter is solved at *Shahrestan* level, like farm road maintenance, provision of small-scale bridge over main canal, and land leveling maintenance. Project to be adopted by a provincial government is little bit bigger than *Shahrestan* level

Cost Sharing on Scheme Appraisal & Construction

		Government Side	Farmer Side	Remarks
Appraisal Stage	Preliminary survey	Only advise	100%	Soil, topo-survey
	Detailed plan & design	100%		
Construction Stage	Water source, main canal	100%		Ref. cost allocation between Govt. & farmer
	Appurtenant facilities	30～40%	70～60%	
	Main drainage	100%		
	On-farm facilities	30～40%	70～60%	

project. Further bigger scale project is conveyed by the central Government. Reference points for those classifications are not clear, but obviously the scale of the project cost is considered.

A point that must be mentioned is the importance of the Technical & Infrastructure Deputy of the MOJA in Karaji city for the provincial and national level projects. Most of major aspects of planning and design like detailed design of facilities, cost estimation, implementation plan are handled by the Deputy, not in the Province.

(3) Project Cost Sharing System

With no difference among the administrative hierarchies, the cost of any project are shared between the beneficiaries and the Government. All costs of water source facilities and main canal networks are responsibility of the government. Costs related to on-farm facilities and appurtenants are shared by both side. The farmers (or farmers' cooperative) should prepare the necessary fund from commercial bank under the government's authorization, with 14% interest rate. Its redemption period varies from 5 to 10 years.

It is explained that the Government has a policy to hand over the cost sharing gradually from the Government to the farmers and the ratios in the above table varies from year to year.

(4) Farmers Cooperative as Owner of Irrigation and Drainage Scheme.

It is said that the O&M of all irrigation schemes shall be done by the farmers cooperative. Though, the facilities provided by the Government shall belong to the Government. Hence, it has been enhanced to establish one farmers' cooperative for one I&D scheme and several cooperatives are functioning now.

In the initial stage of the facility provision, the Government encourages the establishment of farmers cooperative as a body to receive any assistance from the Government. The general procedure for establishing farmers' cooperative is as follows:

In the case of farmers requesting assistances to a local government office, a relevant agricultural office starts to guide the farmers to establish a farmers' cooperative, introducing the benefit principal and scope of government's assistances. The farmers select the cooperative board, generally consisted by seven members including a chairman,

Establishing Procedure of Farmers' Cooperative.

Major Steps for Cooperative Establishment		Farmers	Cooperative Board	Shahrestan Agriculture Office	Ostan Agriculture Organization
1	Project proposing	●			
2	Consultation to Agriculture Office	●		●	
3	Guide to farmers to establish cooperative	●			
4	Define sub-groups in a scheme by location	●			
5	To conduct election to select group leaders.	●			
6	To conduct election to define cooperative board	●			
7	To establish farmers' cooperative		●		
8	Provincial govt dispatch cooperative manager (generally 5 years)				●
9	Project appraisal			●	●

Source : Summarized interview results

selecting the group heads by each area after it. In parallel to the cooperative formation, the local government, mainly the provincial government, dispatches a manager who will take care of the cooperative in the first five years. The manager has to be approved by the cooperative members before starting the consultation. The farmers' cooperative, as a parent body of ownership of a certain scheme, is now completed.

Major tasks of the cooperative are:

a. To define admission fee and annual membership fee and their collection.
b. To set water allocation rule for the irrigation season.
c. To conduct public awareness for aspects which the members need to decide as a scheme owner.
d. To define cost allocation rule and its collection for certain expenditures.

Procedure of Project Appraisal and Implementation of I&D Scheme

	Major Steps for Project Implemetation	Farmers	Shahrestan Agriculture Office	Ostan Agriculture Organization	Ostan Budget & Planning	Ministry of Agriculture	Bank
Project Proposing	Project proposing	●					
	Consultation for the proposing		●				
	Project digesting		●				
	Appraisal at Shahrestan level		●				
Shahrestan Level Project	Planning as Shahrestan project		●				
	Supervising the Tendering	●	●				
	Project implementation		●				
	Disbursmet of the Govt budget		●				
	Funding from bank to farmers						●
Ostan Level Project	Project request to Ostan Govt		●				
	Basic design at J.A.O.			●			
	Project digesting			●			
	Appraisal at Ostan level			●	●	●	
	Planning as Ostan project			●			
	Project implementation			●			
	Disbursmet of the Govt budget			●			
	Funding from bank to farmers						●
National Level Project	Planning as National project					●	
	Detailed design & cost estimate					●	
	Supervising the Tendering			●			
	Project planning					●	
	Project implementation			●		●	
	Disbursmet of the Govt budget					●	
	Funding from bank to farmers						●

Chapter 4	Problems, Potentials and Basic Concept of the Agricultural Development of the Study Area

CHAPTER 4

PROBLEMS, POTENTIALS AND BASIC CONCEPT OF THE AGRICULTURAL DEVELOPMENT OF THE STUDY AREA

4.1 Problems of the Agricultural Development

The problems of the agricultural development are discussed below.

4.1.1 Natural Conditions

(1) Water Resources

The major problems of the water resources can be summarized as follows:

1) Inappropriate distribution of rainfall and high rates of evaporation
2) Scarcity of surface water for irrigation
3) Overuse of groundwater resources

The rainfall and evaporation balance in the Study Area do not provide enough water resource for the agriculture use. The evaporation rate is very high and the rainfall is very low. Hence, irrigation is an essential practice to the agricultural production.

The other two water resources for the agriculture are the groundwater and surface water. The groundwater exploration already reached a level that no more exploration is recommended. Hence, the existing groundwater resources shall be utilized more efficiently mainly by the agricultural sector, which is the greatest consumer in volume and the most inefficient user. The groundwater shall be utilized in a way that shall prevent the soil deterioration and conserve the environment.

The remaining potential water resource comes from surface water. But before any exploration of new water resources, the present water resources shall be used more efficiently. First the existing water exploration conditions shall be improved before looking for new sources.

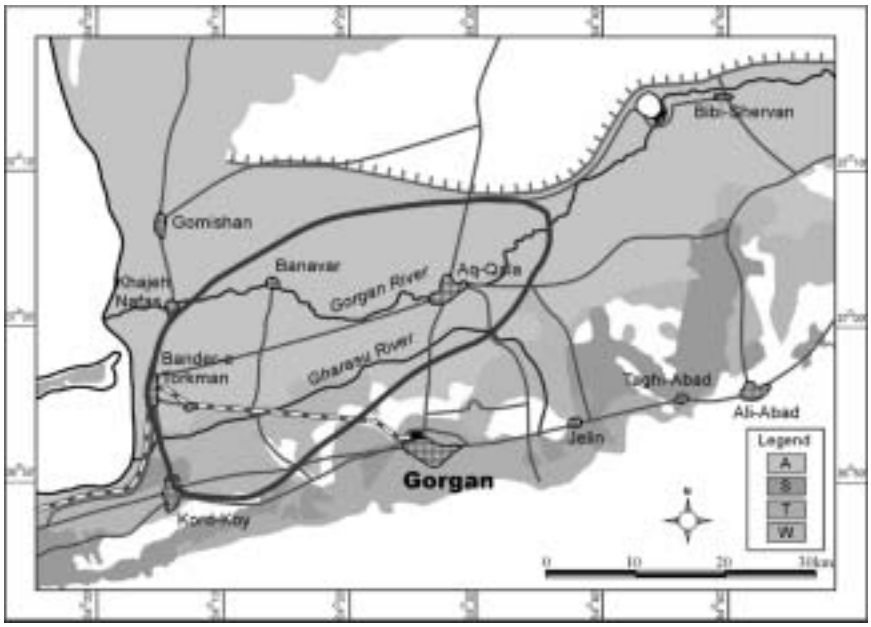
(2) Soils

The major problems related to the soils in the Study Area are as follows:

1) Salinization and alkalinization of the soils
2) Soil Limitation (texture, permeability, limiting layer, etc.)
3) Drainage limitation (groundwater depth, ponding problems, etc.)

As it can be seen from the following Figure, the northern part of the Study Area has severe salinity and alkalinity problem. The accumulation of excess amounts of soluble salts in the

crop root zone is one of the major problems, which reduces the productivity of the soils. This salinization and alkalinization are caused due to various reasons, which include geological composition of the parent materials of the soils, surface water, seawater intrusion, and poor soil and water management. Similarly, the Gaspian Sea water intrusion into the shallow groundwater in the Study Area has also lead to the salinization of the soils. The soluble salts have harmful effects due to the particular ions in excess level, which are harmful to the crops and raising the osmatic pressure of the solution around the roots of the crops. Salinity imposes serious limitations on economic crop production mostly because of lack of enough quantity of fresh water required to flash the salt out of the root zone.



Legend

A - Salinization and alkalinization

S - Soil Limitation (texture, permeability)

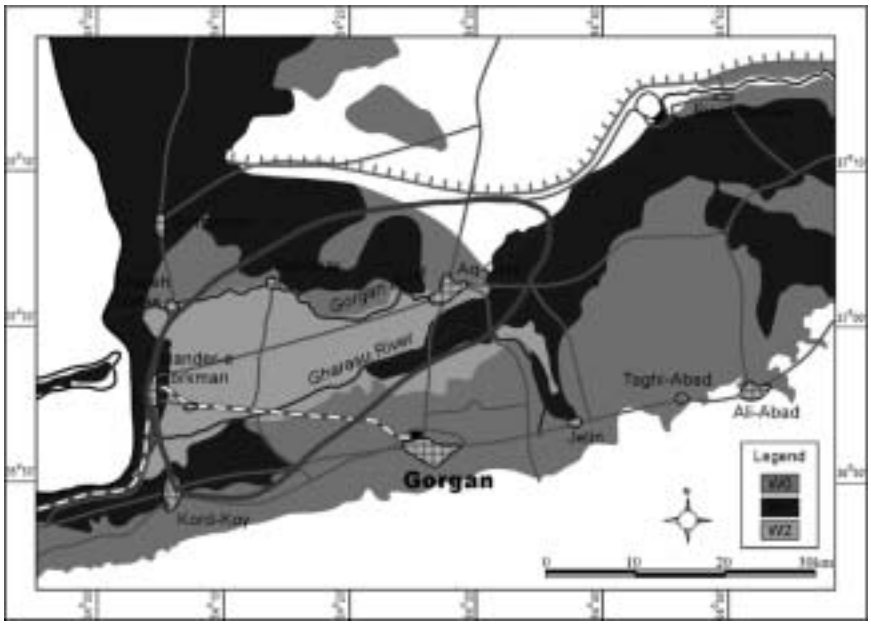
T - Topographic limitation

W – Drainage limitation

Major Limitations of the Soils in the Study Area
(Source : GIS Section, MOA, Golestan Province)

The soil limitation, which includes texture, and permeability are mostly in the area near Kordkuy in the Cheldin project area. This project area has a very heavy clay texture which causes water logging and ponding problem. If the soil moisture level is low, ploughing will be extremely difficult.

As it can be seen from the following Figure, the middle part of the study area has a groundwater depth of 2-3m and the groundwater depth in most of the Study Area lies within 1 to 3m. In the poorly drained areas, a large quantity of salts leached from the higher regions have accumulated in the slowly flowing shallow groundwater, and the salts have ascended into the soil because of a high evapotranspiration rate.



Legend

W0- No groundwater table limitation

W1 – Slight limitation (2-3m)

W2 – Moderate limitation (1.2-2m)

Limitations of Groundwater Depth in the Study Area
(Source : GIS Section, MOA, Golestan Province)

Apart from these major limitations, other limitations include the fertility status of the soil which varies from a low to moderately high level. If leaching is carried out in an extensive manner, then there will be fertility problem because of leaching of nutrients. Therefore balanced fertilization and balanced water management practices are necessary.

4.1.2 Socio-economy

The major problems of the agricultural development from the socio-economical point of view are as follows:

1) Urbanization in the vicinities and income gap between urban and rural areas
2) Insufficient establishment of marketing system
3) Social aspects, especially the traditional nature of farming

1) Difference of living standard between rural and urban areas and urbanization in the vicinities and income gap between urban and rural areas

    1. Living standard of rural population is low and there is a wider gap in the living standard between the rural and urban areas
    2. The farmers in the rural areas are inclined more towards sending their children to urban areas
    3. Urbanization in the vicinities has been rapidly encroaching to the rural area not only physically but also socioeconomically, which seems to shift the farmers' intention to outside world as alternatives for higher income for their families, and higher education for younger generation.

4. Land less farm laborers sharing more than 40% of rural population leaves from villages, and therefore the farmers have to use expensive agriculture machinery.
5. The society is more inclined towards the non-agriculture industries because of higher income and modern life style.

2) Insufficient Establishment of Marketing System and Supporting Industries

1. During the last half century, the farmers have not experienced a well established commercialized market system and the traditional marketing system of local grains has been continuing.
2. The local markets are not sufficient enough to enhance crop diversification, which might be one of the potential solution options to improve farm income.
3. Rural supporting industries are not introduced in the Study Area

3) Social aspects

1. Ethnic culture keeps the farmers in traditional cultivation and isolate them from free market.
2. The recent tendency of privatization and cost sharing concept based agriculture policies is a new subject for the local government and is difficult for them to digest before extending to the farmers who are carrying out traditional way of cultivation.
3. Just one or two generations have passed after the introduction of modernized irrigation system to farmers, who kept their own nomadic-life based culture during several centuries. Hence irrigation itself is still a new subject for them including farm management practice considering marketing.
4. The farmers are still highly dependent on the government for any decision making or cooperative management while the government would like to encourage privatization or participation of farmers for their selves-management. It indicates the necessity of some institutional strengthening measures, such as the ownership-oriented participation;
5. Most of the government agencies have quite proper potentials to overcome the given tasks but it seems to be difficult to combine each potential into one objective-targeted approach combining together.

4.1.3 Agriculture

The farming activities in the study area, especially in the northern region, has many limiting factors for agricultural development which can be broadly classified into 3 categories as follows:

1) Problems related to land tenure and farm management
2) Problems related to the present farming technology
3) Problems in the agricultural researches

1) Problems related to land tenure and farm management

① High rate of agricultural population,
② Many farmers engage in the agriculture sector without lands,
③ Few opportunity of employment for excess laborers,
④ Small scale of the rural properties,
⑤ Many rain-fed lands under cultivation (56%),
⑥ Traditional raising methods of livestock and shortage of feed,
⑦ Lack of public centers of machinery maintenance,
⑧ Lack of will to serve in the machinery owners in promotion of mechanization, and
⑨ Imbalance between the increase rates of prices of farm materials and farm machinery, and that of producers' prices of products, which results low incomes of farmers.

2) Problems related to the present farming technology

① Low productivities of main crops in even irrigated fields,
② Lack of reliable cultivation technologies and low productivities in rain-fed fields,
③ Lack of awareness on soil fertilization with organic matter (officials and farmers),
④ Week combination of ordinary crops and forage crops in cropping system,
⑤ Low development of processing sector for agricultural products,
⑥ Lack of measures for the aging society in farming,
⑦ Undeveloped farmers' cooperatives,
⑧ Undeveloped technology of plastic greenhouse,
⑨ Inefficiency in extension activities,
⑩ Imbalance of agricultural researches.

3) Problems in the agricultural researches

① Low cost construction method of irrigation and drainage facilities,
② Effective plot size of farms,
③ Selection of suitable crops and varieties and improvement of cultivation methods,
④ Sustainable farming by modernized combination of agriculture and animal husbandry, especially by introducing of forage crops to the cropping system to increase the soil fertility,
⑤ Integrated technologies in farming, and
⑥ Technology of plastic greenhouse cultivation, etc.

4.1.4 Animal Husbandry

The limitations and problems of animal husbandry in the Study Area are summarized as follows:

1) Limitation in forage sources

   ① Absence of plant cover in pasture lands
   ② Limited area of pasture lands (about 110,000 ha)
   ③ More concentration of livestock in pastures because of poverty
   ④ Long use of pasture area in low lands

2) No policy of guaranteed price

   ① Increase in forage price and other costs of husbandry
   ② Low cost of livestock in comparison with other merchandises and service

3) Lack of proper investment on improving sanitary activities for livestock and veterinary services

   ① Lack of proper timely veterinary services because of long distances
   ② High cost of veterinary services and medicines and anti parasite pesticides
   ③ Deficiency of medicine, pesticides and vaccines in lowland areas
   ④ Lack of knowledge of nomads with veterinary and livestock hygiene

4) Low production, which means low income

   ① Malnutrition (because of shortage and high cost of forage)
   ② High casualty
   ③ Low rate of birth

5) Lack of slaughterhouse, forcing the farmers to sell the animals to dealers at a very cheap price

6) Conversion of pasture lands to farm lands

7) Lack of deposition places of forage in low land pastures, because nomads can not own pasture fields, and hence they cannot make a deposition place

8) Shortage of water.

9) Production and Distribution

   ① Lack of constancy in price of livestock feed and daily products
   ② Lack of budget (loan with low interest)
   ③ Lack of proper pasturelands
   ④ Lack of proper feeding schedule
   ⑤ Lack of cooperation between the livestock and agriculture sector to cultivate forage plants
   ⑥ Lack of knowledge to use agriculture waste for the animal husbandry

⑦ Not utilization of technicians in the production units
⑧ Not proper marketing condition for the livestock production
⑨ Lack of modernized slaughterhouses and processing factories
⑩ Lack of government support

4.1.5 Marketing

The problems and constraints of agricultural marketing are listed as follows:

1. Most of the middlemen who deal with agricultural products are illiterate or have a low educational level.
2. The middlemen's knowledge on their business is low and so their activities are limited.
3. Transportation means are too short to transport the products due to large production in the Province
4. Shipping cost is high
5. Storage facilities are not enough, especially for selling the products at the highest price
6. Pricing is difficult due to the lack of the standards for agricultural products
7. The number of cooperatives which deal in agricultural marketing is not enough to create job opportunities for unemployed persons
8. There is no training on modern management and sales for wholesalers.
9. There is not insurance for damages and robbery of the agricultural products dealt by wholesalers.
10. The budget of those who deal in agricultural distribution business is low limiting their activities
11. Domestic and international market information are not sufficient
12. The number of large markets is too small to support farmers
13. Quality of some products are low since proper price is not set because of lack of classification process
14. Problems in poultry meat and eggs distribution
15. Big difference of price at farm gate and market
16. Price fluctuation depending on the economical condition
17. Price fluctuation of egg depends on market need

4.1.6 Irrigation and Drainage

The major problems of irrigation and drainage are as follows:

1) Absolute insufficiency of usable water resources to introduce irrigated agriculture
2) Unstable security of irrigation water
3) Incomplete drainage system to avoid salinization and alkalinization hazards
4) Improper OM on I&D facilities due to the low income

(1) Absolute insufficiency of usable water resources to introduce irrigated agriculture

All of the three areas, excluding Cheldin Area, depend on Gorgan river water through the existing pump stations. But any measure to secure sufficient water are provided in the upstream of the river due to the discharge fluctuation of the river that occurs every year and every season, and farmers have been affected with an unstable water use. Such condition causes insufficient irrigation coverage, not providing water to the whole project area, just partially being irrigated. It means that the present condition is the same as the 'rainfed farming'.

So, the present water allocation has been done under a situation of insufficient water supply from the Gorgan River. So it is quite rare situation to fulfill the total demand of the whole project area. It can be said that the present irrigation is like complementing water supply measure to the dry farming area.

Such present condition seems to be a 'quite high risk situation' for the area due to the following:

1. Salinity of river water is high during the dry season. Hence, the water use in the dry season will cause salt accumulation in the field.
2. Irrigation practice without proper drainage system will cause salt accumulation.
3. Present agricultural planning was set without consideration of such water insufficiency and causes trade-offs along the river.

(2) Unstable security of irrigation water

As already reported, necessary facilities and measures to secure sufficient irrigation water have not been provided in the upstream part, even though the Study Area is depending on Gorgan River as water source for irrigation. All of Voshmgir Dam, Golestan Dam and the Golestan No.2 Dam (under construction) utilize water for their own irrigation schemes and are under the responsibility of Ministry of Energy. They don't have any obligation to supply water to the irrigation schemes or farms in the downstream, which includes the Study Area. Hence potential water sources for the Study Area are only rainfall, flood discharges from the dams mainly in the rainy season, and base flow in drought season only.

Hence, the actual condition of the present irrigation schemes in the Study Area has to be concluded as ‘dry farming with irrigation facilities’.

(3) Incomplete drainage system to avoid salinization and alkalinization hazards

The Study Area, especially the area from Gharasu river to the north, has high risk potential for salt hazard caused by accumulation of salts in deep soil by the capillary rise. Hence provision of proper drainage system to avoid such salt hazard is a fundamental requirement for proceeding agricultural development with irrigation in the area.

But the existing open canal drainage systems were provided to drain inundated surface water, and not to intercept of the salt capillarity. It might be said that drainage system to intercept salt capillarity and necessary measure to secure sufficient irrigation water have to be provided as a part of obligation of the Government, if they would like to introduce agriculture with irrigation.

(4) Improper O&M on I&D facilities due to the low income

The actual present condition of the so-called irrigation schemes in the Study Area, excluding the Cheldin Area, have never been improved completely from ‘dry farming’ to ‘irrigated farming’, even though they are called as ‘irrigation scheme’, due to insufficient water and high risk condition of salt hazard. Under such conditions, farmers have already shifted their farming practices from previous livestock combined dry farming to the present condition following to the Government’s instruction. Such condition causes lower income for the farmers, instead of increasing the crop production.

Most of the farmers in the Study Area have severe debt problems. The improper O&M of the facilities are noticeable because of the low income or insufficient financial capability to rehabilitate the damaged irrigation canals, insufficient maintenance of farm roads, and incomplete land leveling of farm plots and so on.

4.2 Potentials of the Agricultural Development

4.2.1 Irrigation and Drainage

The potentials of agricultural development from the irrigation and drainage point of view are presented below:

(1) New water resources development plans

The Gorgan river watershed, including the Study Area, has scarcity of usable water resources presently, which was already recognized by the local government, mainly by the Water Organization, in Golestan. They examined some solution options such as provision of new reservoirs in the upstream side. Also there are other ideas, such as the water conveyance from

Mazandaran Province. If these ideas are made concrete, then the present water scarcity will be solved. Based on these ideas, there is an expectation of new irrigation schemes in the future, although the exact details of the plans and the actual implementation are not yet clarified.

(2) Already drained farmland

Efforts of Golestan Jihad-e-Agriculture Organization for developing drainage system to lower the groundwater level has expanded dry farmland in the swampy areas, after a period of about ten years. These drained farmlands are available to cultivate crops under less salinity hazard potential. If the drainage density is increased, the groundwater level at the tertiary level farm blocks will decline.

(3) Existance of basic production infrastructure

Though most of the existing I&D schemes are facing the scarcity and uncertainty of water resources, there are production infrastructure that has already been constructed in lowland areas and alluvial plains. It is quite an advantage to begin the examination of the agricultural development of the Area, not starting from the zero. Drainage system direct to the Caspian Sea can avoid discharge of salt accumulated water from farmlands and could provide drier root zone, though it takes longer time than costly pipe drainage. Also irrigation canal systems can distribute water to the blocks. These are the positive accomplishments for further development.

(4) Desilting reservoirs

As the silt depositing reservoir at Tazer-Abad I&D scheme is a good example, it is obviously necessary to set some measures to reduce silting trouble before distributing water through the irrigation system. The water storage function shall be combined to increase the water availability. So, it can easily promote those advantages of the existing production infrastructure.

Also, an idea to unify the reservoir provision in the upstream side and conveying desilted water to the existing I&D schemes, might be an advantage to solve silting problems and uncertainty of water availability in the area, instead of combining with the existing pump station.

(5) Increment tertiary level drainage system

It can be noticed that many blocks are left without drainage system in tertiary level, not connected with the trunk drainage system. So effects of existing trunk drainage system are hardly reaching to inner farm plots, just limited in verges. Some measures to increase density of tertiary level drainage system can increase the advantage of prior countermeasures of trunk drainage system.

4.2.2 Agriculture

If the problems mentioned above in the agriculture sector are solved, then these problems of the present farming can turn to potentials of agricultural development. In other words, if the researches on low cost construction methods of irrigation and drainage facilities, effective field plot sizes, cultivation methods and other items are carried out, many cooperatives are established, many processing plants are constructed, and the Government's price policy is adopted to keep balance between the increasing rates of the agricultural materials and machinery prices and the prices of the agricultural products, then there will be potentials (possibility) for agricultural development as follows:

1. High and stable production of crops, especially of wheat, the staple food in Iran,
2. Low cost mechanization of the agriculture by establishment of cooperatives,
3. Sustainable farming by modernized combination of agriculture and animal husbandry, especially by introducing grass to the cropping system,
4. Effective extension activities,
5. Increase of the employment opportunities, and
6. High living standard of farmers.

4.2.3 Animal Husbandry

Potentials of the animal husbandry are listed below:

1. The fertility of the fields allows to plant forage such as soybeans.
2. Cultivation of alfalfa, clover, etc. are possible, providing a big feed source for livestock's and birds.
3. Production of more than 1,097,771 ton TDN of feed source for livestock,
4. Existance of investment for dairy product facilities, slaughter house (15 unit) and milk collection facilities (13 unit),
5. There should be enough information on husbandry since there is a high rate of graduated people in veterinary and there is a college of forage livestock in Gorgan.
6. There are four factories of animal feed with a production capacity of 197,500 ton per year and 3 complementary factories with 14,800 ton capacity.
7. There are several cooperatives including 11 for husbandry, 3 for horse breeding, 7 for poultry and 2 for apiculture.
8. Advantage of being close to the Mid-Asian countries and low distance from big markets in those countries,
9. Existence of 2 units of fattening chickens (meat chicken) with 139,000 piece capacity and 2 units of chicken making poultry with 1,287,200 eggs in each period,
10. 3 slaughterhouses of birds with killing capacity of 8,300 pieces in an hour,

11. Existence of animal husbandry stations, sheep breeding, duck breeding in Gorgan, and apiculture in Bandar Gaz
12. Existence of different kinds of livestock, birds and honey bees, 453 units of meat chicken with capacity of 4,589,120 piece in each period, 8 units of egg chicken with capacity of 1,757,000 piece, 30,151 hives of honey Bees, 2,731,238 heads of sheep, Goat and 41,509 heads of pure cows, 199,244 heads of Buffalo and 4,077 heads of Camels
13. Existence of 1 million ha of pasture and also more than 1 million heads of livestock belonging to nomads, which provides 30% meat of province need
14. Potential technicians for artificial insemination and vaccination training
15. Because of being near Caspian Sea, the products of this sea such as Kilka fish and others can be used to feed the poultry.
16. Production of 28.4 thousand ton of eggs, 133 ton of honey, 24,831 ton of red meat and 291,373 ton of milk in a year.

4.3 Basic Concept of the Agriculture Development

After identifying the problems in relation to socio-economic and natural conditions and analyzing the problems and potentials for irrigation & drainage and agricultural development, the basic concept of agriculture development is analyzed considering various solution options for each sector.

1) Irrigation and drainage
2) Soil Improvement
3) Rural infrastructure
4) Land Use
5) Farming

4.3.1 Irrigation and Drainage

(1) Improvement on Water Utilization

1) Strengthen the Extension Services of Proper Irrigation Practice

Now the Provincial Jihad-e-Agriculture yearns to extend ‘Furrow Irrigation Method’ instead of ‘Basin Irrigation Method’ which the farmers are widely adapted. It is well known that ‘Furrow Irrigation Method’ can save irrigation water consumption up to 1/3 or 1/4 of the present consumption. They are expecting that the water-saving by the furrow irrigation method can alleviate the scarcity of irrigation water.

One of the reasons hampering the extension of the furrow irrigation method is the lack of tractors among the farmers. Tractor is indispensable to form furrows in such wider farm plots. The cooperatives have only two or three tractors in one irrigation scheme because they sold out it to solve debts or can’t purchase one under the lower income conditions. Hence, while

letting farmers to be aware of the effectiveness of water-saving methods, some Government assistances are necessary to share or to reach tractors which can plow furrows easily.

The extension services for 'Proper Irrigation Practice" have to be carried out in synchronization with the departments of 'Soil and Water', 'Cooperative' and 'Extension Service'. The actual component might be 1) provision of 'Demonstration Plot' by each irrigation scheme as one of Government's obligations, then 2) to demonstrate detailed work procedure of the method , and 3) to let farmers about the know-how on the increment of the yield and benefit due to the saving of the payment of water charge.

2) Provision of Farm Pond

The Golestan J.A.O has plans to provide farm ponds to each irrigation scheme as a countermeasure to secure required water volume for irrigation during the dry season. Stable crop production cannot be achieved while supplying river water directly through pump intake from the river which has seasonal discharge variation. Hence some water storage facilities are required as both of supplemental source for rainy season and main source for dry season. Farm pond plan is quite realistic and inevitable, which can be provided in the near future.

Required capacities of farm pond in each existing scheme were estimated as the following table, which is based on an assumption of annual water requirement as 13.30 MCM / 1,000ha / year.

Required Capacity of Farm Pond in Each Irrigation Scheme

Irrigation Scheme	Tazeh-Abad	Hemmat	Shadi Mehr	Banaver	Gomishan Kesht
Project Area	3,300 ha	1,200 ha	1,000 ha	1,450 ha	4,700 ha
Required Capacity	11 ha	4 ha	4 ha	5 ha	15 ha
(Basin Irrigation Case)	350 ha	135 ha	115 ha	165 ha	500 ha
Required Capacity	4 ha	1 ha	1 ha	2 ha	5 ha
(Furrow Irrigation Case)	115 ha	45 ha	40 ha	55 ha	165 ha

3) Provision of Desilting Pond

Plan of desilting pond is the most effective and realistic idea, which aims to provide the pond just after the pump station for solving the situation of sediment deposition in the canals. If is possible to locate the farm pond just downstream of the pump station, then the farm pond can share this function while storing water.

4) Irrigation Canal Lining

Most of the existing irrigation canals are still left as earth lining. It is said that the main reason of low accomplishment is caused by the lack in the Government budget. To secure the proper delivery of the irrigation water, it is necessary to line the existing irrigation canals (main and secondary canals) as earlier as possible.

5) To Realize Proper Water Management

The matter of realizing proper water management is related deeply to cost sharing concept and water-saving practices. Even though the Government has made great efforts to provide irrigation schemes as the national level assistances to the farmers, recognition or understanding of the ‘water cost’ has never been progressed.

It is quite indispensable to let farmers and officers in charge to grasp proper water management, while keeping the record of water use, pump operation cost, facility maintenance costs and others, as measures to show that the irrigation water is a high cost resource, and is sufficient enough to increase the benefit if they can save the water consumption.

6) Examination of New Water Resources Development

An integrated approach is indispensable to achieve a stable water use condition through the examination of basin-wide new water resources development, rationalization of water use for irrigation and water-saving practice. Some new surplus water can be expected through the water-saving agriculture in the upstream area, which is to be use by farmers in the downstream side.

Besides efforts such as improvements in agricultural sector, both of urbanization and activation of economy will also increase the water demand. It is necessary to commence a study of such integrated and inter-sector water resources allocation, including basin-wide hydrological circulation analysis, evaluation of usable water resources and examining concrete and feasible approaches to develop new water resources. A plan of ‘Mazandaran Water Supply Project’ shall also be included into such studies.

7) R&D on Natural Environment Harmonized Farming Program.

The natural environment harmonized farming program shall be started under mutual involvements and participation of relevant agencies. They can improve the soil condition with increment of soil fertility, while producing agricultural products, also securing certain farm income to owe some parts of the cost to install pipe drain system, as a permanent measure to avoid salt hazard.

The modification of farm program can reduce the water demand, by adapting diversified farming in the area. Also the present crop production such as mono culture production, which deeply depends on wheat and cotton production, is one of the causes for today’s constant water shortage. Hence R&D on improvement of farming program has to consider aspects of radical solution options considering the major constraints of farming.

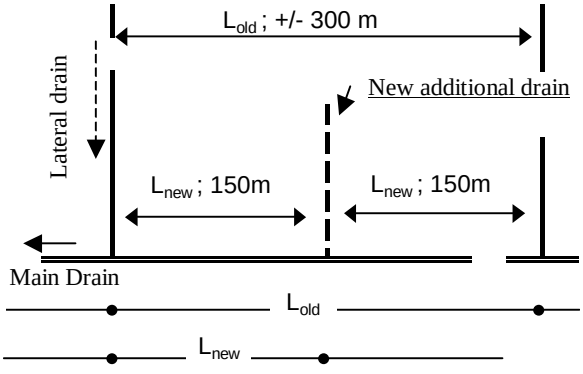
(2) Improvement on Drainage Systems

1) Increment of Drainage Density

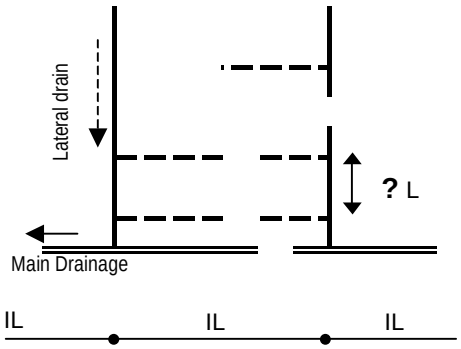
Existing drainage system (main and secondary drainage canal) was excavated to improve soil conditions before the introduction of irrigation system, since the groundwater level was so high and the lands were inundated with flooding frequently in a year. Presently the bottom of main drainage canal is dried up already. Hence it might be said that the present groundwater level is under the bottom of the canal, at least near the ditch. On the other hand, the farmers are complaining of low yield due to high groundwater level, especially at midways between existing drainage canals.

Generally, it is reported that proper intervals of drain are 50 – 150m for good permeable soil, 20 - 50m for medium permeable condition and 10 - 20m for low permeable soil.

Presently the interval between two drainage canals is from 300m to 400m (secondary canals). If it is necessary to increase drainage density as requested by farmers, it might be more realistic to add one more open drain at the midway between the two existing canals and connect them to the existing main drainage. If more drainage density is needed, then tertiary drains are to be provided to connect to those secondary canals.



Provision of Additional New Drainage at Midway Between Two Existings



Provision of Mole Drains Connecting To Exisiting Drains.

Before deciding on the additional drains, it is obviously needed to conduct the monitoring of groundwater fluctuation by season at the fields and also to confirm the depth of impermeable layer referring to the existing available soil profile maps obtained through a well drilling.

Mole drain is one of the potential countermeasures. But it is better to wait for the results of trial provision of mole drains because of clay content, which is lower than 45% being the minimum requirement to keep the mole structure and also trencher for drilling moles deeper than 0.6 m depth.

Pipe drain system is still in a trial level, not applicable yet, because of its high cost. And, there is no guarantee of whether the crop production after applying the pipe drain is sufficient to repay the construction cost or not. Again a trial stage is required for the judgment.

2) Lowering of Groundwater Level

Lowering of groundwater level is to be controlled by proper depth of the drainage system. Until now, suitable researches were not carried out to find out the optimum groundwater level up to which it should be lowered. According to a report on central Asian area under the Ex-Soviet, 4 or 5 m is the most recommendable depth to intercept the capillary from rich salt contained soil layer.（Evolution of Salinity, Alkalinity and Waterlogging. V.A.Kovda, Prognosis of salinity and alkalinity FAO. Soils Bulletin No.31）。

Considering the above report, it can be said that the pipe drainage system in the army farm near the Tazeh-Abad Scheme is a good example. Also 2.5m depth open canal drainage applied to the field can be a proper measure considering the cost – effect relationship.

However, continuous monitoring of groundwater fluctuation to know seasonal movement and long-term tendency has never been carried out. Hence the Golestan J.A.O and the Water Organization should try to carry out continuous monitoring of groundwater level in the Study Area. And, proper depth of drainage system should be defined with those information.

4.3.2 Soil Improvement

The major soil improvement to be made to reclaim the soils of the Study Area can be broadly classified into two categories:

1) Reclamation of salinity, and alkalinity
2) Improving the soil fertility

(1) Reclamation of Salinity and Alkalinity

There are three basic ways to reclaim the salt affected soils as mentioned below:

1. Establish drainage through installation of drainage system
2. Leach out the soluble salts
3. Replace exchangeable sodium by gypsum, sulfer or sulfuric acid, enriched by Thiobacillus bacteria

In order to remove excess salts in these areas, establishment of an adequate drainage system along with the irrigation system is necessary. Drains of higher depths are necessary to leach out the surplus salts below the root zone. If adequate amount of low salt irrigation water is available, saline soils can be reclaimed by surface or subsurface drainage.

Although the drainage system is installed in the pilot project areas, the EC values of the soils

are still high because of the following reasons:

1. After installation of drainage system, the quantity of applied irrigation water is not sufficient enough to facilitate leaching.
2. The water quality of irrigation water itself is not good enough. If less amount of water is applied with the salty water, the salt content of the soil will increase.
3. In some cases, salty drainage water is pumped up and used for irrigation.

The main problem is to leach out the salts downwards and out of contact with irrigation water. The major factors determining the amount of water needed for leaching are 1) initial salt content of the soil; 2) the desired level of salt content for good growth of crops; 3) the depth to which the reclamation is required; 4) soil characteristics such as texture, permeability etc., and 5) crops and the variety to be grown. Since the water table in the Study Area is within 2 to 3m of the soil surface, leaching without drainage will have little lasting effect on soil salinity.

In order to reclaim the salty soils, sulphur (S) 200 to 500 kg/ha is recommended by Golestan J.A.O, although the actual need is more than 1 t/ha. Gypysum is not popular and is used only in very low level in the province. Although gypsum is considered to be better than sulphur, sulphur is normally recommended and applied, since it is cheaper and are readily available in the area. Although sulphur is recommended almost each year to improve the soil, only 5% of the farmers in the province apply sulphur on a regular basis.

Recently, balanced fertilization is applied to various crops, grown on salt-affected soils, and irrigated with saline water. The results have demonstrated that the split application of N-fertilizers (mostly ammonium sulfate) and potassium sulfate at higher rates than that conventionally applied, give better yield on saline soils.

Apart from these methods, use of salt tolerant crops and varieties and suitable agronomic management and cultural practices such as subsoiling can be practiced in these soils. Salt tolerant of selected crops according to the USDA rating are given below:

Salt Tolerance of Selected Crops According to USDA Rating

Crop	ECe, mS/cm	ECe at 50% Yield, mS/cm	Crop	ECe, mS/cm	ECe at 50% Yield, mS/cm
Field Crops			Vegetable Crops		
Barley	8.0	18.0	Beets	4.0	9.6
Cotton	7.7	17.0	Tomato	2.5	7.6
Sugarbeet	7.0	15.0	Cucumber	2.5	6.3
Wheat	6.0	13.0	Spinach	2.0	8.6
Soybean	5.0	7.5	Potato	1.7	5.9
Sorghum	4.0	11.0	Cowpea	1.3	9.1
Groundnut	3.2	4.9	Lettuce	1.3	5.2
Rice	3.0	7.2	Onion	1.2	4.2

Crop	ECe, mS/cm	ECe at 50% Yield, mS/cm	Crop	ECe, mS/cm	ECe at 50% Yield, mS/cm
Sugarcane	1.7	9.8	Forage Crops		
Corn	1.7	5.9	Bermuda grass	6.9	14.7
Fruit Crops			Ryegrass	5.6	12.1
Date Palm	4.0	17.9	Alfalfa	2.0	8.8
Olive	2.7	8.4			
Pomogranate	2.7	8.4			
Orange	1.7	4.8			

(2) Improving the Fertility

1) Improving Organic Matter Content

Most of the soils of the Study Area on both the sides of Gorgan river have low organic matter (<1% O.C), and therefore, it is necessary to increase the organic matter of the soil. It can be achieved by two ways:

1) Application of organic fertilizer
2) Crop rotation with forage crops

At present organic fertilizer of 5-30 ton/ha is normally recommended. However, this level is relatively low considering the poor organic matter content status of the soil. Besides, the cost of organic fertilizer is also high.

It is necessary to consider the crop rotation with forage crops. The cultivation of forage crops will leave a huge amount of roots in the soil, which will be converted to organic matter. Besides, the forage can be fed to the animals and their excreta can again be used in the field to increase the organic matter content of the soil. In order to improve the fertility in a long-term basis and for sustainable improvement, it is necessary to consider the crop rotation with forage crops. The forage crops shall be experimented in the Study Area in order to increase the organic matter content of the soil.

2) Improving Fertility by Application of Fertilizers

Although the amount of fertilizer recommendation varies depends on the crop, the soil expert of the Golestan J.A.O makes the fertilizer recommendation based on Soil Analysis as mentioned below:

Recommendation of Macronutrients in Golestan Province

Nitrogen		Phosphorus		Potassium	
O.C, %	Urea, kg	P, ppm	Triple super phosphate	K, ppm	Potassium Sulfate
<0.5	400	<5	150	<150	150
.5 – 1.0	350	5-10	100	150-200	100
1.0 – 1.5	250	10-15	50	200-250	50
>1.5	200	>15	0	>250	0

Mostly the acidic fertilizers such as Triple super phosphate (TSP) Potassium Sulphate or ammonium sulphate and urea are recommended to improve the fertility. Amount of fertilizer recommended is higher for irrigated cultivation and is lower for dryland cultivation.

In general, the micronutrients including Zn, Mn, Fe and Cu are least available in basic (alkaline) soils. The fertilizers including Zn SO_4 (zn = 24%), Mn SO_4 (Mn = 24%), Fe SO_4, CuSO4 (Cu = 24%), and Boric acid (17% B) are normally recommended based on the soil analysis and the crops grown. The normal recommendation levels are as follows:

Zn = 50 kg/ha, Mn = 20 kg/ha, Fe = 100 kg/ha, Cu = Not used, B = no need (if needed, 15 kg/ha).

Among the micronutrients, Zn is recommended whenever necessary. However other micronutrients such as Mn and Fe are not applied by the farmers, since the micronutrients are expensive, and some times sulphur alone is applied instead of Fe and Mn.

Apart from the two major soil improvements mentioned above, it is also necessary to improve the heavy soil texture at some parts of the Study Area. Many physical soil properties such as infiltration into the soil, soil structure, compactability, and soil moisture capacity depends on the texture of the soil, especially the clay content. In general, the soils of the Study Area is medium textured silt loam with high silt content. However, the southwestern part has a heavy clay with a clay content of about 50% which needs careful management. Some farmers near Kowsar dam area also use sediments of the dam to improve the physical and chemical characteristics of soil. These characteristics of these sediments are shown below.

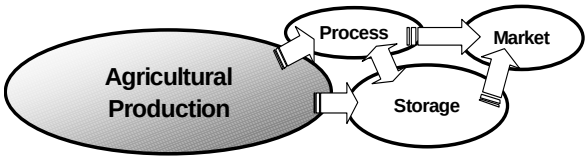
pH	EC mS/cm	O.C %	Total N (%)	P(ava.) (ppm)	K(ava.) (ppm)	Clay	Silt	Sand	Texture
7.6	2.6	0.74	0.07	3.0	100	18	32	50	Loam

Although the fertility status of these sediments is in the low level, the texture of the sediments is medium texture loam with 50% of sand, which will help to improve the heavy texture soils.

In Golestan province, it is recommended to apply compost of 5-30 t/ha, when the clay content is above 20%. Besides, it is recommended to apply 50kg/ha of more potassium for heavy texture soils. Application of Urea or Ammonium nitrate should be done for 3 times in heavy soils and 4 times in lighter soils.

4.3.3 Agricultural Production Infrastructure

The agricultural production infrastructure can be divided in 4 important sectors. The production sector that increases the agriculture production. The storage sector that will retain the products for a period before its transportation is possible. The agriculture products process sector generally increases the products value in the market. And finally, the market sector that includes public and private market facilities.



The figure shows the relation between each item. As shown in the figure, the agricultural production shall be the center and starting point for the development of the other sectors as processing, storage and market.

Between the components of the production item, the rural roads, machinery infrastructure and irrigation & drainage facilities are the most important in the study area.

The provincial main roads in the area are relatively in good conditions. Many of them were paved recently. The problems are related to the rural roads that were constructed inside the agricultural areas.

The agriculture machinery infrastructure deals with storage and maintenance facilities to be used for the agricultural machines. The machines shall be utilized to increase economically the production of grains, for example, cultivating larger areas. But this item depends on the crop to be cultivated in the area.

The storage form shall be according to each product. Fruits storage generally makes necessary refrigerated facilities, opposite to the grains that shall have a ventilated one.

The processing items can be developed only after the definition of the crops and the initiation of the production. This sector shall be developed to increase the farmer's profits by increasing the value of the products. It will make possible at the end to increase the income and the living condition of the farmers.

(1) Agricultural Production Infrastructure

- Rural Roads Improvement

The first impression of the site visits where that the rural roads, usually utilized for the operation & maintenance works are not good. The roads are very slippery during the wet season making difficult the vehicles transit. The best way is to cover it with gravels before it is possible to cover it with asphalt.

Basically, the construction of roads shall be responsibility of the government. The farmers association shall be responsible for the maintenance of the roads in the agriculture areas, carrying out easy repairs and maintaining the conditions of other roads, requesting

maintenance activities to the government for heavy works, whenever necessary. The farmers will be responsible basically for the road construction in their properties and those to link their properties to the nearest road.

A well maintained rural road system is one of the basic and important conditions to make possible a good production. It will be important for the operation and maintenance of the canals, for the transportation of the products, for the traffic of agricultural machineries, etc.

- Agricultural Machinery Infrastructure

As a basic concept, the association can obtain the machines that can be shared by the farmers. The association, or a group of association can acquire machines and keep an operation & maintenance machinery unit. The storage and repair of the machines shall be realized in this unit. Of course, it will depend on the crops to be cultivated by the farmers. So the association shall be composed of farmers producing crops that utilize same equipments.

(2) Processing Infrastructure

The processing of agriculture products is a way to increase their value in the market. The processing activity includes the treatments for exportation, production of cheese, juices, canning and others. It shall be defined after the selection of the crops to be cultivated in the study area.

The marketing shall also be considered and the targeted market will define the final form of the product.

(3) Storage Infrastructure

The storage infrastructure also depends on the crop selection. For example, silos shall be planned if the main product shall be grain. On the other hand, refrigerated units shall be planned, if fruits are the main product.

(4) Agricultural Products Market

The market facilities shall also be considered depending to the agriculture product and demand of the product in the study area.

4.3.4 Farming

(1) Increase of productivities of crops

The objectives of the project are the increase of production of wheat, which is the staple food and is about 59% of self-sufficiency rate in Iran, and the improvement of income of each farm household and their living standard. As the expansion of irrigable area is impossible due to limitation of water resources, farmers have no choice but to increase the yield of each crop and to decrease production cost in irrigated field or rain-fed field at present. Therefore, it is

required to increase the yield of each crop, where the irrigation and drainage schemes are already completed. After desalinization and prevention for alkalization, the productivity of each crop will become high under suitable management of soil and irrigation.

On the other hand, in rainfed fields, the cultivation of ordinary crops, mechanization, soil management are very difficult due to various field conditions. For the present, it is required to select varieties tolerant to salinity and to introduce the fruit trees, which are tolerant to salinity. Furthermore, the area irrigated with wells should be planned to introduce the plastic greenhouse of vegetables and flowers, and fruit trees to effectively use irrigation water.

(2) Promoting researches corresponding to real farming conditions

There are imbalances of the agricultural researches to develop the farming in the study area. As mentioned above, the following researches, which correspond to the real conditions of the farms, are required at first.

- Construction method of irrigation and drainage in low cost,
- Effective plot size of field,
- Improvement of varieties for less chemicals and less chemical fertilizers in condition of high salinity of soil,
- Soil fertility with organic matter to establishing of sustainable farming,
- Modernized combination of agriculture and animal husbandry,
- Integrated technology in farmers' fields, and
- Technology of plastic greenhouse cultivation, etc

(3) Sustainable farming

Farming should be carried out in consideration of minimizing of environmental destruction. In Golestan province, the means of sustainable farming are desalinization, preventing of alkalization, improvement of soil physical and chemical properties by increasing of soil organic matter, decreasing of chemical fertilizer and chemicals, etc. Especially, the increase of soil organic matter is important to realize the sustainable farming. However, straws of wheat and barley, which are one of the important resources of organic matter of soil, are removed from field and sold as livestock's fodder. Besides, feeds (TDN) of livestock is very short. Therefore, it is required to plan to carry out the sustainable farming by modernized combination of agriculture and animal husbandry, especially by introducing of forage crops to the cropping system.

(4) Promotion of plastic greenhouse

Under condition of limited quantity of irrigation water, it is necessary to introduce the new farming with effective water use, such as plastic greenhouse, fruit trees for processing, etc.

(5) Promotion of processing

It is necessary to introduce mechanization of farming and excessive labor since mechanization should be allocated to processing of farm products, handicraft manufacturing, etc. Especially, surplus of vegetables and fruits should be processed by the food processing plants, which make the opportunity of employment for excessive laborers.

(6) Promotion of rural production cooperatives

The cooperatives have many merits, such as decreasing of cost by jointly purchasing inputs, increasing of income by jointly selling the products, promotion of development of infrastructure including irrigation and drainage facilities, education and training, mechanization, etc. Therefore, it is required to organize many rural production cooperatives in the Study Area.

(7) Promotion of mechanization

One of the problems in mechanization is the lack of will to service in the machinery owners, due to high cost of machinery maintenance and low insurance benefits. At present, there is no public maintenance service centers in the province. Therefore, it is required to construct the public maintenance service center of machinery at least in each district.

(8) Introducing pastures into crop rotation

Farmers in the Survey Area, except the area at the foot of the Elbourz Mountains, have never experienced cultivation of pasture, especially production of silage and hay of pastures by mechanization. When farmers introduce pastures into their crop rotations for the first time, they should acquire the production techniques of silage and hay, and the changes of the technologies of the succeeding crop cultivation, the feeding methods of the high quality roughage, the modernized raising methods of livestock, marketing of silage and hay, etc.

Therefore, possibility of introducing pastures into crop rotation is discussed as follows;

1) Necessity of introducing pastures into crop rotation

1. To carry out the sustainable farming, farmers should make efforts to increase organic matter in soil. For that purpose, it is necessary to introduce pastures, which have a lot of residues and roots, into crop rotation. At present, the quantities of soil organic mater in four provinces are shown in the following table.

% of Organic matter content in soil（2001）

District	Average	Max.	Min.
Aq Qala	1.11	2.47	0.50
Torkman	1.11	1.65	0.39
Gorgan	1.30	1.84	0.44
Kordkuy	1.27	2.07	0.51

Note: 1< ; low, 1 ~ 1.5; medium, > 1.5; high

As shown in the table, about half area of the Survey Area has low organic matter in soil. Increase of soil organic matter contributes to improve the soil physical characteristics, and to save the quantities of fertilizer and chemicals.

2. Most of the farmers are raising a few heads of cows, and intend to increase to 20 heads. Even at the present, the shortage of roughage for cattle is a serious problem, and farmers use the straw's hay of wheat and barley, which are bad in quality. It is necessary to introduce pastures to promote the integral farming of agriculture and animal husbandry.
3. The Government of Iran is promoting the program of production increase of fodder to develop the modernization of animal husbandry. The pastures shall be introduced into crop rotation is in line with the national policy.

2) Introducing pastures and farm economy

The Dept. of Forage Crops of the Ministry of Agriculture recommended on the suitable pasture crops in the Golestan Province and their characteristics, such as cultivation methods, yields, palatability of cow, etc., are shown in Table 4.3.1. The opinion of the department on the introducing pasture crops into crop rotation is as follows;

1. Grass is suitable as the pasture crop, which is introduced into crop rotation. Quantity of residues and roots should be given the highest priority in selection of pastures to increase the soil fertility by increase of soil organic matter.
2. In the area (Aq Qala and Torkman) under condition of strong environmental stress, such as dry weather, salinity of soil, some kinds of grasses, sorghum, Atroplex, Alexandar clover and some varieties of other clovers, which were bred in Iran, are suitable.
3. Atroplex is primarily the fodder for camel, and is surmised for cattle too. The grass has the high tolerance for drought and salinity of soil. There is no need to irrigate, because the roots of the grass penetrate into deep soil and uptake underground water without irrigation.

Table 4.3.1: Recommendable Pasture Plants in Aq Qala District of Golestan Province

		Scientific Name	Common Name	Required times of irrigation	Times of harvesting	Required amount of fertilizer (N) (N-kg/ha/year)	Yield in fresh weight (ton/ha/year)	Yield of hay (ton/ha/year)	Tolerance for		Palatability of cow
									salinity	drought	
Leguminous	Perennial	Medicago sativa	Alfalfa	12	5	50	60~70	6~8	α		very good
		Onobrichis sativa		10	5	50	50~60	5~7		α	very good
	Annual	Trifolium alexandrium	Berssem clover	12	4	50	35~50	4~6			very good
		Trifolium respinatu	Persian clover	10	4	50	30~45	4~6			very good
Gramineous	Perennial	Festuca	Tall Fescue	8	3	100	25~35	3~4			good
		Lolium percenne		10	3	80	25~35	3~4			good
	Annual	Lolium multiflorum	Italian ryegrass	10	3	100	25~35	3~4			good
		Setaria (glauca)		8	2	50	25 (seed 3)	3~4	α		good
		Panicum		10	4	100	50	6~7	α		good
		Sorghum		10	4	150	80~100	8~12	α	α	good

Data Source: Ministry of Agricurture, fodder office, 2002

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4. In the area (Kordkuy) under condition of less environmental stress, clover, alfalfa and many grasses can be used as the rotation crops. Especially, Italian ryegrass is suitable and is extensively cultivated in the paddy fields in Iran.
5. The seeds supply system of these pasture is ready. Whenever farmers apply to purchase seeds to the Golestan Jihad-e-Agriculture Organization, they can get seeds.

It is necessary to clarify the mechanization methods of pasture cultivation and silage and hay making after regional trials on adaptability of these plants in Aq Qala, Torkman and kodkuy.

Assuming that all the products sell as hay, and the producer's prices of hay are 1,240 Rls/kg for leguminous pastures, and 825 Rls/kg for gramineous pastures, which is the mean value between the price of alfalfa and that of wheat straw hay, the gross income is 6.2 ~ 9.9 million Rls/ha/year in production of perennial leguminous pastures, 5.0 ~ 7.4 million Rls/ha/year in production of annual leguminous pasture, 2.5 ~ 3.3 million Rls/ha in production of perennial and annual gramineous pastures. The gross income, including grain and straw's hay, of barley production is 3.1 million Rls/ha in case of 3 tons/ha of yield and 3.9 million Rls/ha in 4 tons/ha of yield, therefore, the gross income of grass hay production is nearly equal to that of barley production of 3 tons/ha of yield. Furthermore, the gross income of leguminous hay production is nearly equal to that of barley production of 6 tons/ha of yield. These data will become one of criterion of decision-making on introducing pastures into crop rotation.

3) Crop rotation with pastures and use of pastures

The crop rotations with pastures are classified into two categories;

1. Three-year rotation of perennial pastures with cereals, oilseeds, cotton and vegetables.
2. One-year rotation of annual pastures with cereals, oilseeds, cotton and vegetables.

It would be better that the farmers harvest the pastures as hay in the harvest time, which can be easily dried in field, and harvest and store as silage for pastures which cannot be completely dried in field. Besides, to produce silage and hay effectively, the pastures should be cultivated with less amount of fertilizer to decrease of moisture content of plants. Therefore, it is better to mainly harvest from June to September to make hay and silage. In case of cultivation of pastures in winter, silage is mainly produced.

In case of the rotation "paddy rice – Italian ryegrass", the high technologies are required in the rice cultivation to remove some injurious organic acids, which break out in decomposing the residues and roots of Italian ryegrass in soil, and to prevent the remarkable reduction in paddy soil.

4) Mechanization of pasture

When pastures will be introduced into rotation in all of the Study Area, the cultivated area of pastures will become several ten thousands ha in future. Therefore, the effective mechanization is required. It is desirable that the machinery will be owned by RPCs.

5) Establishment of marketing system of silage and hay

At present, the producer's prices of wheat, barley and both bran are guaranteed by the Government. It is necessary that the Government also guarantee the producer's prices of silage and hay.

4.3.5 Basic Concept of the Agriculture Development

The relationship between the major problems and solution alternatives are summarized in Table 4.3.1. Tentative plan for improving present agriculture for each existing I&D scheme is shown in Table 4.3.2. According to the table, it is obvious that the Study Area might be classified into two parts, one is the area in the plain which depends on Gorgan River and the other is the area belonging to the piedmont zone.

Figure 4.3.1 Concept of Agriculture Development of the Study Area

Issues	Cause & background of problems		Potentials	Solution options	Development Plan	Consideration for Further Development	Target
	Subdivided problems	Causes & backgrounds of problems					
Water Related Issues	1a Water supply for irrigation is uncertain by year.	2a Reservoir provision is never completed to adjust water uncertainty.	3a MOE has development ideas for new water resources to solve the uncertainty, including water conveyance from neighbor province.	4a To provide new reservoirs to absorb seasonal water demand fluctuation.	5a Irrigation & drainage plan	6a To raise irrigation water availability & stability	
	1b Water resource is not sufficient for complete irrigation.	2b Detailed clarification on water resources allotment in the basin has never been completed.	3b The above MOE ideas for new water resources will allow to expand irrigated agriculture in the Study Area.	4b To introduce measures to reduce irrigation losses with proper irrigation facilities with applicable technology.			
		2c Previous preparation such as drainage works has been done without synchronizing with water resources	3c Existing drainage schemes have contributed to turn the swampy conditions to dry farmland to a certain extent and lessen risks of salt capillary rise.	4c To introduce measures to reduce irrigation losses on water management practice within applicable technology.			
		2d Previous national agricultural policy attached to emphasis wheat production.	3d Basic production infrastructures have been provided for enhancing irrigated agriculture in the severe conditioned region.	4d To introduce water saving agriculture, without sticking on wheat production.			
Soil Related Issues	1c Saline, alkaline soil causes low crop production.	2e Soils contain salts originally from parent materials.	3e Permanent drainage system with proper leaching can change saline soil suitable for cutlivation.	4e To construct controlable permanent drainage system and use soil ammendments	5b Soil improvement plan	6b To enhance soil improvement measures.	
		2f Water scarcity does not allow sufficient leaching.	3f New water resources development can allow sufficient leaching water.	4f To let farmers follow water allocation rules & regulations.			
	1d High groundwater level in soil impedes proper crop growth.	2g Present drainage system is not sufficient to decline water level.	3g Provision of tertiary level drainage system can increase the farm lands with less salt hazard.	4g To construct tertiary level drainage canals up to individual blocks.			
	1e Low fertile soil causes low productivity.	2h Improvements on fertility and soil textureis insufficient.	3h Traditional nomadic husbandry can be applied as one of the soil improvement measures.	4h To introduce multiple farming practice & program to improve soil.			
Socio-Economy Related Issues	1f Lower income and living standard in villages influences the farmers	2i Urbanization presents off-farm incomes for farmers and both of them affect farmers to realize the gap from cities.	3i Urbanization offers markets and opportunity to introduce rural industries to villages, because of location of the Study Area.	4i To introduce improvement measures to raise farm income & to improve rural social infrastructures.	5c Landuse plan	6c To expand & reinforce farmers' self-reliance in farm management issues.	
	1g Farmers prefer traditional farming and farm management	2j Majority of farmers have settled to the Area just 2 generation before and still keeps their ethnic prides & culture.	3j Some measures based on their traditional method generate sustainable / independent intention to keep farming with their prides.	4j To guide farmers to establish activate cooperative through bottom-up approach, with less intervention of government.	5d Rural infrastructure plan		
	1h Imbalanced land tenure & farm management.	2k Allotted land is not sufficient to live by farming due to severe natural conditions.	3k Alternate of farming from grains monoculture to others might raise land base productivities.	4k To introduce regulations to unite small plots through taxation and others to enlarge farm management.			To approach sustainable agriculture maximising available resources
Agriculture Related Issues	1i Farming technology is immature for both rain fed and irrigated farm lands.	2l Site based design and O&M extension were not carried fully due to previous centralization.	3l Existing R&D agencies and their potential can be reinforced with some assistances from donors, while making self-efforts.	4l To enforce field & market oriented R&D and extension activities on their accomplishment.	5e Farming plan	6d To set measures to expand farm income including integrated farm program.	
	1j R&D of farming practice needs continuous attention.	2m Govt's supports to meet with the sector's transition has never been continued.	3m ditto.	4m ditto.	5f O/M & Extension plan		
	1k Immature marketing system can not effect farmers towards diversified farming	2n Small scale local markets have less capacity to generate diversification & similar vicinal regions cause trade-off.	3n New market information system can be applied to expand their market oriented crop productions, aiming to outer regions.	4n To introduce higher-income products combined with value-added processing aiming to national & outer markets.			
	1l Low gate price of wheat restrains farmers' interest for wheat production.	2o Wheat market price of neighboring countries is cheaper than Iranian relatively and the Govt does not have protective policies.	3o New crop selection instead of wheat can be a trigger of starting crop diversification in the region.	4o To introduce available scope which the government to owe for maintaining gate		6e To activate government's integrated public services by including enforcement of site oriented R&D capability.	
				4p To introduce higher income farming program, combining with wheat cropping.			
Irrigation and Drainage Related Issues.	1m River water depended I&D schemes have to bear cost for silted canal maintenance.	2p Desilting of intake river water containing thick sediment doesn't function properly.	3p The present condition can be improved through enforcing desilting reservoirs by I&D scheme.	4q To conduct measures of watershed management to realize better basin conditions through multi-sectorial approach.	5g Irrigation & drainage plan		
			3q Clearer water can be used by constructing desilting reservoir with intake facility in the upstream.	4r To introduce desilting reservoir also as water storage facility.	5h O/M & Extension plan	6f To reinforce existing I&D related infrastructure & O&M potential for ensuring production stability.	
				4s To examine stabilization of river bed & bank slopes to reduce sediment.			
	1n Insecurity for water scarcity makes farmers to deviate from irrigation allocation practice	2q Deviated irrigation allocation spurs on water scarcity & uncertainty, especially in the upstream side of a scheme.	3r Continuous awareness through cooperative assistance & extension can improve their attitudes and manners towards positive direction.	4t To conduct continuous extension activities to let them understand the importance of water management.			
		2r Farmers' recognition for cost oriented management with irrigation water scarcity has never been mature.	3s ditto.	4u To let farmers to follow the rules of water allocation.	5i Considerations for regional economy, agriculture policy and others.	6g To set up agriculture policy to support farmers.	
	1o High O&M cost makes heavy burden on farm management.	2s Subdivided small plots are to be integrated to realize sufficient size for cost covering.	3t Increasing farm income through market based continuous extension and changing crop program can solve the conditions.	4v To implement regulations through taxation to accelerate farmland integration to increase optimum-sized farm plot.			

Note → Direct relations
⇢ Indirect relations.

Table 4.3.2 Tentative Plan For Improving Present Agriculture By I&D Scheme

Problems / Constraints Expected To Be Solved			Tazeh-Abad	Agghala		Banaver		Cheldin	Common
			Tazeh-Abad	Aghghalla (Aghghabar)	Shadi Mehr	Gomishan (Banaver)	Gomishan Kesht	Mehtar Kola	
Irrigation & Drainage Related Aspects for Improvement	a	Shortage of Irrigable water. River flow in dry season is absolutely scarce	To provide farm pond to store river water Required pond area 385.0 ha Capa. for the above 11.55 MCM	To provide farm pond to store river water Required pond area 150.0 ha Capa. for the above 4.50 MCM	To provide farm pond to store river water Required pond area 115.0 ha Capa. for the above 3.45 MCM	To provide farm pond to store river water Required pond area 165.0 ha Capa. for the above 4.95 MCM	To provide farm pond to store river water Required pond area 550.0 ha Capa. for the above 16.50 MCM	To provide farm pond to store river water Required pond area 185.0 ha Capa. for the above 5.55 MCM	To conduct hydrological circulation &optimum water allocation in the region To conduct water resources development study for Gharasu River Basin To provide a head race from Gharasu to Gorgan.. To provide reservoir connected with the head race. To conduct a study on inter-provincial head race from Mazandaran.
	b	River bed is scoured easily.	To provide ground sill at pump intake	To provide ground sill at pump intake (Share the facility with Shadi Mehr)	(Share the facility with Aghghalla)	To provide ground sill at pump intake (Share the facility with Gomishan Kesht)	(Share the facility with Gomishan)	Not correspond	
	c	Hardly to co-share individual wells.	Not correspond	Not correspond	Not correspond	Not correspond	Not correspond	To set rule to share individual wells. To provide public facility to share each well.	
	d	Canals are filled with sediment often.	(Desilting pond is already provided)	To correspond with farm pond	To correspond with farm pond	To correspond with farm pond	(Desilting pond is already provided)	Not correspond	
	e	Present water distribution is inproper.	To provide canal lining while maintaining deformed portions. To increase 2 & 3rd canal system. Already function allocation rule. To conduct water delivery monitoring.	To provide canal lining while maintaining deformed portions. To increase 2 & 3rd canal system. Never provided allocation rule. To conduct water delivery monitoring.	To provide canal lining while maintaining deformed portions. To increase 2 & 3rd canal system. Never provided allocation rule. To conduct water delivery monitoring.	To provide canal lining while maintaining deformed portions. To increase 2 & 3rd canal system. Never provided allocation rule. To conduct water delivery monitoring.	To provide canal lining while maintaining deformed portions. To increase 2 & 3rd canal system. Never provided allocation rule. To conduct water delivery monitoring.	Presently farmers use groundwater individually.	
	f	High salinity in soils.	To raise density of open drainage sys. To provide mole drainage system. To conduct salinity & alkarinity monitoring.	To raise density of open drainage sys. To provide mole drainage system. To conduct salinity & alkarinity monitoring.	To raise density of open drainage sys. To provide mole drainage system. To conduct salinity & alkarinity monitoring.	To raise density of open drainage sys. To provide mole drainage system. To conduct salinity & alkarinity monitoring.	To raise density of open drainage sys. To provide mole drainage system. To conduct salinity & alkarinity monitoring.	To conduct salinity & alkarinity monitoring.	
	g	G.water table is high.	To provide mole drainage system.	To provide mole drainage system.	To provide mole drainage system.	To provide mole drainage system.	Groundwater level is high in the area.		
	h	Innundated areas along streams.	Not correspond	Not correspond	Not correspond	Not correspond	Not correspond	To conduct exchange & consolidation.	
	I	Muddy farm roads hardly to pass.	To set road maintenance machine to cooperative.	To set road maintenance machine to cooperative.	To set road maintenance machine to cooperative.	To set road maintenance machine to cooperative.	To set road maintenance machine to cooperative.		
	j	Farmleveling is done inproperly.	To set tractor rental sys under Govt releif.	To set tractor rental sys under Govt releif.	To set tractor rental sys under Govt releif.	To set tractor rental sys under Govt releif.	To set tractor rental sys under Govt releif.		
	k	Unrational farming is caused by scattered small farm plots.	Not correspond	Not correspond	Not correspond	Not correspond	Not correspond	To conduct exchange & consolidation.	
Agriculture Program Related Aspects for Improvement.	a	Present farming doesn't mmet with agri-conditions.	To trial program based grain production including pasture & livestock. To strengthen extension capa. on pasture cultivation. To function farm machinery bank sys for pasture. To provide hay storage facility with assistance. To strengthen extension capa. on livestock cultivation. To strengthen marketing sys on livestock and dairy products.	To trial program based grain production including pasture & livestock. To strengthen extension capa. on pasture cultivation. To function farm machinery bank sys for pasture. To provide hay storage facility with assistance. To strengthen extension capa. on livestock cultivation. To strengthen marketing sys on livestock and dairy products.	To trial program based grain production including pasture & livestock. To strengthen extension capa. on pasture cultivation. To function farm machinery bank sys for pasture. To provide hay storage facility with assistance. To strengthen extension capa. on livestock cultivation. To strengthen marketing sys on livestock and dairy products.	To trial program based grain production including pasture & livestock. To strengthen extension capa. on pasture cultivation. To function farm machinery bank sys for pasture. To provide hay storage facility with assistance. To strengthen extension capa. on livestock cultivation. To strengthen marketing sys on livestock and dairy products.	To trial program based grain production including pasture & livestock. To strengthen extension capa. on pasture cultivation. To function farm machinery bank sys for pasture. To provide hay storage facility with assistance. To strengthen extension capa. on livestock cultivation. To strengthen marketing sys on livestock and dairy products.	To trial paddy cultivation with vegetables.	
	b	Soil's poor fertility is not good for crop production	To improve soil due to introduction of pasture & livestock.	To improve soil due to introduction of pasture & livestock.	To improve soil due to introduction of pasture & livestock.	To improve soil due to introduction of pasture & livestock.	To improve soil due to introduction of pasture & livestock.	Not correspond	
	c	Management capability is to be strengthened	To encourage willingness declined by lower income. To introduce agri-program included pasture. To set renedies for farmers' defts. To reinforce R&D on basic agro-techniques. To reinforce farm management techniques.	To encourage willingness declined by lower income. To introduce agri-program included pasture. To set renedies for farmers' defts. To reinforce R&D on basic agro-techniques. To reinforce farm management techniques.	To encourage willingness declined by lower income. To introduce agri-program included pasture. To set renedies for farmers' defts. To reinforce R&D on basic agro-techniques. To reinforce farm management techniques.	To encourage willingness declined by lower income. To introduce agri-program included pasture. To set renedies for farmers' defts. To reinforce R&D on basic agro-techniques. To reinforce farm management techniques.	To encourage willingness declined by lower income. To introduce agri-program included pasture. To set renedies for farmers' defts. To reinforce R&D on basic agro-techniques. To reinforce farm management techniques.	To increase co-working system.	
	d	Low achievement of organization for farmers' group	Strengthen public awareness on advantages of cooperative Govt has to examine & show proper agri-program. To secure sufficient irrigable water Govt has to show advantage of cooperative.	Strengthen public awareness on advantages of cooperative Govt has to examine & show proper agri-program. To secure sufficient irrigable water Govt has to show advantage of cooperative.	Strengthen public awareness on advantages of cooperative Govt has to examine & show proper agri-program. To secure sufficient irrigable water Govt has to show advantage of cooperative.	Strengthen public awareness on advantages of cooperative Govt has to examine & show proper agri-program. To secure sufficient irrigable water Govt has to show advantage of cooperative.	Strengthen public awareness on advantages of cooperative Govt has to examine & show proper agri-program. To secure sufficient irrigable water Govt has to show advantage of cooperative.	Strengthen public awareness on advantages of cooperative Govt has to examine & show proper agri-program. To secure sufficient irrigable water Govt has to show advantage of cooperative.	

4.4 Initial Environmental Examination (IEE)

IEE is the preliminary environmental review to assess whether Environmental Impact Assessment (EIA) is necessary or not for the development plan. Major study components of IEE include identification of project outline, and site environmental conditions (Project Description and Site Description), preliminary assessment on negative environmental impacts of a proposed project and evaluation of whether EIA is required for the development plan.

IEE for this Study is carried out together with the counterparts of Golestan Provincial Directorate of Environment and Golestan Jihad-e-Agriculture Organization. According to the Environmental Consideration in Iran, Preliminary EIA is considered as the equivalent of IEE and the detailed EIA is considered as the equivalent of EIA mentioned in this report.

4.4.1 Joint Screening and Scoping

Joint screening and scoping were undertaken together with the counterparts of the Environment and Agriculture and the checklists were prepared. Most of the environmental issues have positive environmental impacts because of the agricultural development of the area through the improvement of irrigation and drainage system. However, agricultural development also results in increased use of agricultural fertilizers and chemicals, which induce pollution in the Gorgan river. Water quality is one of the most important environmental aspects, for which regular monitoring is necessary. The activities related to agriculture development such as agro-industries might also result in atmospheric pollution.

4.4.2 Project Description

In the project description, the outline and components of the proposed project including 1) the project background, 2) general information such as objectives, executing agencies, beneficiaries and area of proposed project, 3) project components and scale are described.

The major environmental aspects and impacts to be reviewed or assessed in the environmental consideration process can be preliminarily selected after clearly identifying the project components. The Project description is shown in Table 4.4.1. At the present stage, no new works of irrigation and drainage is planned and only the rehabilitation of the existing areas is proposed.

Table 4.4.1 Project Description

1. Study Title (Project Name)

   The Study on Improvement of Irrigation, Drainage and Agricultural Development for Gorgan Plain, Golestan Province

2. Background information and objectives of the Project

   In order to improve the agricultural production in the Gorgan plain of Golestan province, the Study is carried out to prepare an Irrigation and Drainage Plan, considering efficient water use and the salinization control in 800 km2 area.

3. Brief Description of the Project

Outline of Study Area	800 km^2 in the districts of Bandar-e- Torkman, Kordkuy, Aq Qala District and Gorgan in the Golestan Province.
Beneficiaries and Benefited Area	800 km2 area with the 4 districts popuplation of 674,000 (2001, estimated by MPO)
Relvant project components	Irrigation and drainage and agricultural development
Executing Agencies	Golestan Province Agriculture Organization
Environmental Agencies	Golestan Provincial Directorate of Environment, Department of Environment

4. Major Components and Development Scale of Project

Main Components of the Project		Type of Project		Scale of Project		Remarks
		New	Rehabilitation	Area	Major Facilities	
a.	Irrigation	No	X	7,750	Not yet decided	
b.	Drainage	Not yet decided	X	14,089	Not yet decided	
c.	Land clearing & leveling	Not yet decided	Not yet decided	Not yet decided	Not yet decided	
d.	Sea/swamp reclamation	No	No	Nil	Nil	
e.	Land consolidation	Not yet decided	Not yet decided	Not yet decided	Not yet decided	
f.	New land settlement	No	No	Nil	Nil	
g.	Dam & reservoir	Desilting ponds	No	Nil	Nil	
h.	Substantial changes in farming	X	X	Not yet decided	Not yet decided	
i	Others	No	No	Nil	Nil	

4.4.3 Site Description

The environmental conditions with particular significance in the Study Area are described in the site description. There is no environmentally sensitive area in the Project area, except for the arid and semi-arid lands and a very small part of wetlands in the Cheldin Project Area in the southern part of the Project Area.

However, there are some sensitive areas in the vicinity of the Project area as mentioned below:

1. The Miankaleh reserve is located in the western part of the Study area in Gorgan Bay.
2. There is an international swamp of Gomishan lagoon designated in Ramsar convention (Site no. 1109), which is one of the best habitats for immigrant birds in winter.
3. In the northern part of the Study area, there is a lake called Incheh lake which is a good habitat for immigrant birds such as Flamingo (*Phoenicopterus rubber*). A bit further at the border line of Turkmenistan, there are 3 international swamps for immigrant birds called Alagol, Almagol and Ajigol, which are good ecotourism areas.
4. There valuable birds such as otter (*Lutra lutra*), Barbary Falcon (*Falco Pelegrinoides*), Peregrine Falcon (*Falco Peregrinus*) and Imperial Eagle (*Aguila heliaca*) living around Gorgan and Gharasu rivers and have been listed in Cites 1. The birds migrate from Afghanistan and China during the period of August to October and then move on to the

Southern part of Iran.

5. Arid and semi-arid lands are located in and around the Study Area
6. Reservoirs including Voshmigr dam and Golestan dam are located at the north-eastern part of the Study Area.
7. The Gorgan river passes through the center of the study area through Aq Qala and Khajeh Nafas and then joins with Caspian sea. Gorgan river is a place for breeding fishes such as white fish, anchovy and sturgeon fishes.
8. Gharasu river is also a breeding place for fishes such as white fish and anchovy.
9. The two rivers mentioned above act as drainage system and the fertilizers and pesticides discharged from the farms are drained into these rivers causing water pollution.
10. Industrial complex of Aq qala with an area of 100 ha is located in the south of Aq qala city and the complex includes food and electronic industries. Industrial complex of Banavar with an area of 10 ha is located in the south of Banavar. Besides, there are some flour, oil, soap and cotton industries located in the Study Area. There are some traditional and industrial animal husbandry and poultry inside and outside of the Study Area.

4.4.4 Preliminary Assessment of Environmental Impacts

At the present stage of the Study, it is mostly a rehabilitation project and therefore the present environmental problems due to the irrigation and drainage and agricultural development projects in the Study Area are addressed as the significant environmental impacts. The mitigation measures to be undertaken are also discussed along with the environmental impacts. Based on the joint screening and scoping and in consideration of site description and project description and the project activities to be undertaken, the major environmental impacts to be assessed are as follows:

1. Water contamination and deterioration of water quality including eutrophication
2. Sedimentation
3. Soil contamination by agrochemicals
4. Soil salinization and alkalinization
5. Influence on surface water hydrology
6. Influence of groundwater hydrology
7. Atmospheric Pollution
8. Health and sanitation

4.4.5 Environmental Monitoring and Management System (EMMS)

An environmental monitoring and management system shall be established to monitor the project’s environmental impacts on the project area and the surrounding areas, aiming at adequately protecting the environment both during and after the project implementation. The monitoring and management measures corresponding to potential adverse impacts mentioned

above are listed below.

1. Regular monitoring of water quality in Gorgan and Gharasu rivers and appropriate use of fertilizers and agriculture chemicals
2. Inclusion of desilting ponds in the project areas
3. Regular monitoring of soil properties and proper recommendation of fertilizers and chemicals
4. Inclusion of proper drainage system and adaptation of salinity resistant varieties
5. Proper distribution and usage of surface water and use of water saving methods
6. Regular monitoring of groundwater and use of water saving methods
7. Regular monitoring of atmospheric pollution and adoption of proper farm management practices
8. Monitoring of regulations of waste disposals and provision of waste disposal measures.

Golestan Provincial Directorate of Environment and Golestan Province Agriculture Organization shall coordinate together in establishing EMMS for the province.

4.4.6 Positive Impacts of the Project

The agriculture development through irrigation and drainage projects will have the following the significant positive effects in the Study Area and the region:

- Increased food production through the effective utilization of the wide area of the plain
- Settlement of the people who have a strong nomadic culture
- New economic activities through marketing and agriculture processing
- Expansion of employment opportunities of the local population
- Substantial improvement in way of life
- Reduction of inundation and flood by drainage projects

In line with the Government policy of agriculture development of the region, the positive impacts due to the projects weigh much higher than the negative impacts to be caused by the project.

4.4.7 Necessity of Environmental Impact Assessment (EIA)

As per the regulations of Iran, EIA needs to be executed for the following projects related to irrigation and drainage and agriculture development.

- New irrigation/drainage project, which exceeds the size of 5000 ha or more.
- Dam of more than 15m high with area more than 400 ha area
- Man-made lake with area more than 400 ha area

At present stage of the Study, only rehabilitation or improvement of existing projects are included. Tazeh Abad project area has a desilting pond and a storage pond under construction. Aq qala project managed by Hemat cooperative and Cheldin project also have storage ponds. Among the pilot projects, only Banavar project and Aq qala project managed by Shadimer

cooperative don’t have storage ponds. For the effective use of water, it is planned to construct storage ponds in the above two projects. Besides, it shall be also planned to construct desilting ponds in all the projects except Tazeh Abad Project. However, the storage ponds and the desilting ponds which are planned to be constructed are much smaller than the size of 400 ha. Therefore EIA is not necessary for constructing these ponds.

In regard to irrigation and drainage works, construction of irrigation and drainage canals are not fully completed and are planned to be completed in the near future based on the budget availability. It is also hoped to improve the drainage system in the project areas based on the necessity and the budget availability. Since these works are only a part of on-going works, there is no need to carry out EIA.

Chapter 5 Scenario of Agriculture Development in Gorgan Plain and Selection of Priority Areas

CHAPTER 5

SCENARIO OF AGRICULTURE DEVELOPMENT IN GORGAN PLAIN AND SELECTION OF PRIORITY AREAS

5.1 Government Policies for Agricultural Development

5.1.1 Second Five Years Development Program

The second five years development program (1995-1999), which focused on economical, social and cultural aspects was carried out from 1995 with the purpose of improving the unbalanced economy, which depends on the oil production. In order to attain the objectives of this program, the development strategies were undertaken with the emphasis on structures such as water and gas resources, transportation and services.

The main policy of this program was to increase exports of agricultural and industrial products and other products not relying on oil to improve the mixed-up and disorganized economy of the country depending on the oil production. In order to reconstruct the economy, the government emphasized on development and potentials of remote villages. Therefore, agriculture has been considered to have an important role in solving the economical problem of Iran.

5.1.2 Third Five Years Development Program

The third five year development program (1999-2004) for economical, social and cultural development has the main objective of cutting the economic dependency on oil, and increasing the exportation of non-petroleum products. However, strengthening of agriculture infrastructure is of great importance to achieve these goals. The major policies of agricultural development are as follows:

1. To focus on suitable agricultural products to support the economy not based on oil, such as oil seeds
2. To achieve proper agricultural conditions to increase national investment and investing it in other areas
3. To complete unfinished projects and implementing regional projects in small scales
4. To program the regional development projects in regard to needs, existing resource and potentials of the area.
5. To regulate government and the related organizations
6. To increase the exploitation of natural resources for agriculture development
7. To improve the conditions of agro-industries
8. To build or complete the production line of agricultural products and industries
9. To direct plans of other sectors related to water, energy, transportation, banks in order to

support agricultural sector

10. To provide facilities for agricultural development plans, natural resources and directing government credits and banks to invest in this sector and developing shareholding system.

5.1.3 Related Policies of Central Government

(1) Task Allocation among Ministries and Agencies

One of the important purposes of this plan is the cooperation among policy makers and the others in charge of implementation. For achieving this purpose, Ministries of Agriculture and Energy are working together by constructing and improving dams, water resources and irrigation systems. Banks are spending 25% of their resources for agriculture and have good cooperation with Ministry of Agriculture. The bank branches are in charge of social and economical aspects of the 5 years development plan.

(2) Major Aspects of Agricultural Development Policies

1. To increase agricultural products and income of the farmers and to improve the facilities of marketing
2. To develop agricultural training and activities specially in the field of soil, water and renewed natural resources
3. To carry out development plans of water resources such as reservoirs, irrigation and drainage systems to increase the irrigation potential
4. To organize agricultural cooperatives, improving the livestock sector in regard to the existing pasture lands
5. To improve the administrative structure or organizations related to the objectives of development of agricultural sector
6. To provide new technical methods to farmers (conversion of traditional method to modern agriculture)
7. To Improve crediting system and investment in agricultural sector
8. To Improve and protect natural resources by social and economical approaches.
9. To Improve and develop exportation of agricultural products.

According to the statistics of the Ministry of Agriculture, the total land under cultivation in 1998-99 was 590,358 ha in Golestan province, which is 5.72% of the total area under cultivation in the country. In Golestan province 279,509 ha is irrigated area (47%) and 310,849 ha (53%) is dryland. The total production of the province was 2,122,403 ton, which represents 4.39% of the total production of the country.

From the above statistics, it is clear that the Golestan province is an agricultural province and therefore the development of agricultural sector is the main focus of the central and the provincial government.

5.2 Intentions of the Province for Agricultural Development

5.2.1 Intentions of the Provincial Government

(1) Potentials for Development

The majority of the Golestan province's southern part has good natural resources for the agriculture development. However, enough attention has not been paid on the arid and semi-arid areas in the northern part of the province because of the limitation of soil and water. Development of agriculture can be achieved by providing drainage and irrigation water needed for cultivation.

The province has potentials for the following:

1. It is necessary to implement development plans in the alluvial lands of the Gorgan plain with an area of 270,000 ha and in the lowlands of the northern bank of Gorgan river with 346,600 ha. These lands can reach high efficient production after the improvement and in the case of providing irrigation water and drainage system.
2. Planting trees such as walnut, hazelnut, almond and other fruit trees on the mountainous areas. The olive trees can be cultivated on the mountain areas with an elevation of less than 1,000m, which has high productivity potential.
3. Projects to provide irrigation water for the agriculture development and increase of productivity on plain lands, which are suitable for planting different types of crops.
4. Availability of raw materials for processing industries

(2) Third Five Years Plan for the Golestan Province

In the Third Fiver Years Plan (1999-2004) of economical, social and cultural development of each province, prepared by the Ministry of Management and Programming, many objectives are anticipated as priorities in regard to constrains and medium term potentials.

Some of these objectives in regards to Golestan Province are mentioned below:

1. To increase the efficiency of water transfer (supply) and its distribution for different uses
2. To decrease the occurrence and damages caused by floods
3. To conserve the soil quality in order to prevent the process of soil degradation and its salinization / alkalinization.
4. Execution of studies and construction of irrigation / drainage systems and water supply plan
5. To establish the optional exploitation of groundwater
6. To "transfer the excess water of Mazandaran Province to Golestan Province through the construction of canal between the provinces"
7. To emphasize on social participation

8. To prioritize the plans which aim to increase in exploitation of water resources and agricultural lands
9. To create favorable grounds for promotion of farmers

Therefore, agricultural development for Gorgan plain, through the improvement of irrigation and drainage project, is considered to occupy an important part of the third five years plan of the Golestan province. The development of Gorgan plain will have a significant influence on the regional and the provincial economy.

5.2.2 Intention of Farmers on Agricultural Development

One of the purposes of this agricultural development plan is to increase farmers' income and attain a stable living condition. In this meaning, the interview survey was conducted for 128 farm households about their living standards, the change of their living standards during the latest 10 years, and target income in the near future. Moreover, the intention survey on the method of increasing income was also conducted. The results are described below.

(1) Target income of the farmers

Table 5.2.1 shows the present farmers' awareness of living standard and target income in the near future. As for living standard, it can be summarized as mentioned below:

1) The farmers whose farm scale is less than 3ha recognize their living standard as regular or bad. The recognition of the farmers whose farm scale is more than 5ha varies from good, reasonable and regular. Specially, in Aq Qala Prefecture, most of the farmers whose farm scale is between 5 and 20 ha answered as good or reasonable. Moreover, it is noted that the farmers whose farm scale is more than 20ha recognize it as very good or good.
2) As for the change of their lives during the latest 10 years, many of the farmers belonging to any farm scales answered that their lives have worsened in Kordkuy Prefecture. In Bandar-e-Torkaman Prefecture, the answers are distributed over "improved," "same" or "worsened". They are not clear in Aq Qala Prefecture.
3) As for the target income of the farmers in the near future, it ranged between Rls. 20 million and Rls. 80 million among the farmers whose farm scale is less than 20ha. When their farm scale is larger, their target income becomes higher. Among the farmers whose farm scale is more than 20ha, the target income ranged between Rls. 115 million and Rls. 130 million both in Bandar-e-Torkman and Aq Qala Prefectures.
4) In many cases, this target income is around 2-3 times of the sum of the present production cost and living expenses of family.

Table 5.2.1 Perspectives of the Farmers in the Survey Area (average, 2002)

District	Farm scale	Life standards (%)							Changes of life during the last 10 years (%)			Expectation of annual income (million/year)	Financing production cost 01/02 (a) (million/year)	Family's expense 20/01 (b) (million/year)	Family's budget (a) + (b) (million/year)
		Excellent	very good	good	reasonable	regular	bad	very bad	improved	same	worsened				
kordkuy	1 ~ 3 ha	0.0	0.0	0.0	37.5	0.0	50.0	12.5	37.5	12.5	50.0	33.1	4.6	16.3	14.8
	3 ~ 5 ha	0.0	0.0	0.0	66.7	0.0	16.7	16.7	0.0	33.3	66.7	51.7	13.5	18.5	32.0
	5 ~ 10 ha	0.0	0.0	0.0	50.0	0.0	25.0	25.0	50.0	0.0	50.0	77.5	17.8	16.3	30.1
Bandar-e-Torkman	1 ~ 3 ha	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	50.0	50.0	20.0	1.1	8.7	9.9
	3 ~ 5 ha	0.0	12.5	0.0	25.0	0.0	62.5	0.0	12.5	62.5	25.0	48.4	18.1	14.9	33.0
	5 ~ 10 ha	0.0	0.0	33.3	22.2	33.3	11.1	0.0	33.3	33.3	33.3	40.0	17.7	15.6	33.3
	10 ~ 20 ha	0.0	0.0	0.0	38.5	23.1	15.4	15.4	15.4	38.5	38.5	52.2	11.5	13.1	24.6
	> 20 ha	0.0	0.0	16.7	16.7	16.7	16.7	16.7	16.7	16.7	33.3	115.0	47.1	18.2	65.3
Aq Qala	1 ~ 3 ha	0.0	20.0	0.0	33.3	0.0	40.0	6.7	13.3	26.7	60.0	52.3	4.3	9.7	13.1
	3 ~ 5 ha	0.0	9.1	36.4	45.5	0.0	0.0	9.1	63.6	0.0	36.4	35.5	4.2	11.4	15.6
	5 ~ 10 ha	9.1	18.2	45.5	18.2	0.0	9.1	0.0	9.1	0.0	90.9	59.1	6.8	15.9	17.8
	10 ~ 20 ha	0.0	0.0	50.0	25.0	0.0	25.0	0.0	50.0	50.0	0.0	38.8	14.5	21.5	36.0
	> 20 ha	0.0	75.0	25.0	0.0	0.0	0.0	0.0	25.0	25.0	50.0	130.0	34.3	15.9	37.7

This target income becomes one of the sources for setting up the target income of beneficial farmers in development plan.

(2) Intention of farmers on development of farming

The intention of farmers on the improvement of farming in the Study Area is shown in Table 5.2.2 and the summary is mentioned below:

1) Most of the farmers intend to continue agriculture in the future.
2) Many of the farmers whose farm scale is less than 5ha in Kordkuy Prefecture and more than 20ha in Bandar-e-Torkman Prefecture intend to extend their farm areas.
3) Overwhelming majority of farmers in Aq Qala and Kordkuy Prefecture intend to introduce new varieties. They strongly request for the varieties which suit to climate and soil.
4) All of the farmers, except those whose farm scale is less than 3ha intend to introduce animal husbandry. Especially, about 80% of the farmers intend to introduce dairy cattle in Aq Qala Prefecture. The number of introducing cattle is 2-20 heads. As depending on farm scale, 50-70% of them intend to introduce dairy cattle in Bandar-e-Torkman Prefecture.
5) Intention of introducing sheep is remarkable in Aq Qala Prefecture and 25-45% of the farmers intend to introduce them.
6) Intention of investing in facilities is also high.
7) As for new farming plan in the near future, there are intending for the construction of green houses, irrigation facilities, and reservoir, and introduction of aquaculture (Kordkuy Prefecture).

5.3 Scenario of Agricultural Development in Gorgan Plain

5.3.1 Main Aspects of Agricultural Development Planning

The development of irrigation water source is the precondition for the agricultural development in the Study Area. The development of water source can be done in short, middle and long-term plans.

In order to achieve the targets, establishment and execution of the plans on the following items are required.

Table 5.2.2: Intentions of the Farmers in the Survey Area (average, 2002)

District	Farm scale	Intend to continue the farming (yes/no)	Intend to increase land (yes/no)	Intend to use new variety (yes/no)	Intend to introduce animal (yes/no)	Cow		Sheep		Intend to invest in facilities (yes/no)	Future plan
		%	%	%	%	%	heads	%	heads	%	
Kordkuy	1 ~ 3 ha	87.5	50.0	37.5	37.5	37.5	1~5	0.0	0.0	50.0	in 2002, a well was constructed. Purchase of machinery, independent well fish breeding
	3 ~ 5 ha	100.0	83.3	100.0	66.7	66.7	15~20	16.7	100.0	33.3	fish breeding help of government's project
	5 ~ 10 ha	100.0	100.0	100.0	100.0	100.0	2~10	0.0	0.0	75.0	
Bandar-e-Torkman	1 ~ 3 ha	100.0	100.0	0.0	50.0	50.0	10.0	50.0	30.0	0.0	
	3 ~ 5 ha	100.0	87.5	62.5	62.5	62.5	3~10	12.5	50.0	75.0	changing pump system to electricity reservoir, soil improvement
	5 ~ 10 ha	100.0	88.9	66.7	77.8	66.7	4~20	0.0	0.0	55.6	green house land consolidation, consolidated cultivatio
	10 ~ 20 ha	92.3	61.5	46.2	46.2	46.2	3~10	0.0	0.0	53.8	introduction of irrigation changing pump system to electricity mechanization
	> 20 ha	83.3	50.0	50.0	66.7	50.0	10~50	0.0	300.0	50.0	soil fertility , wheel move system of irrigat
Aq Qala	1 ~ 3 ha	93.3	93.3	100.0	86.7	33.3	2~20	33.3	20~150	50.0	
	3 ~ 5 ha	100.0	100.0	100.0	90.9	81.8	4~10	45.5	20~100	63.6	
	5 ~ 10 ha	90.9	100.0	100.0	81.8	72.7	1~50	45.5	100~300	100.0	expanding the farm make well electricity Increase of the yield
	10 ~ 20 ha	100.0	75.0	100.0	75.0	75.0	5~10	25.0	75.0	50.0	
	> 20 ha	100.0	75.0	100.0	75.0	75.0	10~20	75.0	100~200	75.0	request for training courses

1. Basic pattern of crop rotation for extricating from gamble farming should be established in a short-term plan, and it should be extended and included in a medium term plan. The crop rotation would be fixed in a long-term plan. The basic pattern of the crop rotation includes annual leguminous pastures and annual grass besides cereals, cotton, rape seeds, and soybeans in order to increase organic matter of soil. It intends to improve the physical characteristics of heavy textured soil in this area and saving chemical fertilizers and pesticides. According to national policy, increase of wheat and oilseeds production need to be focused.
2. Integrated farming with livestock farming which is intended by farmers needs to be established through introducing pastures into a crop rotation, and establishment and extension of the method of making silage and hay of grass in order to use them in dry season. Moreover, livestock farming is promoted through planning of the increase of milk production, the hygienic management, and the construction of milk processing factories. Promotion of livestock farming completely consists with the idea of the basic crop rotation for sustainable agriculture in this plan.
3. Establishment of low cost irrigation and drainage methods.
4. Systematic improvement of finance and assistance for farmers should be executed according to the plan, and the system for planning and executing by local administrations also should be established.
5. Construction and improvement of social infrastructure. Construction and improvement plan and its execution of roads, storehouses, and processing factories should be proceeded simultaneously.
6. Improvement of marketing system is required according to the plan.
7. Supply system of farm materials, fuels, and agricultural machinery should be improved to supply them to farmers in time. In order to operate high technique effectively, timely farm work is important. It should be improved according to the plan.
8. Strengthening of extension agencies should be promoted according to the plan. Especially, extension of production of forage for domestic animals, methods of making silage and hay, and hygienic management of dairy cattle are not enough. This technical extension contributes much to escape from gamble farming. It is proposed that local TV stations have the programs on agriculture and animal husbandry to broadcast market information on agricultural and livestock products and technical information. It must be effective.
9. Technical research supports all of the plans mentioned above. The research sectors, such as irrigation and drainage, soil improvement, sustainable crop rotation, making methods of silage and hay of grass, etc., and provincial government should carry out the integrated technological research.

By executing the plans mentioned above, it is sure to increase the possibility of agricultural development in the Study Area. Suitable measures should also be setup to secure sufficient water resources for the agricultural production in the Gorgan plain. A 'Phased Development Approach' is necessary to realize the actual measures to be carried out for the agriculture development as mentioned below.

(1) Expected countermeasures

1) Water Resources Aspects：To secure sufficient amount of water resources for a wide range of agriculture development.

Absolute shortage and instability of available water resources are the main problems of the Gorgan plain. The potential measures are as follows:

a.	To provide farm ponds to store river water of wet season by scheme	Short Term
b.	To provide regional water distribution system from the Piedmonts region to the area	Medium Term
c.	To generate availability of water by the rationalization of dam operation	Short & Medium Term
d.	To proceed watershed management including reforestation of upstream area	Medium & Long Term
e.	To conduct river bed stabilization to enhance normal pump intake	Short & Medium Term
f.	To clarify hydrological circulation & appropriate water allocation by sectors	Short & Medium Term
g.	To examine inter-province water conveyance	Medium & Long Term
h.	To extend water saving irrigation practice in the basins	Short & Medium Term

2) Soil Aspects：To promote leaching of salts, and to improve poor fertility

The soils in the Gorgan plain areas contain high quantity of salt and are poor in fertility. Therefore, suitable soil and water management practices are necessary to get rid of salt hazards and to enrich soil fertility. The measures to be carried out in consideration of these aspects are as follows:

a.	To secure sufficient irrigation water to leach out salts	Short, Medium & Long Term
b.	To introduce improved farm program to enrich soil.	Short, Medium & Long Term
c.	To provide permanent drainage system to avoid salt hazard	Medium & Long Term
d.	To provide drainage networks in areas with high Potential for inundation	Short Term

e. To provide economical mole drains to control. groundwater level — Short & Medium Term

f. To conduct soil monitoring — Short, Medium & Long Term

3) Socio-Economic Aspects: To provide and implement agricultural policies acceptable by the farmers and to realize inter agencial Government's assistances.

Most of the farmers, especially in the plain, have quite huge debts due to the instable production and low market prices of the products, even though both farmers and the governments have been making efforts to reconstruct the country after the revolution and the war. It is observed that the number of farmers leaving their farms is increasing and it will continue, if proper measures are not carried out to release their heavy burden. Measures based on these considerations are as follows:

a. To start R&D on sustainable agriculture to improve farm income — Short Term

b. To examine & implement promotion programs to increase farmers' willingness. — Short & Medium Term

c. To introduce proper scale farming capable to maintain a better life — Medium & Long Term

d. To rationalize administrative procedures and qualify assistances sufficient enough to eliminate farmers' distrust. — Medium & Long Term

e. To conduct debt relief assistances to farmers — Medium & Long Term

f. To promote programs to avoid traditional land tenure customs, which cause farm poverty due to land subdivision — Short Term

4) Agriculture Aspects：To establish proper farming programs to cope up with the conditions of the plain area, not only imitating those practices of the piedmont plain.

Irrigated agriculture has been introduced in the plain areas to realize high productivity farming with high water consumption, without proper consideration of the natural conditions and traditional culture of the farmers in the region. Also, the farmers in the plain area utilize similar agro-practices of the piedmonts using the groundwater to get the necessary water. Hence, it can be said that the approaches alienate from the natural conditions and livestock based cultures. Measures to be carried out considering these aspects are as follows:

a. Agricultural program harmonized with livestock, pasture land farming and dry farming is to be examined to cope up with the natural conditions of the plain — Short & Medium Term

b. To distinguish areas that can be irrigated to avoid instable irrigation water supply — Short & Medium Term

c. To establish the government assistance programs to realize stable crop selling — Medium & Long Term

d. To examine concrete plans to secure sufficient water sources for a stable water use — Medium & Long Term
e. To provide permanent drainage system capable to leach out salts — Medium & Long Term

5) Irrigation and Drainage Aspects：Towards stable water use and relief from salt hazards.

It must be recognized that the present water resources are far from sufficiency to promote irrigated agriculture. Besides, there is a high risk potential of salinization problems. Measures should be carried out, based on the above mentioned considerations are as follows:

a. To secure sufficient irrigation water to leach out salts — Short, Medium & Long Term
b. To provide permanent drainage system to avoid salinization problems — Short, Medium & Long Term
c. To promote water saving irrigation practices in the basins — Short & Medium Term
d. To provide farm ponds to secure stable water use in dry season — Short & Medium Term
e. To provide drainage networks for inundation potential areas — Short Term
f. To provide economical mole drains to control groundwater level — Short & Medium Term

(2) Necessity of Phased Development Planning as Basic Concept for Agricultural Development in the Plain

It is obvious that all the measures listed in the previous section can not be implemented in one time, and it is not appropriate to do so. They have to be prioritized and synchronized between each other. With this understanding, a ‘Phased Development Approach’ is to be set as a basic concept for planning the agricultural development in the Study Area.

5.3.2 Scenario of Agricultural Development

The scenario of agricultural development in Gorgan plain is developed plain based on the discussions with government agencies and farmers, including their intentions and opinions to promote a sustainable agricultural development in Gorgan plain.

(1) Phasing Alternative

Tentatively 3 phases with 5-year period for each stage are proposed, starting in 2005, considering that this Study will be finished in spring 2003. Those stages are as follows:

a.	Preparatory stage	from the spring of 2003 to the end of 2004	2 years
b.	Phase-1	from 2005 to 2009	5 years
c.	Phase-2	from 2010 to 2014	5 years
d.	Phase-3	from 2015 to 2019	5 years

(2) Preparatory stage From the spring of 2003 to the end of 2004 (2 years)

All of the necessary preparations to commence the phased development need to be completed during this period, including necessary coordination with relevant agencies and stakeholders and requests for foreign collaboration, if any.

(3) Phase-1 from 2005 to 2009 (5 years)

This phase is to be set as a period of "Preparation for Sustainable Agricultural Development and Rural Activation". The main subjects to be tackled are as follows:

1) To commence the study for the 'Integrated Water Resources Management and Watershed Conservation in the Gorgan Plain'
2) To commence research and development activities focusing on analyzing the optimal and suitable farm management practices for the region
3) To clarify available resources to be mobilized and
4) to strengthen the coordination activities among relevant agencies

The activities during this phase are to be focused on the improvements of the existing irrigation and drainage schemes, and not on the expansion of irrigated area because of insufficient water resources.

(4) Phase-2 from 2010 to 2014 5 years

Phase 2 is to be titled as 'Improving the Present Agriculture and Preparation for Wider Development'. The results of the research and development activities during the previous phase should be continued further for the examination on new subjects. The facilities to be proposed in the 'Integrated Water Resources Management in the Gorgan Plain' shall be implemented to facilitate sufficient water availability for the plain. Construction of facilities shall also be started, if the study on 'Mazandaran Water Supply Project' is concluded to be feasible.

(5) Phase-3 from 2015 to 2019 (5 years)

This phase is to be captioned as 'Implementing Sustainable and Wider Range of Agricultural Development". The results of research and development activities should be extended in the region. Enough quantity of water shall be conveyed through 'Mazandaran Water Supply Project', which shall be commenced and the water will be utilized for further agricultural development of the region, as per intentions of the Iranian Government. Scenario of Agricultural Development Planning in the Gorgan Plain is summarized as shown in Table 5.3.1.

Fig. 5.3.1 Scenario of Agricultural Development in Gorgan Plain

Phase & Duration		Phase 1 : 2005～2009 (5 Years)	Phase 2 : 2010～2014 (5 Years)	Phase 3 : 2015～2019 (5 Years)
Tasks of Phase		Preparation for Sustainable Agricultural Development & Rural Activation	Improving present agriculture & Preparation for wider development	Implementing Sustainable Wider Range Agricultural Development
Development Frame		* To promote information sharing among stakeholders * To enhance effective water use technology & make concrete regulations * To enhance improvement within existing resources & infrastructure * To commence the Study for the Integrated Water Resources Management and Watershed Conservation in the Gorgan Plain	* To secure available water capacity through rational operation of dams * To improve production infrastructure for water saving agriculture * To commence preparation works for Mazandaran Water Supply Project.	* To promote middle & large scale sustainable agriculture & integrated green house farming.
Approaches for Agricultural Development	Project Management	* To set up "Golestan Agriculture Board" : Planning Phased development on clear task allocation	* M&E on whole activities related with agriculture development to meet with harmonized resources mobilization in the region.	* Most of tasks are to be handed over to "Farmers' Organization" respecting their Self-Reliance, while continuing M&E and Future Planning.
	Water Resources	To set measures within present water resources capabilities. * To construct Farm Pond(s) by each Irrigation Scheme.	To set measures under all dam completion & their available water by * To provide Farm Pond(s) for Dry Land Farming Area * To supply water to dry land farm ponds from DWCNS	To set up measures under Mazandaran Water Supply Project. * To connect "Mazandaran Water Supply Project" to " Dam Water Connection Network System " and start water distribution and storage.
	Soil Resources	* M&E on soil condition on Sub-Surface Drain System. * Implement Sub-surface Drain System Provision Project (Only Irri. Scheme) * Study / Test efficiency & feasibility of "Pipe Drain " & " Mole Drain" * Study / Test soil improvement under crop & husbandry integration practice.	* Implement mole drain sys. extension projects (Dry land) * Implement Pipe Drain Sys. Provision Project (Irrigation area) * Extension of soil improvement under crop & husbandry integration practice.	* To continue M&E for soil improvement
	Irrigation & Drainage	* Study / Test on efficiency of Sub-Surface Drain System * Implement Sub-Surface Drain System extension (present irrigation schemes) * Provide Desilting Pool at each present irrigation scheme * Provide & implement Demonstration Farm (D.F) * Study / Test water saving type irrigation practice at Demonstration Farm (D.F)	* Implement mole drain sys. extension projects (Dry land) * Implement pipe drain sys. Provision project (Irrigation area) * To enhance farmers' awareness on "Water Cost Concept". * To maintain efforts of extension for water saving irrigation practice to farmers.	* To conduct M&E to maintain proper conditions of irrigation & drainage facilities by farmers' participation.
	Farmers' organization	* Train on Participatory Learning & Action for Deh Council & Cooperative. * Strengthen cooperative function & take-off from Govt supports to self-management * Extension on group farming management & new technologies.	* To Accelerate promotion of rural production cooperatives.	* To enhance establishment of aspects proposed in the left column.
	Extension	* Provide & implement "Demonstration Farm (D.F)"	* To strengthen agricultural & livestock extension services.	
	Agricultural Management	* To improve present agricultural management at field level. * Implement study/trial to integrate administration and R&D activities. 1) Enhance salt leaching & crop production by under drain sys. in irri-land. 2) Soil & crop production improvement at dry lands 3) Improve soil fertility with introduction of pasture plants to crop rotation. 4) Plastic greenhouse farming trials 5) Windbreak tree trial planting and their M&E 6) Food processing (Aiming at exporting of grain, dairy products, olive, etc)	* Extend crop & husbandry combined farming practice. * Increasing of productivities of crops & fruit trees * Enhancement of Sustainable farming practice * Promotion of plastic greenhouse * Promotion of food processing * Promotion of mechanization system	* To enhance establishment of aspects proposed in the left column.
	Marketing	* To maintain present improvement approaches.	* Enhance value added production.	
	Assisting Fund	* To conduct clarification survey on farmers' debts and solution alternatives. * To maintain present improvement approaches.	* Conduct Govt assistances aiming to choose proper farm size to survive.	* Set assistance entrepreneur type farming to meet with national food security policy.
External Conditions	Project Management & Policy	* Establish integrated regional development sys. "Golestan Develop' Board (GDI * Exhibit examples of stable production & success stories through social services * Both Central & Provincial Govts have to have clear regional plan for furture.	* Set policy to distinguish & choose proper farm size through land integratio * Encourage small scale farmers to introduce green house farming.	* Reinforce & assist middle & large scale plot farming.
	Water Resources & Basin Management	* To conduct a study of "Dam Water Connection Network System". * Study on Optimum Dam Operation System in the Watershed. (SODOSW) * Study on Hydrological Circulation and Watershed Conservation (SHCWC) * Basic study, F/S & D/D on Mazandaran Water Supply Project. (SMWSP) * Commence watershed conservation project & social forest extension.	* To implement "Dam Water Connection Network System". * Complete all dams which are under planning now * Clarify water allotment by sector in the region. * Commence and complete "Dam Water Connection Network System" * Commence "Mazandaran Water Supply Project" construction.	* Commence water supply to Golestan through Mazandaran Water Supply Project. * Connect the water from Mazandaran to the " Dam Water Connection Network Project " and start water distribution in the region.
	Market, Others	* Demand Grain Same as present Vegetable Same as present	* Demand ; Increase market demand and crop diversification by urbanization. * Market ; Increase contract cultivation by activation of regional economy.	
	Donors	* JICA PTTC Scheme Reg. to integrate administration & R&D activities. Extension on verified trial results * Foreign Assistances > for SODOSW, SHCWC, SMWSP	* Loan from International Agencies for Mazandaran Water Supply Project	

Note;

G.D.B ;	Golestan Developmet Board.	F/S	Feasibility Study
JICA ;	Japan International Cooperation Agency.	D/D	Detailed Design
JICA PTTC Scheme ;	JICA Project Type Technical Cooperation Scheme.	SODOSW,	Study on Optimum Dam Operation System in the Watershed.
R&D	Research and Development	SHCWC,	Study on Hydrological Circulation and Watershed Conservation
M&E	Monitoring and Evaluation.	SMWSP	Study on Mazandaran Water Supply Project.

As stated in the scenario of agricultural development, it is highly important to secure stable and sufficient water resources to realize sustainable agricultural development in the Gorgan Plain. Besides, watershed conservation is also necessary to prevent the sedimentation and flooding problems in the Gorgan plain. Therefore the Study on 'Integrated Water Resources Development and Watershed Conservation in the Gorgan Plain' shall be carried out to clarify availability of usable water resources and the watershed conservation measures necessary for the area. A brief description of the Study is given below.

5.3.3 Study on Integrated Water Resources Development and Watershed Conservation

(1) Necessity of the Study

A study of the water resources in the area was carried out in 1972. But the conditions of the water resources utilization have been changed due to several changes in the basin, such as the construction of actual dams. Hence, it is necessary to revise the water use condition to permit an efficient and optimal utilization of water resource. Cutting of the trees in the upstream areas have also created significant impact in the watershed during the past 30 years. It is necessary to propose suitable watershed conservation measures for the area.

(2) Effects of the Study

The study shall recognize the exact water circulation in the whole area, while evaluating the effective water distribution. It will allow an efficient water use and watershed conservation in future for the regional development, based on the availability of water resources. It will also recognize the water availability in both the watersheds, creating the basic conditions to succeed projects such as 'Water Supply from the Mazandaran Province'.

(3) Contents of the Study

The Study mentioned here shall be realized for the watersheds of Gorgan and Gharasu rivers, clarifying the actual water use condition and water demand in the area. The usable water resources shall be studied, pointing out the water shortage by area in the watershed.

This study shall also re-evaluate the actual conservation and management structures of the dams and water resources, including the present information transmission system. The improvement of the information transmission system includes the transmission of information from the dams and meteo-hydrological measurement stations.

The same thing can be said to the dam operation structure. The data (including the dam's storage condition) should be available for the involved institutions in and out of the province to permit an effective water use. The instantaneous availability of information such as water shortage and surplus will permit an efficient water use in the basin. The water supply from the

Mazandaran Province to the Gorgan Plain will also require an efficient communication system. Hence, the present system shall be improved to permit a more flexible decision to manage the water use according to each condition.

The improvement plan shall include the following aspects, but the detailed evaluation shall be carried out in the study.

First the Gorgan plain can be divided into 2 watersheds: Gorgan and Gharasu. All dams will be connected to the Golestan Central Office. Each dam will be connected to the dams in the same watershed to permit the communication between them. The climatological and hydrological stations will be linked to the dams to make possible the prediction of the dam operation. Also all irrigation schemes shall be linked to the responsible dam. The Golestan Central Office shall be linked to the Mazandaran Central Office to permit an efficient management of the water supply between both provinces in the future.

The final form of this system shall be an on a line network. The possibility to share detailed information will make it possible to control the water use considering the general conditions of the watersheds, allowing an efficient water use. So, the hard component is very important, but the soft component must also be sufficiently considered to improve the possibility of succeeding the results of the development project.

Considering the above aspects, the Terms of Reference (TOR) for the Proposed Study is prepared as mentioned below.

(4) Objectives of the Study

1) To analyze the existing conditions of the Gorgan and Gharasu river watersheds including water resources potential, existing problems of the watersheds, watershed conservation measures, estimating the present and future water demand and realizing water balance in the Gorgan Plain;
2) To formulate a well-balanced integrated water resources and watershed conservation, including inter-basin and inner-basin water transfer, considering natural and social environment in each river watershed as well as in the neighboring watersheds.

(5) Study Area

The Study Area covers the watersheds of the Gorgan river (11,480 km^2) and Gharasu rivers (1,720 km^2).

(6) Phases of the Study

The Study shall be divided into two phases.

Phase I: Evaluation of the Existing Water Resources Development and Watershed Conservation

Phase II: Elaboration of the Integrated Water Resources Development and Watershed Conservation Plan

Phase II-1: Alternative Study for the Integrated Water Resources Development and Watershed Conservation Plan

Phase II-2: Formulation of the Integrated Water Resources Development and Watershed Conservation Plan

(7) Study Schedule

The total period for the Study will be 14 months. The period for each phase is as follows:

Phase I: 6 months

Phase II: 8 months (Phase II-1: 4 months and Phase II-2: 4 months)

Study Schedule

Phase	Phase I: Evaluation of the Present Water Resources						Phase II: Master Plan Study							
							Alternative Study				M/P Formulation			
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Schedule														

(8) Expertise Required

1) Team Leader (Regional Development Planner)
2) Water Resources Management Engineer
3) Hydrologist (Including Modeling)
4) Hydrogeologist
5) Irrigation/Drainage Engineer
6) Agronomist
7) Environmental Management Engineer
8) Water Supply Engineer (Including Water Quality)
9) Institutional and Organization Planner
10) Socio-economist and Financial Planner
11) GIS Specialist

(9) Implementing Agency

The Ministry of Energy and Water Resources shall be the implementing agency and also acts as the coordinating organism in relation with other government and non-government organization for the smooth and appropriate implementation of the Study.

5.4 Selection of Priority Area for the Feasibility Study

At the first step of the scenario of agriculture development, it is necessary to select a priority area, which can be developed as a 'sustainable development model' for the future Gorgan plain agriculture development and to provide a 'success story' to the farmers in the vicinities for the future development of the region. With this purpose, a priority area was selected as mentioned below.

5.4.1 General

(1) Role of the Study

The main task of this Study is to examine the most appropriate measures to develop the agriculture in the Gorgan Plain, based on the results of the present conditions. Especially, agriculture in the northern part of the Study Area presents many expectations such as improvement of staple food production by the effective utilization of the wide area of the plain, expedition on settlement of the people who have strong nomadic culture, generation of employment opportunity, etc.

It can be said that the selection of the development priority areas has to be the first step to provide a success story for the farmers in the vicinities to refer for future development.

(2) Meaning of Selection of the Priority Area

There are four development districts in the Study area, which consist on five irrigation schemes, mainly supported by the Government, and one district which has been developed from the ancient time. Also, different sources of irrigation are utilized, such as groundwater and river water. Usually farmers are managing both irrigated area and dry farming according to the circumstances.

Nomination of potential area is to select proper precedent schemes, which are to be adopted in the further feasibility examination, basing on the results of the inventory survey.

5.4.2 Selection of Priority Area

(1) Pre-requisites for the Selection of Priority Area

It has been recognized commonly among the stakeholders that both of quality and quantity of water must be secured to realize the agricultural development in future, desired by the

Government. The lack of water will increase the problems due to salt accumulation in the future. The nomination of the development potential areas in this study stage will be done under a pre-requisite that a phased development approach is to be adopted within the present limited resources.

(2) Criteria of Selection of Priority Area

The definition of the "Priority Area Selection" can be done in two ways: one is to nominate certain area(s) directed for the improvement from present conditions and the other is for areas with difficulties to keep the present production and need development to change the actual situation. The criteria for the area selection will be set as follows based on the above understanding.

1) Farmers' Organization, Participation Intention and others.

It is well known commonly that stakeholders' "sense of ownership" is the most important factor to sway results of any projects and activities. Any project has different problems and constraints.

The organization of the farmers, cooperative activation, sense of ownership and participating conditions of the farmers can be listed as reference indicators of farmers' willingness. Those information is not numerical statistical data, excluding the organization of the farmers. Those non-numerical data are entirely subjective, just impression obtained by the Study Team through field surveys.

2) Sufficiency of Present I & D Facility

There are six irrigation and drainage schemes in the Study Area. All the schemes have never reached to the completed conditions as planned originally. The main cause of those under-development is "Scarcity of the National Budget" for project implementation. There is no assurance to define the project completion year. Besides, farmers' financial capability to has been getting worse due to propelling the social movements and policies of 'Cost Sharing Concept'.

Both of comparative sufficiency of present I & D facility and assurance of proper conditions for crop cultivation are necessary to secure the results of improvement. Hence 'Sufficiency of the Present I & D Facility' is to be set as one of criteria for the selection.

3) Salinization of Irrigation Water Source

All of irrigation schemes in the study areas are depending on Gorgan River as water source. The water quality, during the dry season, becomes worse in the downstream direction due to the drainage water from farm lands along the river. Hence, 'Salinization of Irrigation Water Source' at the intake point is to be referenced as one of criteria for selecting the site(s).

4) Availability of Irrigation Water

The flow of Gorgan river in dry season comes only from the “Environmental Conservation Maintenance Flow”, discharged from the Voshmgir Dam after the completion of the Golestan Dam construction in 2001. So, the available river water gets smaller in the downstream direction.

So, the project success will depend on the water availability at the intake point along the river, which will be one of the reference item for the selection criteria.

5) Actual Irrigable Area

All of the existing irrigation schemes have pump station. But they are not supplying 100% of the irrigation requirement. It is planed in the future the construction of farm ponds to store enough water, capable to satisfy the total irrigation requirement.

The coverage rate of the actual irrigated area can be one reference to indicate how many farmers are benefited by the present irrigation facility. If the irrigation system is not sufficient, naturally the farmers are going to find out other alternatives to secure their crop yield or to obtain a rational benefit/cost, decreasing their intention to participate in cooperative activities. So, the ‘Actual Irrigable Area’ will be one of the selection criteria.

6) Affinity of the farming conditions to vicinities

The Government expects to propel staple food production, mainly wheat production, through utilizing the wide area of the Gorgan Plain. Sufficient water for irrigation on both quality and quality is indispensable to avoid salt hazard and to secure sufficient crop yield to meet with the Government intentions, while solving many constraints to reach to the target.

The affinity of farming condition is to be one of references to nominate the site, to apply the results of activities to solve constraints to the vicinities.

7) Accomplishment of drainage activities

It is known widely that salt accumulation in the soil deeper layers is found at major part of the Study Area because it was included in the inundation area of the ancient Caspian Sea. Also, the high groundwater table condition and low permeability situation is recognized as a result of “loess” deposit. Golestan J.A.O has poured efforts to improve such soil conditions by providing open channel drainage networks as preparatory works before introducing irrigation practices in the Area.

It is known, through their experiences, that it takes several years to decrease the water table and leach out the salts in the soil with only natural rainfalls, by the open drainage system. According to this, the accomplishment of preparatory drainage activities will be one of the criteria to select the site(s).

Comparision Nominated Development Potential Areas

Descriptions	No.1 Tazeh-Abad	No.2 Hemmat (Aghghabar)	No.3 Shadi Mehr (Aghghabar)	No.4 Gomishan (Banaver)	No.5 Gomishan Kesht	No.6 Cheldin (Mehtar Kola)
Cooperative entry accomplishment	6	5	1	3	2	4
Cooperative activation	6	5	1	4	2	3
Sense of ownership, participating conditions of farmers	6	5	1	4	2	3
Sufficiency of Present Irrigation. & Drainage Facility	6	6	1	3	2	6
Salinization of irrigation water source	5	4	4	2	2	6
Availability of irrigation water source	5	4	4	2	2	6
Actual irrigable rate on extent	5	4	2	3	2	6
Affinity of the farming conditions to vicinities	6	6	6	6	6	1
Accomplishment of drainage activities	5	5	2	3	2	0
Total	50	44	22	30	22	35

Note ; 1). Bigger number is superior comparatively.
2). Numbers are only impressive puriority only.

(3) Selection of Development Potential Area

The selection of the target areas for the feasibility study was carried among the five existing irrigation schemes. The selection of the development potential areas was made based on the nomination criteria presented in the previous section.

The right side table shows the results of the selection comparing each scheme according to each criteria. The numbers are not from any numerical information, but just show the result of comparison obtained through the field survey.

It was found that the Tazeh-Abad Scheme is the most potential area, followed by the Hemmat, Mehtar Kalateh and Gomishan Scheme. The Gomishan-Kesht and Shadi-Mehr Scheme did not have not sufficient time to show concrete results of the open drainage effects after their provision. It seems that few more years will be necessary for the crop cultivation without high salinization problems. The Gomishan Scheme seems to have relatively higher risk potential than the others, in relation to the stable production and farm income, if continuing the present farming practice, due to the scarcity of usable water and high salinization problems.

Hence, Tazeh-Abad Scheme was selected as the area that represents the present farming conditions in the region and will be utilized for the studies in the feasibility study stage.

5.4.3 Selection of the Case Study Area

(1) Arguments of the Iranian Side

While expressing approvals for the site selection, Golestan J.A.O requested further consideration to select also the Cheldin Irrigation Area. The Iranian side arguments are as follows.

a. Cheldin area shares a part of piedmont agricultural area, which is considered as the main agriculture production area in Gorgan Region

While the greatest intentions of the Iranian Government is on the agricultural development of Gorgan Plain, which has been left out of the major development activities, it is known that the piedmont region has contributed for a major part of the agricultural production of in the region since old days. It was explained that the reason to have added this area as a part of the Study Area came from such understanding, while signing the Scope of Works of the Study.

b. Necessity of effective example to show the farmers the way to improve the present conditions independently

Golestan J.A.O understood that the major constraints in the Cheldin Area are related to the management aspects, such as land reform to enhance more rational agricultural practices, utilize private wells as common water sources to solve unbalanced water allotments, land donation to provide public drainage system against seasonal inundation. A case study in the Cheldin Area will facilitate to show farmers the way to improve the present conditions independently.

(2) Recognition for Cheldin Irrigation Area

The following aspects were recognized in the Cheldin Irrigation area in the initial site selection.

a. Cheldin Area does not represent the farming condition in the Gorgan Plain

The stronger intension and expectation of agricultural development, under a very severe natural condition of the Gorgan Plain is included in the background of the given subject of the Study, instead of the improvement of agriculture in the piedmont zones, where the conditions are more stable and milder. It can be said that Cheldin Area does not represent the farming condition of the Gorgan Plain.

b. Maturity and problems of the Cheldin Area

The agriculture in Cheldin Area is relatively plentiful with less problems of salinization and well diverted products with relative enough irrigation water and fertile soil, different to the plain area. The problems and constraints raised by the farmers were mainly directed to the management aspects and less to the engineering one. Aspects like land reform to enhance more rational agricultural practices, utilization of private wells as common water sources to solve the unbalanced water allotments, land donation to provide public drainage system against seasonal inundation, are not handled well through the Government’s interventions. It seems better to wait for the growth of farmers’ self-reliance to co-work against those constraints.

c. Necessity on improvement of agriculture in Cheldin Area is relatively lower.

The farmers in the Cheldin Area utilize water from the mountain torrents and groundwater for irrigation. Comparing the agriculture of Gorgan Plain, the development is well-balanced with high productivities and a high crop variation. The necessity to improve the Cheldin Area agriculture is relatively lower than the Gorgan plain.

(3) Proposed ‘Case Study Area’

Golestan J.A.O expressed their intention to select a case study area as an example of improvement in Cheldin Area, even though not adapting for a feasibility study.

The scope of the Case Study as expressed by the Golestan Jihad-e-Agriculture Organization was to conduct a field survey in an area of about 20 ha in order to examine the possibility of agricultural development for the area by proposing a suitable cropping pattern, based on analysis the present conditions of the area.

In regard to other aspects such as drainage, suggestions shall be made for the future study of the project area.