

**JAPAN INTERNATIONAL COOPERATION AGENCY  
THE ISLAMIC REPUBLIC OF IRAN**

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

**ANNEX**

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**DRAFT FINAL REPORT  
(ANNEX)**

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## ANNEX 1

### BACKGROUND OF THE STUDY

#### A1.1 General Profile of Iran

The Islamic Republic of Iran covers an area of 1,650,000 km<sup>2</sup>. 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.

##### A1.1.1 Social Conditions of Iran

###### (1) Population

The population aspect of Iran should be looked at from the perspective of Islamic teaching. In the opinion of many Islamic scholars, Islam favors big family. As the Islamic revolution reinforced Islamic values and principles, the Government initially considered family planning as a controversial issue, following a pro-nationalistic stand. As a result, during the first 10 years after the Islamic Revolution, the population of the country grew rapidly from almost 34 million in 1976 to over 49 million in 1986 with the total fertility rate increasing from 5.5 to 6.3 births per woman during the same period and the phenomenon was called as 'Baby Boom'.

In 1993, the Family Planning Law was approved and the Family Planning Program was launched. Then, the population growth fell significantly from an average of 2.5% annually for 1986-1991 to 1.5% during 1991-1996. And the most recent statistics indicates that the average annual growth rate in the year of 2000/2001 is 1.5% (Statistical Center of Iran, 2002).

The estimated total fertility rate is 2.2 births per woman in 2001 (CIA, 2002).

Population of Iran

Year	1976	1986	1991	1996	2000
Population	33,708,722	49,445,010	55,837,163	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%<sup>1</sup> and 42.49% are engaged in agriculture, industry and service sector, respectively.

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<sup>1</sup> Note: Including mining and quarrying, manufacturing, electricity, gas and water supply and construction.

### 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) Education and Literacy

##### 1) Education

Primary education for school children begins at the age of 6. Students who pass the 5-year period of this stage are permitted to enroll in the lower secondary school. Lower secondary education is a three-year course, and different courses are instructed at this level in addition to prerequisite courses of the upper secondary education. According to the three-year average grade of some specific courses, the students are admitted to one of the two educational courses of “technical and vocational and/or services” and “theoretical education.” After passing the three-year course, the student receives the lower secondary certificate.

The upper secondary school system has been changing, and the new system established in the academic year of 1992/1993 has gradually replaced the older one. At present (as of 2001), all the upper secondary students are attending the new system. The new system lasts for three years in which the first year (first and second term) is general education for all fields of study. In the second year (the third term), the students are divided into one of the fields of theoretical (mathematics and physics, empirical sciences and humanities), technical and vocational, and work and knowledge courses. The upper secondary school diploma is given after the final two-year period.

After completing the upper secondary education, the students are admitted to pre-university education (one-year course) and teacher training education (two-year course). The students who complete the pre-university education can be admitted to university, the institute of higher education.

Besides this school education, there are Literacy Movement Organization courses consisting of preliminary, complementary final and fifth grade of primary school. After completing this course, learners can start from fifth grade. Combined primary, lower and upper secondary gross enrollment ratio is 69% in 1998 (UNDP, 2001).

##### 2) 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).

(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 12<sup>th</sup> Imam. 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 Baha'i (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).

### A1.1.2 Economic Conditions of Iran

(1) Outline

After President Rafsanjani assumed the presidency in 1989, an economical reform program was initiated with the introduction of the market economy, that included the liberalization to reconstruct the economy which was damaged after the Iran / Iraq war.

The 3<sup>rd</sup> Five Year Plan (2000 to 2004) promotes the restructuring of the economy, introduction of foreign currency, etc., following the 2<sup>nd</sup> Five Year Plan (1995 to 1999). The decrease of petroleum price after the middle of 1997 directly affected the Iranian economy, of which about 80% depended on the export of petroleum products. However, after 1999, its price has recovered and the inflow of foreign currency has improved.

(2) Inflation Rates

The inflation rate was higher than 20% until 1996. However, after 1996, it lowered down up to 12.6% in the year of 2000.

Trend of Annual Inflation Rates

	1996	1997	1998	1999	2000
Consumer price	23.2	17.3	18.1	20.1	12.6
Whole sale price	25.1	9.9	16.7	24.2	14.7
Producer price	26.4	15.6	17.2	19.1	16.3

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

### (3) GDP by Sectors

In Iran, the GDP is divided into the petroleum and non-petroleum sectors. The petroleum sector shows a high fluctuation according to the international crude oil price. Among the sectors, major share contribution of the GDP is the tertiary sector with about 50%, which is followed by secondary and the primary sector.

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

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

### (4) Trade Balance

The international trade balance of Iran was in a constant surplus but it depends on the crude oil price. Therefore, the account was in deficit in 1998, since the crude oil price declined. From 1999, the trade account has become surplus by the rise of crude oil price.

	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
(Crude oil and Natural gas)	19,271	15,471	9,933	17,089	24,226
Import	14,989	14,123	14,286	13,433	15,207
Balance out of trade	-2,633	-2,438	-1,469	-1,533	-285
Transfer Balance	463	393	497	525	621
Current Balance	5,232	2,213	-2,140	6,580	12,645
Long-term Capital Balance	-5,246	-3,554	-1	-3,342	-2,612
Basic Balance	-14	-1,341	-2,141	3,247	10,033
Short-term Capital Balance	-263	-1,268	2,271	-2,552	-7579
Foreign currency Reserves	2,346	-3,705	-1,572	1,845	937

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

### (5) Trend of Iranian Trade

#### 1) Trend of Trade Balances

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%	(18.7%)	-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

### 2) Export of Agricultural Products

Among the exported agricultural products, pistachio, raisin and caviar are the major products. In recent years, the export of sheep leather has increased due to the improvement of the quality by the investment of the facilities. The destination countries of the major products are pistachio to Germany, raisin to Pakistan, tomato puree to Russia and sheep hide to Italy.

The actual amount of the agricultural products in 1999 and 2000 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

### 3) Import of Agricultural Products

The agricultural products account for approx. 10% of the total amount of import. Among these products, the amount of wheat imported was about 5 to 6 million tons and rice imported was 1 million tons, annually. The major countries of origin of agricultural products are wheat from Canada, rice from Thailand, soybean oil from Brazil and maize from Canada.



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

The share of import amount of wheat accounted for 6.3% in 1999 and 5.2% in 2000 of the total amount of the Iranian import value.

Trend of Import of Major Agricultural Products (Unit: Thousand US\$)					
Item	1996	1997	1998	1999	2000
Wheat	1,024,050	1,107,775	519,405	801,301	739,015
Rice	474,937	245,585	205,638	325,854	339,118
Soybean oil	470,968	218,459	207,552	406,778	293,061
Sugar	322,239	401,050	225,896	276,160	208,981
Barley & Rye	57,276	103,772	30,402	53,556	160,309
Maize	323,922	247,535	112,157	137,948	151,488
Soybean	0	0	53,381	98,010	128,299
Soybean Meal	216,837	140,517	110,143	77,819	115,963
Total Amount of Import		----	-----	12,682,652	14,346,866

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

The trend of the fluctuation of the unit prices of products is shown below.

(Unit: Price in Thousand US\$)					
Item	1996	1997	1998	1999	2000
Wheat	268.75	186.43	149.89	130.17	131.67
Rice	518.93	385.23	325.74	318.89	290.54
Soybean oil	615.03	596.07	723.34	489.66	367.66
Sugar	390.89	337.14	258.99	207.04	226.49
Barley & Rye	181.89	171.46	146.56	126.46	152.71
Maize Seed	224.06	163.93	139.15	136.98	123.32
Soybean	0.00	0.00	277.30	248.77	257.61
Soybean Meal	318.85	359.46	219.62	178.82	206.97

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)

### A1.1.3 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.

#### (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.

#### (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 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.

The development policy of the agriculture sector is compiled in Chapter 13 with the water sector, and described in articles 106 to 108. The outline of the agricultural development policy is mentioned below.

(1) Priority Development Projects for Investment (Article 106)

- Water resource, soil, irrigation/drainage network, small water scheme, restoration of *qanats* and spring
- Animal husbandry, poultry, veterinary and fisheries, natural resources (forest, pasture and desert), watershed management, silkworm harvesting, cultivation and gardening.
- Increment of investment for the agriculture sector by the Agriculture Bank and other non-governmental funds
- To allocate more than 25% of the country's banking system to the water and agricultural sector
- To give priority to the provision of the budget fund for water and agricultural sector
- To enhance employment and to economize foreign exchange by importing oil seed oil cake instead of vegetable oil.
- To create crop pattern in different regions for the water resource and efficient water use through allocating water to products with higher economic return and with less water requirement
- The Ministry of Energy is required to perform, to develop and to equip a survey network, to establish and develop networks to survey of water pollution, to strengthen the local water market, to establish and develop networks for measuring water consumption in the agriculture sector, to strengthen the legal basis of water commensurate with the management and technological changes, and to lay down necessary foundation for strengthening local water management.
- To prepare conditions and criteria of gratuitous assistance and payment of interest subsidy and banking charge for the execution of the projects.

(2) Economizing and Optimal Utilization of Water for Agriculture (Article 107)

To establish efficient water utilization of stream water, irrigation networks, pumping station and deep and semi-deep wells through forming of water users organization.

To prepare and issue water deed documents to the water title holders and proprietors

(3) Optimum Utilization of Land (Article 108)

To utilize the skilled force and entrepreneurs in the water and agricultural sector, government is authorized to provide these people with large parcels of land (maximum 5 years)

To utilize the natural resource space for adequate land use

(4) Priority Issues to Achieve Maximum Growth of Water and Agricultural Sector (Article 109)

- Provision and improving management of agricultural machinery and equipment
- Enhancement of the irrigation, efficiency of water utilization and expansion of irrigated farming through constructions of small dams, large reservoirs, diversion facilities of rivers and installation of pumping stations
- To integrate management of domestic animal and the pasture, and reorganize settlement of the tribal communities
- To increase feed production (specially maize, soybean and fish meal)
- To support the establishment of agricultural production cooperatives and formation of entities for water, soil and natural resources utilization
- To enhance the quantities and quality of agricultural and aquatic products aiming at provision of food securities and development of export
- To organize the settlement pattern of the nomadic tribes from economic, subsistence and occupational standpoints

#### **A1.1.4 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).

However, the success of Iranian agriculture depends on to overcome the restriction on irrigation water and salinization / alkalization of the soils.

1) Vegetations in 4 types of climate

The climate of Iran is classified in 4 types, namely, the continental climate of the plateau areas of the Elbourz Mountains and Zagros Mountains, the Mediterranean climate in the coast region of the Caspian Sea, the desert climate in the east region of the country and the subtropical climate in the coast region of the Persian Gulf, respectively.

a. The plateau areas of the Elbourz Mountains and the Zagros Mountains

In the plateau area, there are many fertile basins as we go down the mountains, and the characteristics of climate is dry and cold in winter and hot in summer. In the plateau area of the Zagros Mountains, there are forests of oak, walnut, almond and pistachio in the higher lands. On the other hand, in basins, there are orchards of figs and pomegranate, and wheat and barley are cultivated. In the Azerbaijan region, in the end of western part of the plateau areas of the Elbourz Mountains, wheat, cotton, paddy rice and tobacco are produced, and in the basins of Khorassan region, in the end of eastern part of the plateau areas of the Elbourz Mountains,

wheat, barley, paddy rice and cotton are actively produced.

b. The coastal region of the Caspian Sea

The climate of the coastal region of the Caspian Sea is mild and the precipitation is relatively high. In this region, woodlands are covered with broadleaf trees. Paddy rice, cotton, tobacco, oilseeds, vegetables, potatoes, forage crops and citrus fruits are cultivated.

c. The coastal region of the Persian Gulf

The climate of the region is oppressively hot and humid under the influence of warm sea of the gulf and strong sunlight. The subtropical vegetation grows in the region.

d. The desert region in the eastern part of the country

The two vast deserts, which lie from the central part to the eastern part of the Iran have an intense heat and a long period of dry season, and the land is barren due to salinity of soil (JETRO-Teheran).

2) Agriculture Population

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

Share of Agricultural Population in Total Working Population for Each Province  
(Census, 1996)

No.	Province	Population engaged in agriculture			Share of agricultural population (%)		
		Sum	Women	Men	Sum	Women	Men
	Total	3,318,547	294,157	3,024,390	22.2	16.7	22.9
1	Ardebil	96,638	7,799	88,839	35.9	28.1	36.8
2	Bushehr	23,165	986	22,179	14.8	8.5	15.3
3	Chaharma-o Bakhtiari	40,557	736	39,821	22.0	1.9	27.2
4	East Azerbaijan	233,962	17,515	216,447	25.6	14.6	27.2
5	Fars	211,381	8,971	202,410	23.7	8.0	26.0
6	Ghazvin	62,077	3,732	58,345	27.5	20.3	28.2
7	Gilan	246,005	82,829	163,176	39.0	60.5	33.0
<b>8</b>	<b>Golestan</b>	<b>158,671</b>	<b>27,374</b>	<b>131,297</b>	<b>45.6</b>	<b>45.9</b>	<b>45.5</b>
9	Hamedan	130,716	3,173	127,543	32.1	8.3	34.6
10	Hormozgan	39,785	2,056	37,729	19.0	13.1	19.5
11	Ilam	27,659	1,528	26,131	29.7	16.5	31.2
12	Isfahan	150,500	2,545	147,955	14.5	1.7	16.7
13	Jiroft & Kahnouji District	46,940	1,327	45,613	58.6	21.8	61.6
14	Kerman	87,916	4,975	82,941	23.5	10.4	25.5
15	Kermanshah	102,962	11,229	91,733	26.5	28.8	26.2
16	Khorassan	457,278	46,672	410,606	29.6	19.9	31.3
17	Khuzestan	140,238	9,184	131,054	19.2	16.7	19.4
18	Kohgiluyeh va Boyer-Ahmad	28,266	1,425	26,841	28.8	18.1	29.7
19	Kurdistan	104,637	3,105	101,532	32.0	8.7	34.8
20	Lorestan	92,534	2,480	90,054	30.0	11.5	31.4
21	Markazi	82,777	1,196	81,581	26.4	2.9	30.0
22	Mazandaran	201,122	23,950	177,172	31.1	31.4	31.1
23	Qom	16,032	289	15,743	8.2	1.5	9.0

No.	Province	Population engaged in agriculture			Share of agricultural population (%)		
		Sum	Women	Men	Sum	Women	Men
24	Semnan	27,829	1,938	25,891	21.2	13.5	22.2
25	Sistan va Baluchestan	99,450	1,978	97,472	31.5	9.5	33.1
26	Teheran	81,676	2,396	79,280	2.7	0.9	2.8
27	West Azerbaijan	214,385	19,502	194,883	33.6	29.3	34.1
28	Yazd	30,563	2,254	28,309	14.3	5.1	16.6
29	Zanjan	82,826	1,013	81,813	38.0	4.7	41.6

Source ; Iranian National Census 1375 (1996/7)

### 3) Agricultural Land Use

In 2000 (Iranian year 1379), 12.34 million ha of agricultural land, equal to 7.49% of the total area of the Islamic Republic of Iran, was cultivated. And 10.27 million ha, namely 83.23% of total agricultural land under cultivation was allocated to annual agricultural products, and the rest (16.77%) to permanent ones respectively.

In the same year, 2.09 million ha of land was allocated to gardens, out of which 94.54% belonged to fertile trees (fruit gardens) and 5.46% to trees with industrial usage (infertile trees). As for permanent products, saplings and fertile trees accounted for 18.48% and 81.52% of the total lands under garden respectively.

The highest rate of utilization of agricultural lands (ratio of land under cultivation of each province to the total area of the same province) belongs to Hamedan province with the share of 29.9%.

### 4) Agricultural Products

#### a. Annual Crops

The area of the total cultivated land for annual crops in Iran is 10,267,568 ha, with a share of about 83% of the total cultivated land. In 2000, 53.97% and 46.03% of the total cultivated land of the country was allocated to irrigated land and rain-fed cultivation land respectively.

The greatest part of the country's total lands under cultivation in 2000 with share of 9.46% belongs to Khorassan province. East Azerbaijan and Fars provinces with shares of 7.16% and 6.75% ranked second and third respectively. These three provinces accounted for 23.37% of the total country's land under cultivation for annual agricultural products.

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

The data in these tables are summarized based on crops with a total cultivated area of above 1%. In the irrigated farming of the country, main crops are wheat, barley, paddy rice, alfalfa, cotton and maize, and the percentage of cultivated area of these crops to the total area are about 39% of wheat, 10% of barley and paddy rice, 9% of alfalfa, 4% of cotton and 3% of maize, respectively. On the other hand, in rain-fed farming of the country, main crops are wheat, barley, pea and lentil, and the percentage of cultivated area of these crops to the total area are about 62% of wheat, 14% of barley, 13% of pea and 4% of lentil, respectively.

In regard to yield, there are significant differences between the irrigated farming and the rain-fed farming. The effect of irrigation on yield is very high. At a glance, there are no differences of yield between both farming in some crops, such as maize, bean, tobacco, sugar cane, etc. However, the cultivated areas of these crops are small. It is considered that these crops are cultivated in good conditions, for example with enough precipitation for crops growth.

In regard to yield, there are significant differences between the irrigated farming and the rain-fed farming, in general. The effect of irrigation on yield is very high, except for tobacco and onion, which do not have difference in yields under both farming conditions.

#### b. Permanent agricultural products

The area of the total cultivated land for permanent products in Iran is 2,090,293 ha, representing about 17% of the total cultivated land.

In 2000, 70.6% and 17.0% of the total cultivated lands with permanent products in the country was allocated to irrigated land and rain-fed cultivation land respectively.

Kerman province is the first with 20.9% the total country's garden ranked first. Fars (11.85%), Khorassan (11.28%) and Mazandaran (5.27%) provinces ranked second to fourth respectively. These four provinces accounted for almost half of the lands under cultivation with these permanent agricultural products, producing 44.13% of the total national permanent agricultural crops.

The cultivated area, production and yield of permanent products of the country are shown in the following Table (Table 2.1.1). The data in these tables are summarized based on trees with a total cultivated area of above 1%.

Concerning to the 2,090,293 ha of gardens in the country, 94.6% is for fruit gardens and the other 5.4% is allocated to infertile trees with industrial usage. About 19% of the total irrigated lands of gardens in 2000 (about 105,000 ha of sapling and 275,000 ha of fertile trees) was allocated to the pistachio cultivation. Grapes, dates and apple summed 14%, 12%, 10% of the irrigated gardens, positioned at the second to fourth ranks, respectively. On the other hand, in rain-fed gardens, grapes, almond, orange and fig summed 22%, 16%, 14% and 12%, ranking the first to fourth, respectively.

12.29 million tons of garden products in 2000, 52% has been produced in five provinces, namely, Fars (13.9%), Mazandaran (12.0%), kerman (10.3%), Khorassan (7.9%), and West Azerbaijan (7.55%). In the meantime, 53.5% of total lands of gardens was located in these five provinces.

Production of Permanent Agricultural Products in the Country (1999-2000)

Trees	Area (ha)						Production		Yield	
	Sapling Total	Fertile trees				Total ha	Irrigated ton	Rain-fed ton	Irrigated kg/ha	Rain-fed kg/ha
		Irrigated ha	%	Rain-fed ha	%					
Apple	21,381	146,580	10	757	0	147,337	2,136,488	5,168	14,576	6,827
Pear	1,395	16,481	1	455	0	16,936	183,248	2,664	11,119	5,855
Apricot	4,577	28,959	2	66	0	29,025	262,031	402	9,048	6,091
Cherry	4,169	24,630	2	615	0	25,245	214,179	2,135	8,696	3,472
Peach	5,662	17,737	1	557	0	18,294	220,663	6,396	12,441	11,483
Grape	28,416	199,218	14	64,474	22	263,692	2,307,557	197,605	11,583	3,065
Almond	39,299	49,944	4	46,516	16	96,460	75,326	14,312	1,508	308
Walnut	39,603	51,736	4	2,654	1	54,390	133,362	7,243	2,578	2,729
Pistachio	104,765	274,728	19	0	0	274,728	303,957	0	1,106	0
Orange	8,160	79,319	6	39,541	14	118,860	1,207,629	635,934	15,225	16,083
Tangerine	2,255	34,400	2	8,036	3	42,436	561,387	115,097	16,320	14,323
Lime	4,740	27,677	2	73	0	27,750	404,488	938	14,615	12,849
Sweet lemon	1,521	24,766	2	755	0	25,521	617,012	10,043	24,914	13,302
Dates	35,635	169,004	12	15,721	5	184,725	830,579	38,996	4,915	2,481
Fig	4,764	5,082	0	34,764	12	39,846	35,841	42,323	7,053	1,217
Pomegranate	5,388	49,074	3	1,040	0	50,114	557,295	12,281	11,356	11,809
Tea plant	1,050	2,938	0	28,120	10	31,058	39,894	182,759	13,578	6,499
Infertile trees	21,642	64,976	5	26,381	9	91,357	0	0	0	0
Mulberry (for silk worm)	848	2,396	0	12,801	4	15,197	15,672	134,287	6,541	10,490
Saffron	20	44,241	3	0	0	44,241	127	0	3	0
Others	51,080	98,965	7	7,746	3	106,711	706,379	64,821		
Total	386,370	1,412,851	100	291,072	100	1,703,923	10,813,114	1,473,404		

Source: Agricultural Statistics Yearbook 1998~1999

In regard to yield, there are significant differences between the irrigated farming and the rain-fed farming in the country, except for some trees, such as walnut, orange, tangerine, pomegranate. The effect of irrigation on yield is very high. At a glance, there are no differences of yield between both farming in some trees, such as peach, lime. However, the cultivated areas of these trees are small. It is considered that these trees are cultivated in good conditions, for example with enough precipitation for the trees growth.

##### 5) Self-sufficiency of agricultural products

Self-sufficiency rates of the main crops in Iran, from 1992 to 1999, are shown in the following Table. The crops with over 100% rate of self-sufficiency have been exported. The rates of wheat and barley were 58.5% and 69.7% in 1999. The self-sufficiency rate of wheat was 82.5% in 1994, and the rate has gradually decreased since 1995. It is necessary to recover the self-sufficiency rate of wheat that is the staple food in Iran.



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

Year	Wheat	Rice	Pulse	Potatoe	Onion
1992	80.6	71.5	107.2	100.3	105.8
1993	81.5	66.4	121.3	100.9	101.5
1994	82.5	82.4	106.1	103.4	109.5
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.

## (2) Agricultural Research, Education and Extension

The Agricultural Research, Education and Extension Organization (AREEO) of the Ministry of Agriculture (Fig. A-6.1.1) is in-charge of the overall administration, management and coordination of the agricultural research, extension and education in Iran and is directed by the Board of Trustees headed by the Minister of Agriculture.

### 1) Research

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. There are 13 national research institutes as mentioned below:

- |   |           |
|---|-----------|
| 1) Soil and water research institute              | Tehran    |
| 2) Agricultural engineering research institute    | Karaj     |
| 3) Plant pests and diseases research institute    | Teheran   |
| 4) Seed and plant improvement institute           | Karaj     |
| 5) Date palm & tropical fruits research institute | Ahwaz     |
| 6) Citrus research institute                      | Ramsar    |
| 7) Pistachio research institute                   | Rafsanjan |
| 8) Rice research institute                        | Rasht     |
| 9) Dryland agricultural research institute        | Maragheh  |
| 10) Sugar beet research institute                 | Karaj     |
| 11) Cotton research institute                     | Gorgan    |
| 12) Agricultural biotechnology research institute | Karaj     |
| 13) Salinity research institute                   | Yazd      |

During the Second Five-year Socio-economic Development Plan of the Government, which ended in March 2000, much attention was paid to restructuring the Organization, capacity building and perfecting methodologies. During this period more than 4000 research projects were executed by AREEO scientists, resulting in the release of 60 new cultivars of different crops and over 600 other research findings. AREEO's activities are an indispensable component in agricultural planning in the Third Socio-economic Development Plan of the Government (2000-2004). The Organization would concentrate its future activities in this plan on basic commodities.

As the results of the Second Five-year Socio-economic Development Plan, large numbers of improved varieties in many crop plants have been released, increasing the production by 53% from 42.4 million tons in 1991 to 65 million tons in 1998 and yet decreasing pesticide use by 55% in the same period from 50,202 tons to 22,574 tons.

## 2) Education

In 1993, three organizations, namely research, education and extension, were merged into one organization under the name of AREEO, and one of deputies of AREEO is Deputy of Education and Manpower Development. The objective of the Education and Manpower Development are as follows:

Assessment planning and coordination of agricultural education in all of the agricultural training centers in the country.

The above mentioned objective is achieved through the 4 following bureaus:

- Human resources optimization bureau
- Staff training bureau
- Agricultural vocational and official training bureau
- Bureau of educational technology and services

During the past four years 100 books, 345 booklets, 40 posters have been published. Activities of the education and manpower development department are as follows:

- Training of managers: A group of managers are annually trained in order to improve their technical skills in farm management.
- Reduction of pesticides and efficient use of chemical fertilizer: The objective of this program is to improve the knowledge of farmers and agricultural authorities in IPM (Integrated Pest Management).
- Staff modular training program of the Ministry of Agriculture: In order to increase the efficiency of the staff in Ministry of Agriculture, a program is elaborated in four fields, namely common knowledge, educational management, occupational education, and special education, respectively.

At present, the education and manpower development department has 32 agricultural training centers and one agricultural college.

## 3) Extension

The Extension Deputy of AREEO is responsible for extension with the following objectives and policies.

- Enhancing coordination among extension, research and education of AREEO.
- Emphasis on rural women and youth activities.
- Study and survey on extension methods to fit the cultural, social and economic conditions of every part of the country.
- Promotion of economic measures to raise productivity.
- Promotion to reduce the use of chemicals to protect the environment and adoption of integrated pest management including biological control.
- Stressing the promotion of land consolidation, farm restoration, mechanization of farming. Reduction of losses, reduced production costs and proper patterns of nutrition.
- Cooperation with universities and research centers in various fields for implementation of joint extension-research projects, extension studies, long and short term training for extension staff, etc.

The agricultural extension carried out its duties through:

- Bureau of extension methodology development.
- Bureau of audio-visual programs and technical publications.
- Bureau of rural women activities development.
- Bureau of coordination and technology transfer.

At the provincial level, there is an agricultural organization in each province of the country. In these organizations, agricultural education and extension management carries out the extension duties under the supervision of the provincial deputy of research, education and extension (AREEO Highlight 1997-1999).

### A1.1.5 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
<b>Cattle and Bovine Meat</b>				
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
<b>Sheep and Goats</b>				
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
<b>Total meat</b>				
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 Jihad-e-Agriculture

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.

#### A1.1.6 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 food processing plants operating in Iran can be classified into three categories:

Plants operating under acceptable standards and practices. They are owned and operated by classified entrepreneurs, and their products comply with the national and international standards and requirements. Since most of these plants have been operating for more than 15 years, some are in need of renovation and refurbishment.

Plants which can be helped to renovate and urged to upgrade the quality of their products to comply with international requirements and standards.

Small scale plants and workshops.

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

Items		In Operation	Under Construction
	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

The following inferences shall be made from the Table.

Owing to the shortage of liquidity, the age of some plants, inadequate local raw material supplies, and in some cases a lack of incentive for the owner to enter in competitive international markets, many plants utilize only 50-60% of their nominal capacities.

Many plants limit themselves to process only one product, which means that they operate for three months at the most even though this constraint can be easily overcome.

A number of plants are located at a long distance from agricultural areas. It raises the cost of transport, creates uncertainties concerning the supply of raw crops, and above all increases post-harvest losses.

The Government, aware of the severity of post-harvest losses, is taking appreciable measures to prevent them by promoting the development of the food processing industry.

To develop the necessary export markets, significant measures will be necessary to improve the quality of Iran's processed foods. Packing techniques must 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, and the Codex Alimentarius in particular.

The numerous concrete recommendations on the packing and standardizations of food made in the 8<sup>th</sup> and 9<sup>th</sup> National Food Congress (1996 and 1997) both of which held in Tehran, should be followed up and implemented (Report of Keshavarz Special Issue 2000).

## **A1.2 General Situation of the Golestan Province**

### **A1.2.1 Social Conditions**

Golestan Province was separated from Mazandaran Province in 1998. Therefore, some data of Golestan Province are not available. The administration of the Province is formed with 11 districts (*Shahrestan*), 18 cities and 50 villages (*Dehestan*). Each district is divided into 2 sub-districts (*Bakhsh*) except Kordkuy. The total area of Golestan Province is 20,893km<sup>2</sup> and the population in 2000 was assumed about 1.6 million persons (MPO).

Sub-Districts, Cities and Villages at the end of 2001

Province and Districts ( <i>Ostan and Shahrestan</i> )	Number of Sub-Districts ( <i>Bakhshes</i> )	Number of Cities	Number of Villages ( <i>Dehestans</i> )
<b>Golestan (Total)</b>	<b>21</b>	<b>18</b>	<b>50</b>
Azadshahr	2	1	4
Aq Qala	2	1	5
Bandar-e-Gaz	2	2	4
Bandar-e-Torkman	2	2	3
Ramyar	2	3	4
Aliabad	2	1	4
Kordkuy	1	1	3
Kalaleh	2	2	6
Gorgan	2	1	5
Gonbad-e-Kavus	2	2	6
Minudasht	2	2	6

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

41.3% of the population is living in the 4 districts (Gorgan, Aq Qala, Bandar-e-Torkman and Kordkuy) of the Study Area.

(1) Population

The population is centralized in Gorgan, the provincial capital, and Gonbad districts showing 40% of the total population of the Province. 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.

Population by Districts/*Shahrestan*

Districts/ <i>Shahrestan</i>	1986	1996	2000	2001	2006
Bandar Gaz	41,864	45,705	48,041	48,504	50,856
Torkman	92,522	111,392	119,754	121,933	133,321
Ali Abad	82,715	117,287	134,461	139,129	164,863
Kordkuy	61,003	67,051	69,563	70,203	73,445
Gorgan	260,498	323,106	351,436	358,877	398,143
Aq Qala	84,950	98,664	104,589	106,118	114,018
Gonbad	206,137	250,617	270,463	275,649	302,835
Azad Shahr	62,006	84,956	96,089	99,088	115,441
Ramidin	62,971	75,949	81,707	83,209	91,059
Minoodacht	82,694	120,681	139,930	145,201	174,529
Kalaleh	107,673	130,880	141,233	143,938	158,118
Total	1,145,033	1,426,288	1,557,266	1,591,849	1,776,628
Urban	422,193	588,985	669,676	689,359	799,104
Rural	722,840	837,303	887,590	902,490	977,524

Note: Figures of 1986 and 1996 are National Census, others are estimated by MPO

Source: MPO of Golestan Province, Statistics of Golestan 2001

The distribution of the population in rural area decreased by 63% in 1986 to 58% in 1996, and the migration of population from rural area to urban area still continues. 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

### (2) Education and Literacy Rate

In comparison with the literacy rate of Tehran, Mazandaran Province has a low literacy rate both in male and female population.

#### Total Population and Literate Population Aged Six and Over Unit (1000)

Ostan / Province	Total population			Literate population					
	Both sexes	Male	Female	Both sexes	%	Male	%	Female	%
Teheran	9,996	5,142	4,854	8,801	88	4,677	91	4,123	47
Mazandaran	3,538	1,757	1,781	2,812	79	1,484	84	1,328	47

The increment percentage of the number of the students is less than growth rate of the population as shown in the following table.

#### Number of Students

	1996	1997	1998	1999	2000
Primary school	224,034	202,070	217,008	209,427	201,445
Junior high school	121,981	124,284	124,100	121,857	118,128
Senior high school	82,511	85,049	92,641	100,761	102,369
Total	428,526	411,403	433,749	432,045	421,942

Source: Province Educational Organization, Statistics of Golestan 2001

The number of students and teachers in 2000 are shown in the following table.

#### Number of Students and Teachers as of 2001

Category	Student			Teacher	School	Classes
	Total	Male	Female			
Primary School	201,445	1,050,593	96,352	8,447	1,469	8,026
Lower Secondary School	117,057	65,703	51,354	4,860	710	3,889
Upper Secondary School	85,960	43,882	42,078	3,308	317	2,813
Adult Evening Lower Sec. School	769	443	326		10	28
Adult Evening Upper Sec. School	4,933	3,022	1,917		36	187
Evening Pre-University Students	2,816	1,572	1,244		21	99

Source : Iran Statistical Year Book 1379, Statistical Center of Iran, 2001

The number of the junior and senior high school students are not equal to the above provincial statistics; however, the above figures include the evening school students and special children.

### (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.

### A1.2.2 Tendencies of the Economy

#### (1) General Conditions of the 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 with the low value, possesses a larger growth.

#### (2) Outline of Industry and Mining

There are 210 registered establishments in 1999 employing about 6,900 persons. The outline of the industry and mining sector is as follows:

Outline of Industry and Mining				Unit: Million rials		
	1997		1998		1999	
Category	Industry	Mining	Industry	Mining	Industry	Mining
No. of Establishments	197	36	198	35	164	46
No. of employees	7,626	1,661	7,570	1,664	5,426	1,590
Products Value*	409,500	55,654	715,000	40,802	823,000	43,141
Value of Investment*	23,491	2,280	35,086	3,572	41,457	5,120

Source: Iran Statistical Center, Statistics of Golestan 2001

#### (3) State Financial Balance

The main source of the province revenue is the central government. 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.

#### Current Expenditures of Executive Bodies in Ostan from General Revenue Unit: Million rials

	1998	1999
Country	15,011,211	17,850,738
Golestan	363,064	432,910
% of country	2.42	2.43

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



Income of the Province (Unit: Million rials)

Item	1998	1999		2000		2001
	Actual	Approved	Actual	Approved	Actual	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.

### A1.2.3 Province Agricultural Development Program

Based on the Central Government's Third Socio-Economic and Cultural Development Plan (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		% of 1998
	Country	Golestan	Country	Golestan	
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 the following

- 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.

In this development program, the agriculture and natural resources sector consists of

development of soil and water, reservoir, forest and pasture, water shed management, agronomy, horticulture, animal husbandry and poultry, fishery, and extension. Each program has its target to be accomplished during five years. For example, the agricultural products except wheat is planned from 974 thousand ton in 1999 of base year to 1,234 thousand ton in 2004 of target year with an increment annual rate of 4.76%. Besides, the agricultural and natural resources sector, the water resources are also programmed for the construction of small dams and pumping stations, to conduct water for small cities and industries and river management.

The water resource sector and the agriculture and natural resources sector in the Golestan Province Five Years Development Program are listed in the following tables.

Program of the 3rd Five Year Development Plan, Water Resources

	Items	Unit	Base year 1999	Year 2004	Growth rate
1	Small plan for water supply and distribution	MCM	60.00	99.50	0.40
1-1	Construction of small dams	MCM	156.00	176.00	0.76
1-2	Construction of small pump station	MCM	15.00	24.00	9.86
2	To conduct water for small cities and industries	MCM	21.25	42.02	14.60
2-1	To study and implementation of water pipelines	km	110.50	170.20	8.10
2-2	To construct water tanks for cities	MCM	18.34	31.11	11.10
3	River management	MCM		102,632.00	
3-1	Management of local rivers outside of city zone	m		102,632.00	
3-2	Volume of exploitation of underground water	MCM			
3-3	Usage of water for agriculture	MCM			
3-4	Increasing of exploitation from existing potentials	MCM			

Source; Management and Planning Organization of Golestan Province, 2001

Development Program for Agriculture and Natural Resources

	Items	Unit ha	Base year 1999	Year 2004	Growth rate
1	Program for Development of Soil and Water Reservoir				
1-1	Land consolidation	ha	500.00	5,015.00	11.71
1-2	Development modern irrigation system	km	1,804.00	11,457.50	8.94
1-3	Farm roads	km	25.00	436.00	15.42
1-4	Restore and renovation of Ghanats	km	10.00	84.00	8.44
1-5	Construction & renovation of irrigation canals	km	5.17	191.60	20.39
1-6	Study of soil & water plans	ha		16,300.00	
1-7	Plan for water & soil facilities	ha	8,000.00	56,000.00	9.51
1-8	Traditional farm ponds	km		100.00	
2	Forest and Pasture				
2-1	Forest Biological operation	ha	13,967.00	88,479.00	8.93
	Pasture	ha	6,000.00	53,614.00	10.99
2-2	Optimal management of animal feeding in pasture	ha	21,000.00	89,000.00	6.69
2-3	Restore of forests				
3	Water shed management				
3-1	Water shed and flood control	ha	45,464.00	358,330.00	10.22
4	Agronomy				
4-1	Pest and disease control	ha	855,000.00	950,000.00	2.13
4-2	Mechanization	ha	18,000.00	128,000.00	48.04
4-3	Seed production	ton	29,800.00	38,950.00	5.50
4-4	Agricultural production	1,000ton	974.00	1,234.00	4.85
4-5	Agricultural area	ha	179,100.00	226,000.00	4.76
4-5-1	Wheat production (irrigated)	1,000ton	457.21	454.00	1.10
4-5-2	Wheat production (rain-fed)	1,000ton	401.76	452.70	2.42
5	Horticulture				
5-1	Pest and disease control	ha	3,000.00	13,007.00	34.09
5-2	Mechanization	ha	89.00	1,500.00	24.58
5-3	Production of sapling	1,000ton	89.00	11,250.00	2.39

Development Program for Agriculture and Natural Resources

	Items	Unit ha	Base year 1999	Year 2004	Growth rate
5-4	Horticulture production	1,000ton	89.00	101.00	2.54
6	Animal Husbandry & Poultry				
6-1	Improvement of animal husbandry	1,000 heads	22.31	91.98	32.75
6-2	Husbandry services	1,000 heads	78.43	112.75	7.53
6-3	Husbandry production	1,000 ton			
6-3-1	Fish & shrimp production	1,000 ton			
6-3-2	Meat production	1,000 ton	24.83	29.40	2.44
6-3-3	Poultry meat production	1,000 ton	28.40	67.46	18.89
6-3-4	Egg	1,000 ton	21.50	28.40	
6-3-5	Honey	1,000 ton	0.13	1.88	
6-3-6	Animal fiber	1,000 ton	3.28	3.80	
6-4	Improvement of converting coefficient of forage to meat	kg	5.33	4.80	
6-5	Improvement of converting coefficient of forage to milk	kg	1.20	1.00	
6-6	Improvement of converting coefficient of forage to poultry	kg	2.46	2.20	
6-7	Seed production	kg	2.90	2.78	
7	Fishery				
7-1	Develop. of infrastructure and breeding sites for fish and shrimp	ha	1,656.30	2,366.20	15.24
7-2	Potential of fish breeding	million	2.60	17.20	45.92
7-3	Shrimp and fish breeding	ton	3,097.50	8,495.00	22.20
8	Training and extension				
8-1	Extension	case		20,000.00	
8-2	Case study for of methods	case		733.00	7.11
9	Development of Veterinary				
9-1	Control of animal contagious disease	1,000	9,458.00	15,977.00	11.06
9-2	Construction laboratory and clinics for pests control	m2	13,240.00	2,600.00	27.78
9-3	Control of raw animal products in ports and fishery ports	1,000	345.00	593.00	11.44
9-4	To consider and control animal parasites disease	1,000	3,501.00	6,373.00	12.72

Source; Management and Planning Organization of Golestan Province, 2001

#### A1.2.4 Agricultural Conditions in the Golestan Province

##### (1) Vegetation

Agriculture in the Province is mostly the agriculture in the climate of the plateau areas of the Elburz Mountains, including partly in the climate of the coastal region of the Caspian Sea.

##### (2) Employment in the Agriculture Sector

The population engaged in agriculture is about 158,671 persons, which consist of 27,373 of women and 131,298 of men. 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. These shares of agricultural population in total, in women and in men are very high in Golestan Province, and in all cases are ranked second between the 29 provinces of the country.

##### (3) Agricultural Land Use

In the Province, 630,718 ha of agricultural area was cultivated in 2000. The percentage of the land used for agriculture in the Golestan Province is 28.67%, of which was ranked second in the country, and the ratio of the land under cultivation in the Province to the total area of the country was 5.11%. The total irrigated land and rain-fed land were 282,400 ha (44.8%) and 348,318 ha (55.2%), respectively.

##### (4) Agricultural Products

###### 1) Annual Crops

The area of the total cultivated land for annual crops is 611,015 ha, of which the irrigated land and the rain-fed land were 269,702 ha (44.1%) and 341,313 ha (55.9%) respectively. The share

of the annual crops for the total cultivated land is about 96.9%,

The Golestan Province accounted for 5.95% of the total country's land under cultivation for annual crops. The Golestan province has 4.87% (fourth) of the irrigated agricultural lands, and 7.22% (eighth) of the rain-fed agricultural lands. 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, and the percentage of cultivated area of these crops to the total area are about 42% of wheat, 25% of cotton, 16% of paddy rice, 8% of oilseeds, 3% of potatoes and 1% of barley, respectively. On the other hand, the main crops grown under rain-fed farming are wheat, barley, oilseeds, cotton and water melon. The percentage of cultivated area of these crops to the total area are about 58% of wheat, 21% of barley, 8% of oilseeds and 1% of water melon, respectively.

## 2) Permanent Crops

The percentage of the Golestan province in the total country's garden was only 0.94%, and the area of gardens in Golestan province was ranked 25th of 29 provinces in the country. 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 land was 1,974 ha (10%), and the rest of 58% was for the sapling.

In Golestan province, about 24% of the total irrigated lands of gardens in 2000, about 163 ha of sapling and 1,516 ha of fertile trees, was allocated to orange cultivation. In irrigated gardens, peach, plum (new variety), tangerine, olive accounting for 18%, 10%, 10%, 6% ranked second to fourth, respectively. On the other hand, in rain-fed gardens, plum (new variety), walnut, peach accounting for 35%, 18%, 13% ranked first to third, respectively.

In Golestan Province, there are significant differences between yield of the irrigated and rain-fed farming in general. The effect of irrigation on yield is very high, except for olive, walnut, pomegranate and greengage, and the yields are not different in both conditions of farming.

Production of Permanent Crops in Golestan Province (1999-2000)

Trees	Land under cultivation (ha)						Production		Yield	
	Sapling			Fertile trees			(ton)		kg/ha	
	Irrigated	Rain-fed	Total	Irrigated	Rain-fed	Total	Irrigated	Rain-fed	Irrigated	Rain-fed
Apple	11.6	13.0	24.6	8.0	2.5	10.5	56.2	8.0	7,025.0	3,200.0
Pear	5.0	0.0	5.0	11.1	1.6	12.7	89.0	5.4	8,018.0	3,375.0
Quince	2.0	0.0	2.0	9.6	0.0	9.6	33.9	0.0	3,531.0	0.0
Apricot	0.0	0.0	0.0	12.0	0.0	12.0	134.0	0.0	11,167.0	0.0
Black cherry	6.6	2.0	8.6	16.6	4.2	20.8	65.6	8.4	3,952.0	2,000.0
Cherry	17.1	2.0	19.1	42.1	7.5	49.6	245.4	25.1	5,829.0	3,346.7
Greengage	8.0	0.0	8.0	27.6	51.7	79.3	193.4	313.2	7,007.2	6,058.0
Peach	235.4	0.0	235.4	1,104.9	261.0	1,365.9	16,231.3	1,535.0	14,690.3	5,881.2
Variety of peach	0.0	0.0	0.0	8.0	0.0	8.0	112.0	0.0	14,000.0	0.0
Nectarine	36.8	0.0	36.8	107.7	1.5	109.2	1,249.5	6.5	11,601.7	4,333.3
Plum	10.5	0.0	10.5	515.0	0.0	515.0	6,486.5	0.0	12,595.1	0.0
Variety of plum	90.1	0.0	90.1	647.3	684.2	1,331.5	10,498.1	5,918.6	16,218.3	8,650.4
Grape	1.1	0.0	1.1	10.0	52.5	62.5	162.0	510.5	16,200.0	9,723.8
Strawberry	100.0	0.0	100.0	402.0	0.0	402.0	2,018.0	0.0	5,019.9	0.0
Mulberry	20.6	0.0	20.6	37.1	38.1	75.2	171.8	121.9	4,630.7	3,199.5
Almond	2.0	0.0	2.0	2.0	0.0	2.0	2.4	0.0	1,200.0	0.0
Walnut	74.3	816.6	890.9	66.5	356.0	422.5	317.8	1,409.8	4,778.9	3,960.1
Hazelnut	0.0	0.0	0.0	0.0	1.5	1.5	0.0	2.1	0.0	1,400.0
Pistachio	18.5	0.0	18.5	10.0	0.0	10.0	1.0	0.0	100.0	0.0
Russian Olive	0.0	0.0	0.0	0.2	0.0	0.2	0.2	0.0	1,000.0	0.0
Medlar	0.1	0.0	0.1	0.3	0.0	0.3	1.2	0.0	4,000.0	0.0

Trees	Land under cultivation (ha)						Production		Yield	
	Sapling			Fertile trees			(ton)		kg/ha	
	Irrigated	Rain-fed	Total	Irrigated	Rain-fed	Total	Irrigated	Rain-fed	Irrigated	Rain-fed
Orange	162.8	0.0	162.8	1,515.5	0.0	1,515.5	21,733.5	0.0	14,340.8	0.0
Tangerine	42.8	0.0	42.8	637.9	0.0	637.9	9,477.0	0.0	14,856.6	0.0
Sweet lemon	1.0	0.0	1.0	2.1	0.0	2.1	42.4	0.0	20,190.5	0.0
Sour orange	30.3	0.0	30.3	36.8	1.0	37.8	523.4	8.0	14,222.8	8,000.0
Other citrus fruits	0.0	3.6	3.6	0.0	48.0	48.0	0.0	386.7	0.0	8,056.3
Fig	6.2	0.5	6.7	26.0	2.5	28.5	149.2	11.5	5,738.5	4,600.0
Pomegranate	12.6	1.0	13.6	51.8	31.5	83.3	504.2	188.0	9,733.6	5,968.3
Kiwi	0.0	0.0	0.0	23.0	0.0	23.0	733.5	0.0	31,891.3	0.0
Date plum	2.0	0.0	2.0	6.8	0.0	6.8	101.8	0.0	14,970.6	0.0
Olive	5,342.0	4,004.0	9,346.0	360.0	76.0	436.0	204.6	38.3	568.3	503.9
Infertile trees	74.0	53.5	127.5	8.3	119.9	128.2	0.0	0.0	0.0	0.0
Mulberry (for silk worm)	95.0	134.5	229.5	489.4	129.0	618.4	4,261.5	1,021.8	8,707.7	7,922.2
Flower gardens	0.0	0.5	0.5	1.5	0.0	1.5	0.9	0.0	600.0	0.0
Lotus	0.0	0.0	0.0	0.0	1.0	1.0	0.0	2.0	0.0	2,000.0
Japanese medlar	2.0	0.0	2.0	0.5	0.0	0.5	0.8	0.0	1,500.0	0.0
	10.0	0.0	10.0	80.0	103.0	183.0	760.0	902.3		
Total	6,420.4	5,031.2	11,451.6	6,277.6	1,974.2	8,251.8	76,562.1	12,423.1		

Source: Agricultural Statistics Yearbook, Ministry of Agriculture, 1379 compiled by JETRO Tehran, 2001

## (5) 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. That is to say, the rates of costs in these crops cultivations are more than that of producer's prices.

### 2) Income of main crops

The net incomes 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

In 2000/2001, the net income per ha of main crops are Rls 1.89 million /ha for paddy rice, Rls 1.04 million /ha for soybean, Rls 0.92 million /ha for irrigated wheat and maize, Rls 0.5 million /ha for rain-fed sunflower, respectively. The net income values for Cotton, rain-fed wheat and barley are negative. To increase the profits of crop cultivation at first, it is important to increase and stabilize the yields of crops.

### 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

Year	Farmers' Living Expenditure (Rls/day)		
	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. However, it is seemed that the average of living expenditure in Golestan province is very low, since the average includes those of laborers. In general, it is said that 15 ha of irrigated land is required to make a living by only agriculture. Therefore, the living expenditure of the owner farmers may be assumed US\$3,000, which is 4 times of average in the province. These problems will be surveyed in the phase II survey.

In general, farmers have various side jobs, such as handicraft, animal husbandry, weaving of carpet, etc.

#### (6) Introduction of plastic green house

In recent years, cultivation of vegetables and flowers in green houses have been tried in Golestan province. The plastic green houses have been introduced at the Mazandaran province since 1996. When a farmer constructs a plastic green house with a bank loan, the farmer must apply for the construction permission to the Golestan Agriculture Organization, to succeed the farming by the guidance of the Organization. Among over 100 cases, which have been permitted by the Organization during the last five years, only 20 green houses are working. The reason of failure of the greenhouses was that farmers could not repay the borrowed loan. The conditions of loan are repayment within 5 years and 15% of annual interest rate. Only cucumber is cultivated in the 20 plastic greenhouses due to its easy techniques of cultivation and relatively high products price. The introduction of plastic greenhouses has many merits for the farming in the Study Area as mentioned below:

1. Crops can be repetitively produced and harvested in the same field.
2. High and stable production is easy to carry out by control of growth environment.
3. Soil improvement is easy, such as applying organic matter to soil, use of low salinity soil, etc.
4. Effective use of irrigation water.
5. Production of high quality products

#### (7) 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 25<sup>th</sup> 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.

### A1.2.5 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
<b>Aq Qala</b>	<b>9.7</b>	<b>14.7</b>	<b>9.9</b>	<b>2.7</b>	<b>11.4</b>	<b>22.5</b>	<b>10.0</b>	<b>10.8</b>
<b>Gorgan</b>	<b>6.5</b>	<b>9.8</b>	<b>9.9</b>	<b>0.9</b>	<b>0.0</b>	<b>22.5</b>	<b>8.1</b>	<b>13.6</b>
<b>Bandar Torkman</b>	<b>9.2</b>	<b>2.5</b>	<b>6.9</b>	<b>4.1</b>	<b>10.7</b>	<b>6.6</b>	<b>8.1</b>	<b>8.0</b>
<b>Kordkuy</b>	<b>2.1</b>	<b>1.4</b>	<b>2.9</b>	<b>26.2</b>	<b>0.0</b>	<b>0.8</b>	<b>2.5</b>	<b>3.3</b>
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
<b>Total</b>	2,563,263	167,975	332,533	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 animal production in the whole country during 2001 was 0.737 million tons of red meat, 5.623 million tons of milk, 0.746 million tons of chicken, 0.554 million tons of eggs and 0.026 tons of honey. On the other hand, the animal 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
<b>Aq Qala</b>	12	6.6	<b>1</b>	6.8	7.0	6.8	6.5
<b>Gorgan</b>	124	22.2	<b>1</b>	19.9	13.0	22.8	19.1
<b>Bandar-e-Torkman</b>	36	7.2	<b>0</b>	0.0	6.1	6.7	0.5
<b>Kordkuy</b>	59	13.2	<b>1</b>	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

90% of sheep and cattle in Golestan province are raised by farmers. Therefore, the raising of livestock is almost carried out by traditional methods. However, cattle have been improved and the new breed, the hybrid between local animals and Holstein, are spreading with the two motives of meat and milk.

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. In Golestan province, farmers are not nomadic to raising sheep and goats.

### 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) 1,053,794	(TDN, ton) 280,237

Source: Golestan Jihad-e-Animal Husbandry Organization

Sheep is raised by the five to ten farm households in each village, and each of this household has about 100 heads of sheep. The processing industries related to animal husbandry in Golestan province is shown in the following table. The processing plants are gradually increasing. 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	Employment 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. Meat 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.

<b>Annex 2</b>	<b>Hydrology</b>
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A2.1 Climate ----- A2 - 1  
A2.2 Hydrology ----- A2 - 9  
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A2.6 Water Resources Development Study ----- A2 - 63

## ANNEX 2 HYDROLOGY

### A2.1 Climate

#### A2.1.1 Gorgan Plain

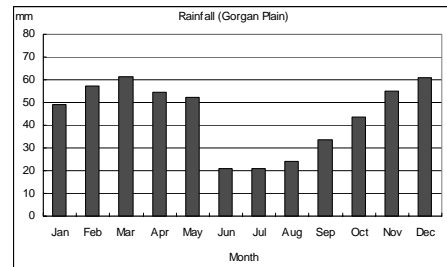
The Gorgan Plain, where the Study Area is situated, is located in the northern part of the country and eastern side of the Caspian Sea.

The climatological data in this study was collected from the measurement stations listed in the table A2.1.1. The data type and collection period are detailed in the same table A2.1.1 and the station's position is plotted in the figure A2.1.1.

The Gorgan Plain is situated in a dry to semi-wet region. The general characteristics of the plain climate is shown bellow.

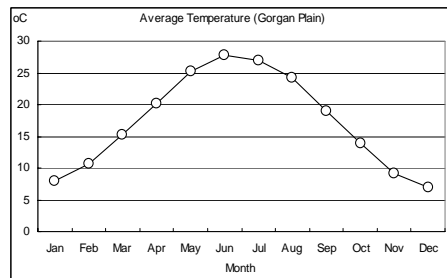
#### a) Rainfall

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. The Isohyets are shown in the figure A2.1.2.



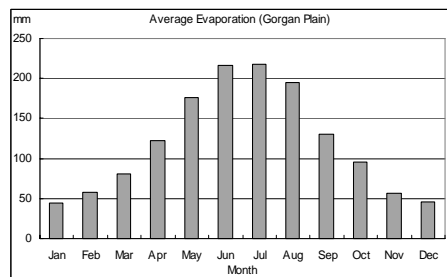
#### b) Temperature

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



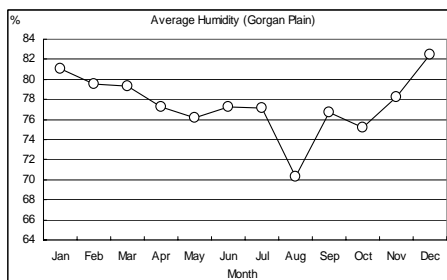
#### c) Evaporation

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



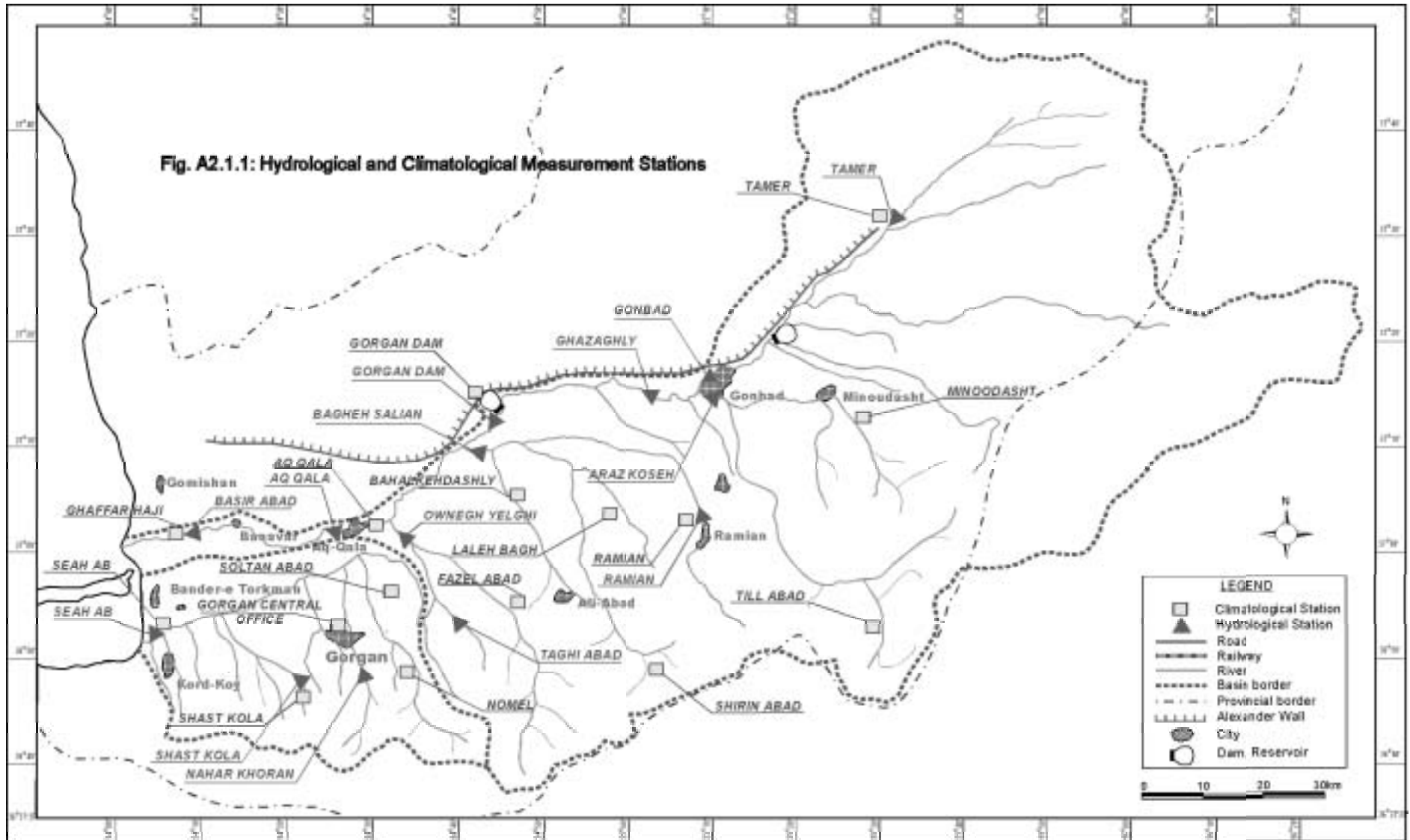
#### d) Humidity

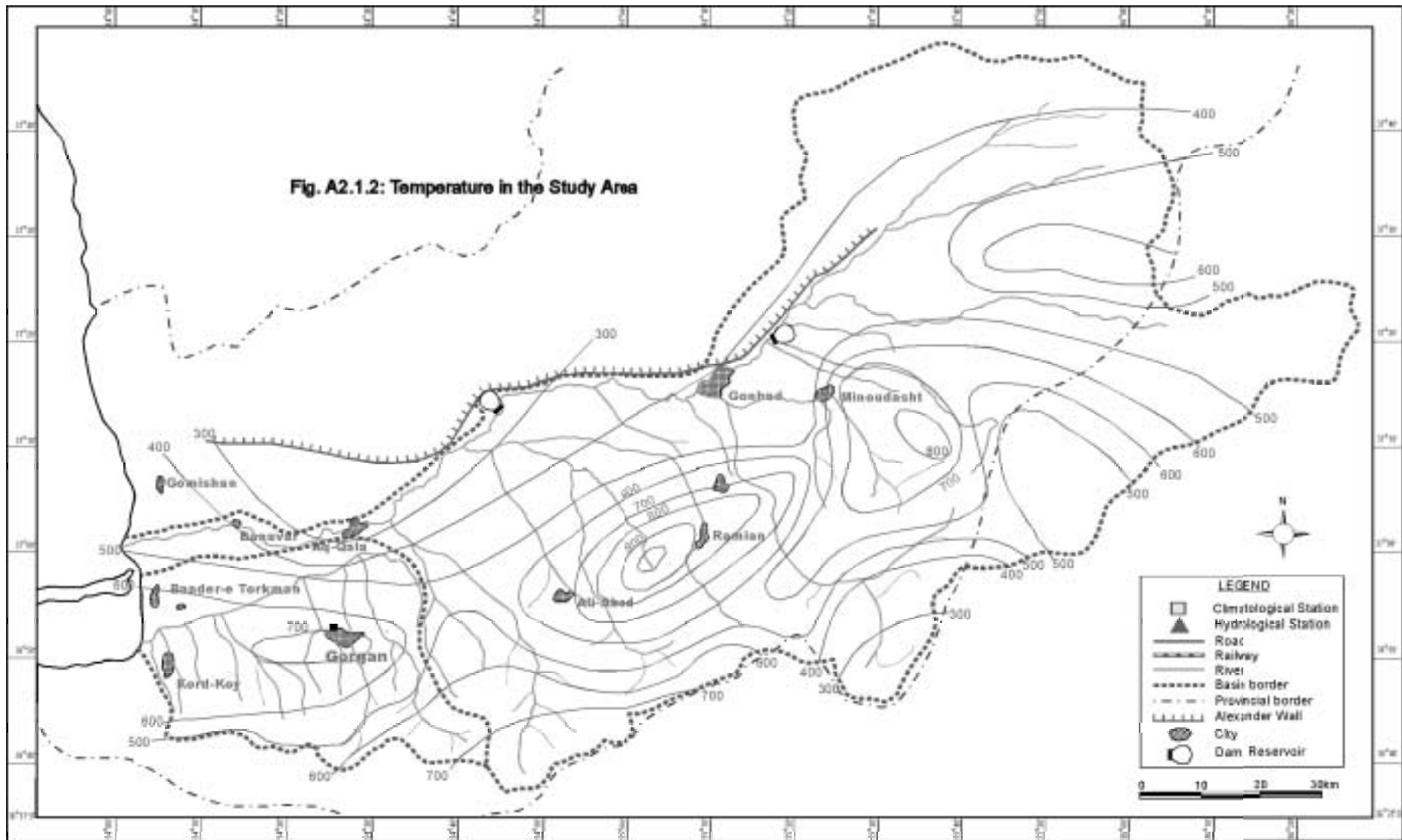
The average monthly humidity is shown in the right figure. The average minimum was 70.3% in August and the average maximum 82.5% in December.









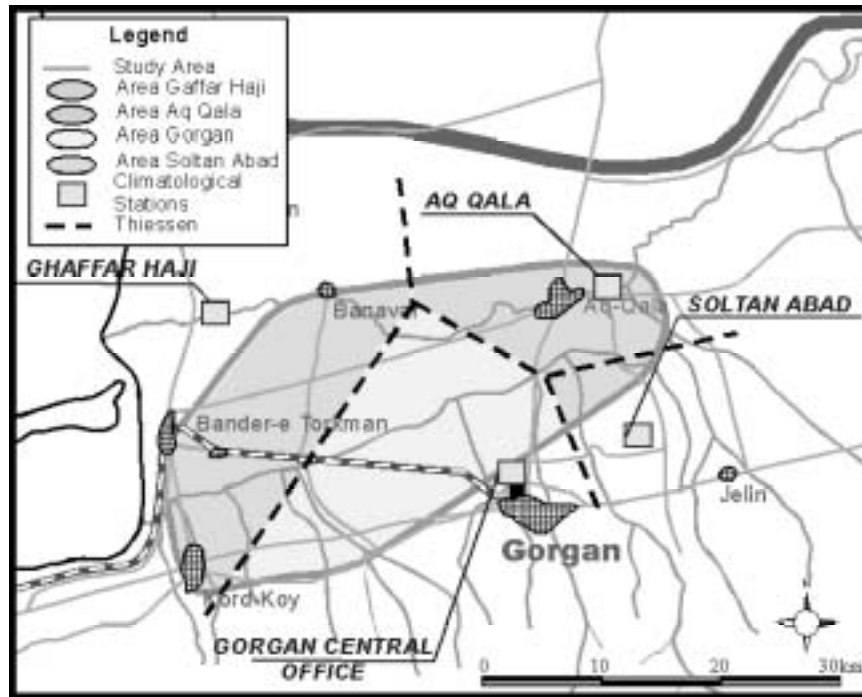




### A2.1.2 Study Area

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.

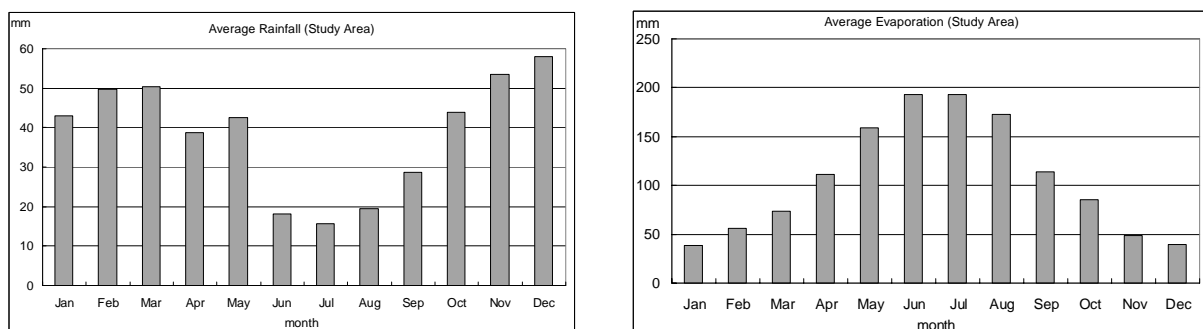
According to the stations position, the study area can be divided in 4 areas, as shown in the next figure, by the Thiessen method.



Study Area Division by the Thiessen Method

#### a) Rainfall and Evaporation

The average rainfall and evaporation in the study area vary as shown in the following figures.

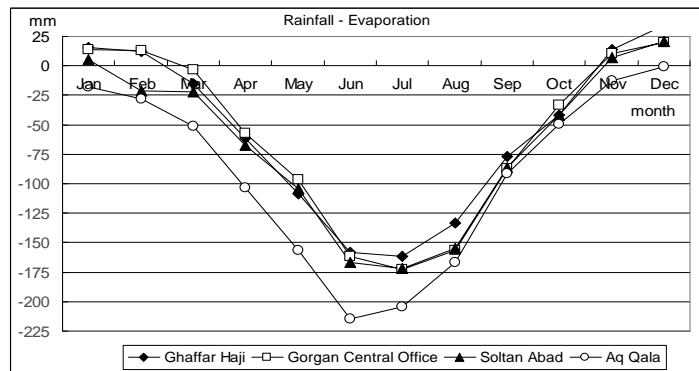


Average Rainfall and Evaporation in the Study Area

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 next

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.



**Balance of Rain-Evapotation in Each**

According to the balance between rainfall and evaporation, the dry period and wet period for the Study can be set as the follows:

**Dry and Wet Period from the Rain-Evaporation Point of View**

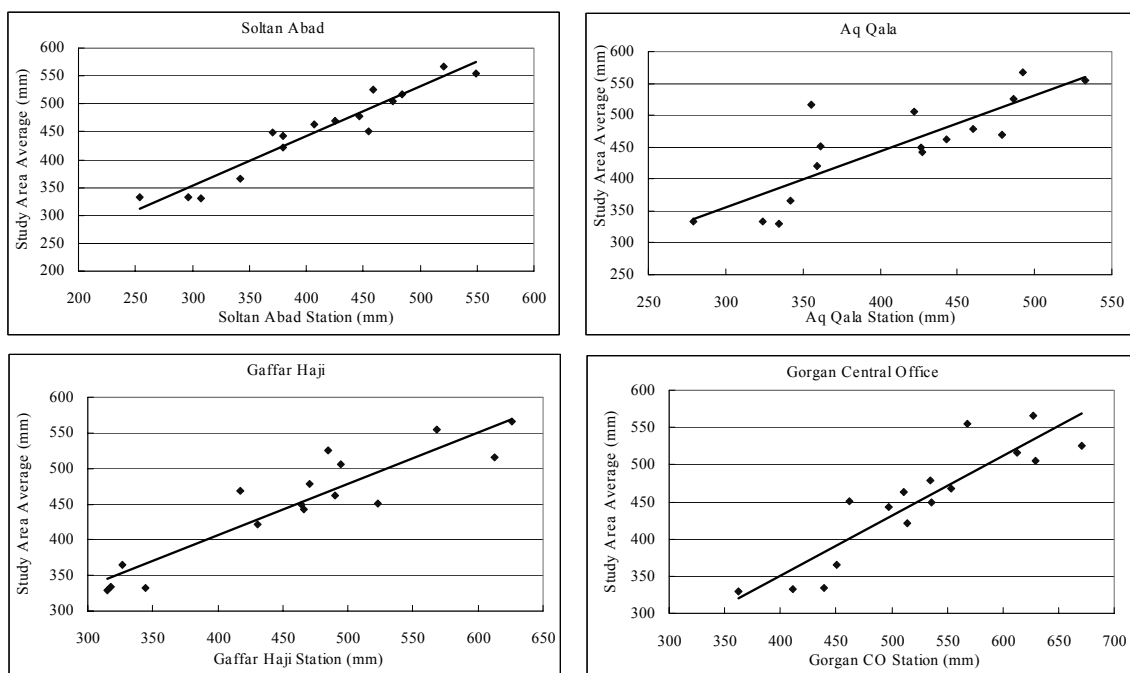
Jan Bahm	Feb Esfa	Mar Farv	Apr Ordi	May Kord	Jun Tir	Jul Mord	Aug Shah	Sep Mehr	Oct Aban	Nov Azar	Dec Dey
Wet Period		Dry Period								Wet Period	

The rainfall in each period shows the following characteristics for each station:

**Rainfall and Evaporation of Each Station**

Station	Rain					Evaporation				
	Dry Season		Wet Season		Total	Dry Season		Wet Season		Total
	(mm)	(%)	(mm)	(%)		(mm)	(%)	(mm)	(%)	
Soltan Abad	263.3	55.1	214.1	44.9	477.4	1,060.1	84	202.4	16	1,262.5
Aq Qala	215.7	53.8	185.6	46.2	401.3	1,207.7	83.2	244.6	16.8	1,452.3
Gorgan Central Off.	308.3	59	213.8	41	522.1	977.4	86.2	156.3	13.8	1,133.7
Ghafar Haji	243	54.4	203.7	45.6	446.7	967.3	88.4	127.4	11.6	1,094.7
AVERAGE	257.6	55.8	204.3	44.2	461.9	1,053.1	85.5	182.7	14.6	1,235.8

The table shows that, in average, about 44 % of the rain occurs during the above mentioned wet period. The following figures show the correlation between each station and the average rainfall of the Study Area.



**Correlation Between Each Measurement Station of the Study Area**

**b) ETo**

The referential evapotranspiration, to be utilized in the calculation of the necessary irrigation water, is as shown in the following table.

**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

## **A2.2 Hydrology**

### **A2.2.1 Surface Water**

The Gorgan plain has two important rivers: Gorgan and Gharasu rivers. There are three more small rivers independent of the Gorgan and Gharasu systems, but not important for the study.

The Gorgan river, the most important permanent river in the area, has 12 perennial and 5 seasonal tributaries. It has a catchment area of 11,480 km<sup>2</sup>, of which 6,266 km<sup>2</sup> are mountainous and 5,215 km<sup>2</sup> are lowlands. The river crosses the Gorgan plain in the east-west direction debouching in the Caspian sea. The river channel has incised a significant canyon, which has vertical sides of more than 20 m deep at some places. There are some places at the upstream where the canyon width reaches hundred meters. The deep depth of the river channel in several places make possible to the Gorgan river acting as a natural drain of the phreatic aquifer.

The occurrence of floods in the plain were common during the rain season before the construction of the Golestan Dam. This fact will be discussed at the later part of the section.

The Gharasu river, with its 10 tributaries, has a catchment area of 1,720 km<sup>2</sup>, where 720 km<sup>2</sup> are in mountainous areas and 1,000 km<sup>2</sup> are lowlands. The main sources of the Gharasu river come from the streams in the mountains located in the south region of Gorgan city.

The basins of Gorgan and Gharasu rivers are shown in figure A2.2.1. The hydrological stations where discharge data was collected for the study are shown in the figure A2.1.1, and the collected period is indicated in table A2.1.1.

The average discharge of each station are presented in the next table. The Aq Qala and Basir Abad stations show an average annual discharge of about 14.5 m<sup>3</sup>/s.

**Average Discharge for Each Hydrological Station (m<sup>3</sup>/s)**

Station	Aug Shah	Jul Mord	Jun Tir	May Kord	Apr Ordi	Mar Farv	Feb Esfa	Jan Bahm	Dec Dey	Nov Azar	Oct Aban	Sep Mehr	Annual
Tamer	0.8	0.6	0.4	1.3	3.3	4.1	2.0	1.3	1.2	1.2	1.3	1.0	1.5
Gonbad	1.7	2.2	1.9	8.1	18.1	23.0	12.6	6.9	5.8	5.3	4.4	3.0	7.8
Araz Koseh	1.2	0.7	0.9	3.8	12.1	19.1	14.6	7.4	5.2	4.4	3.4	2.3	6.2
Ramian	0.4	0.3	0.3	0.9	3.2	5.6	3.3	1.1	0.7	0.6	0.5	0.3	1.4
Gazzaghly	3.5	3.6	3.5	12.0	29.5	44.4	28.4	15.8	12.4	10.4	8.7	6.0	14.8
Gorgan Dam	2.6	2.0	2.0	6.4	18.1	26.9	11.1	14.1	12.8	11.1	9.0	6.4	10.2
Bahe Salian	0.9	0.7	1.0	2.7	7.7	12.0	8.6	5.1	3.6	2.8	1.8	1.0	4.0
Taghi Abad	0.2	0.2	0.2	0.2	0.7	1.2	0.8	0.3	0.1	0.2	0.2	0.2	0.4
Aq Qala	3.1	1.9	2.4	12.4	31.5	45.4	23.7	16.2	12.8	11.1	8.1	5.5	14.5
Basir Abad	2.9	1.6	3.0	10.1	25.4	38.8	23.0	21.4	17.0	14.7	10.4	6.4	14.6
Nahar Khoran	0.3	0.3	0.4	0.5	0.8	0.9	0.6	0.4	0.3	0.4	0.4	0.3	0.5
Shast Kola	0.4	0.5	0.6	0.9	1.1	1.0	0.7	0.5	0.4	0.4	0.4	0.4	0.6
Seah Ab	0.1	0.1	0.5	2.2	3.7	4.4	3.6	2.8	2.7	1.9	1.0	0.7	2.0
Ongheh Yelghi	0.6	1.0	0.2	0.5	3.7	4.3	2.1	1.2	1.1	1.2	1.0	0.6	1.5

Source: Ministry of Energy (Golestan)

The average discharge for several return period is shown in the following Table.

**Average Discharge for Several Return Periods (m<sup>3</sup>/s)**

Station	Dry Season						Average	Wet Season					
	Years												
	1000	500	100	50	25	10	2	10	25	50	100	500	1000
Seah Ab	0.36	0.43	0.61	0.7	0.82	1.02	1.74	2.88	3.44	3.87	4.29	5.26	5.67
Basir Abad	-	0.53	2.22	3.35	4.69	4.99	15.3	28.2	34.7	39.6	44.4	55.5	60.3
Aq Qala	-	-	2.05	3.24	4.67	7.11	15.9	29.6	36.5	41.6	46.7	57.5	63.4
Taghi Abad	0.02	0.03	0.08	0.1	0.13	0.18	0.36	0.64	0.78	0.88	0.99	1.23	1.33
Shir Abad	-	-	0.08	0.12	0.17	0.26	0.59	1.11	1.37	1.56	1.75	2.19	2.37
Bagheh Salian	1.07	1.22	1.6	1.71	2.06	2.49	4.02	6.43	7.64	8.54	9.44	11.5	12.4
Ramian	0.34	0.39	0.52	0.6	0.68	0.83	1.37	2.2	2.63	2.94	3.25	3.97	4.27
Gorgan Dam	2.26	2.67	3.77	4.53	5.31	6.65	11.5	19	22.8	25.9	28.4	34.9	37.6
Ghazzaghly	-	-	-	7.11	7.9	9.27	14.1	21.8	25.7	28.5	31.3	37.9	40.7
Araz Koseh	1.97	2.16	2.67	2.95	3.29	3.87	5.94	9.18	10.8	12	13.2	16	17.2
Gonbad	2.2	2.48	3.25	3.67	4.18	5.05	8.16	13	15.5	17.3	19.1	23.3	25.1
Tamer	0.29	0.34	0.5	0.59	0.69	0.86	1.49	2.47	2.97	3.34	3.7	4.55	4.91
Ongheh Yelghi	-	-	-	0.02	0.15	0.38	1.21	2.5	3.15	3.63	4.11	5.22	5.7

Source: Ministry of Energy (Golestan)

The maximum discharge for different return periods is shown in the following table.

**Maximum Discharges for Several Return Periods (m<sup>3</sup>/s)**

Station	Return Period (year)						
	2	10	25	50	100	500	1000
Seah Ab	15	30	36	44	49	63	68
Basir Abad	108	192	235	266	297	370	401
Aq Qala	140	250	305	346	387	482	522
Taghi Abad	21	57	76	89	103	134	147
Shir Abad	11	17	21	23	26	31	34
Bagheh Salian	41	72	87	99	110	136	147
Ramian	32	70	88	102	116	148	162
Gorgan Dam	123	235	292	333	375	471	512
Ghazzaghly	122	231	285	326	366	460	500
Araz Koseh	90	155	188	212	236	292	316
Gonbad	82	222	293	345	397	517	569
Tamer	18	49	64	75	87	113	124
Oneghyelgh	62	135	172	200	227	290	317

Source: Ministry of Energy (Golestan)

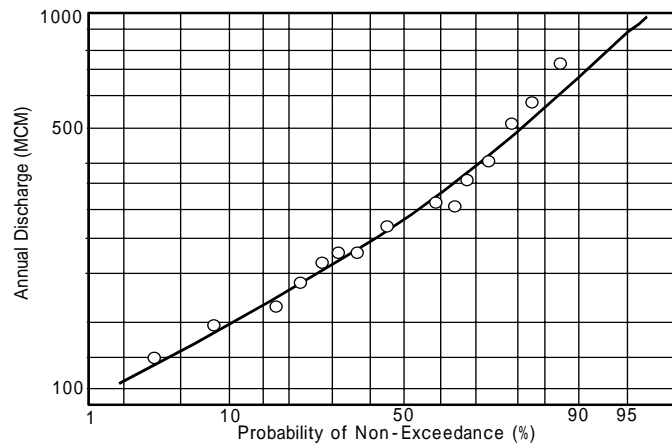
The monthly average discharge in the Seah Ab and Aq Qala stations for several frequencies is shown in the following table.

**Monthly Average Discharge Estimation (m<sup>3</sup>/s)**

Frequency (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seah Ab												
Min	4.98	8.12	7.26	9.37	15.60	10.50	5.38	1.11	0.52	3.19	2.50	7.11
25	2.56	3.05	4.62	5.70	4.14	3.49	0.47	0.00	0.00	0.80	0.95	2.14
50	1.81	2.51	3.33	3.50	2.15	0.83	0.00	0.00	0.00	0.27	0.51	0.98
75	0.94	1.78	1.99	1.98	0.83	0.22	0.00	0.00	0.00	0.02	0.30	0.56
90	0.62	0.75	0.97	1.01	0.47	0.01	0.00	0.00	0.00	0.00	0.12	0.32
Max	0.53	0.46	0.78	0.64	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Aq Qala												
Min	46.00	57.90	70.50	182.20	122.00	91.90	17.70	12.80	19.30	25.00	37.50	35.43
25	16.30	24.90	38.70	60.40	42.00	16.50	4.16	1.77	2.29	7.45	10.30	15.40
50	8.85	12.50	17.80	41.50	20.30	5.61	1.11	0.56	0.57	3.75	5.12	7.55
75	5.79	6.63	5.84	18.80	7.25	1.72	0.42	0.17	0.30	1.41	3.12	3.83
90	2.70	0.03	3.86	8.03	3.58	1.06	0.04	0.00	0.05	0.90	2.26	2.00
Max	0.63	0.00	0.30	3.94	1.36	0.26	0.00	0.00	0.00	0.11	0.98	0.46

Source: Ministry of Energy (Golestan)

The following figure shows the probability of non-exceedance for annual discharges in Aq Qala station.



**Probability of No-exceedance in Aq Qala**

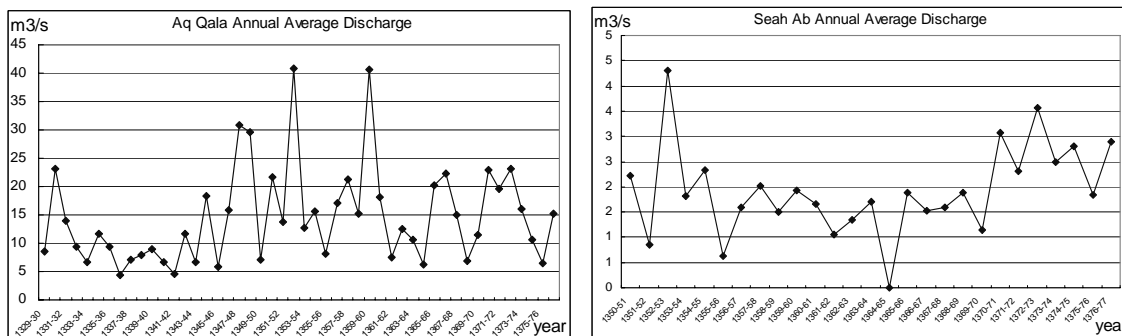
The relation between annual average discharge, average rainfall and area of the station’s basin are as follows:

**Relation Discharge-Area-Rainfall**

Gorgan River	$Q=0.001699A+0.002633P-0.724043$ $r^2=0.9266$ $Q=10^{0.141} * A^{0.338} * P^{-0.24}$ $r^2=0.4331$
Gharasu River	$Q=0.000975A+0.003782P-2.073757$ $r^2=0.9995$ $Q=10^{-14.2} * A^{0.624} * P^{4.488}$ $r^2=0.9684$

Obs: Q=Annual Average Discharge (m3/s); A=Basin Area (km2); P=Annual Average Rainfall (mm); r=constant

The annual average discharge variation in Aq Qala and Seah Ab stations are presented in the following figures.



**Average Annual Discharge in Aq Qala and Seah Ab Stations**

According to the Water Resources Committee, the annual available surface discharge is 750 MCM where 491 MCM/year (65% of the total) is estimated that is in use.

### A2.2.2 Groundwater

The groundwater's flux in the Study Area generally occurs from the south to the north, with a slight westerly component at the northern part of the study area. The Caspian sea water invades the groundwater at the western part of the study area.

The groundwater balance is estimated by the following equation:

$$\text{Inflow} = \text{Outflow} \pm \text{Storage Change}$$

or

$$(Q_i + R) = (Q_o + P + ET + D) \pm \Delta V$$

where:  $Q_i$  = groundwater inflow from the southern recharge area;

$R$  = lumped recharge term incorporating irrigation return flow, unknown leakage, effective rainfall, etc;

$Q_o$  = groundwater outflow across the northern boundary;

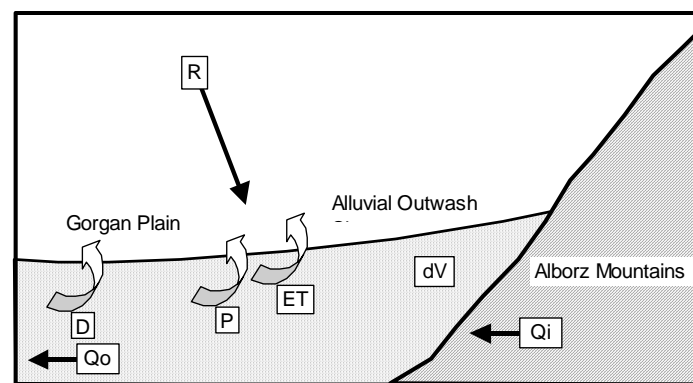
$P$  = total average yearly pumping from shallow and deep aquifer systems;

$ET$  = potential evapotranspiration from high groundwater areas;

$D$  = effluent drainage of the shallow groundwater by the Gorgan and other major rivers;

$\Delta V$  = total change of the groundwater storage of phreatic and artesian aquifers.

The schematic figure of the above mentioned components are shown in the following figure.



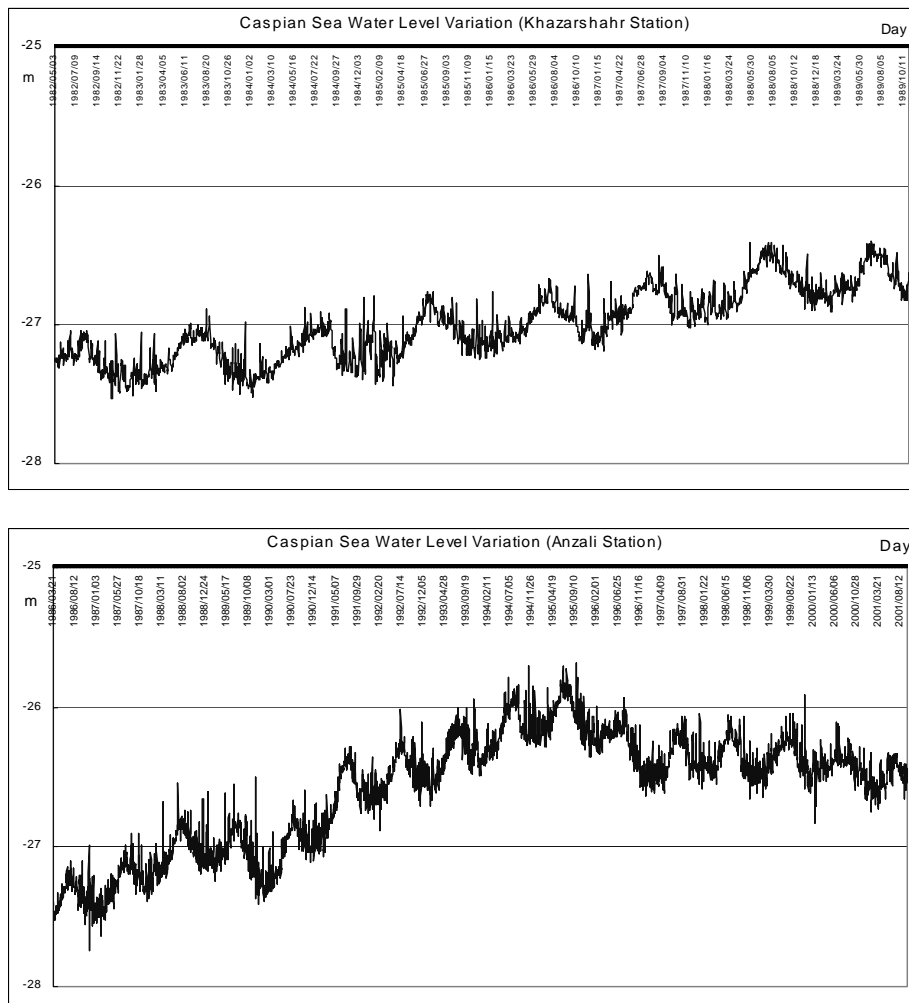
**Groundwater Flux Scheme**

According to this estimation, in 1972, the inflow value was of 1010 MCM/year. This value changed to 983 MCM/year nowadays, where 855 MCM/year (approximately 86% or the total) is already in use.



### A2.2.3 Caspian Sea Water Level

The Caspian Sea water level has been measured since 400 years ago. According to this data, the water level has the longest cycle of about 70 years, when it varies between  $-25.5$  m to  $-27.5$  m below the average sea level. The figure A3.1.5.3 shows the water level variation in two measurement stations. This cycle is said to be achieving the top of the long cycle actually, and probably the water level will decrease in few years. The following figure shows the Caspian Sea water level variation.

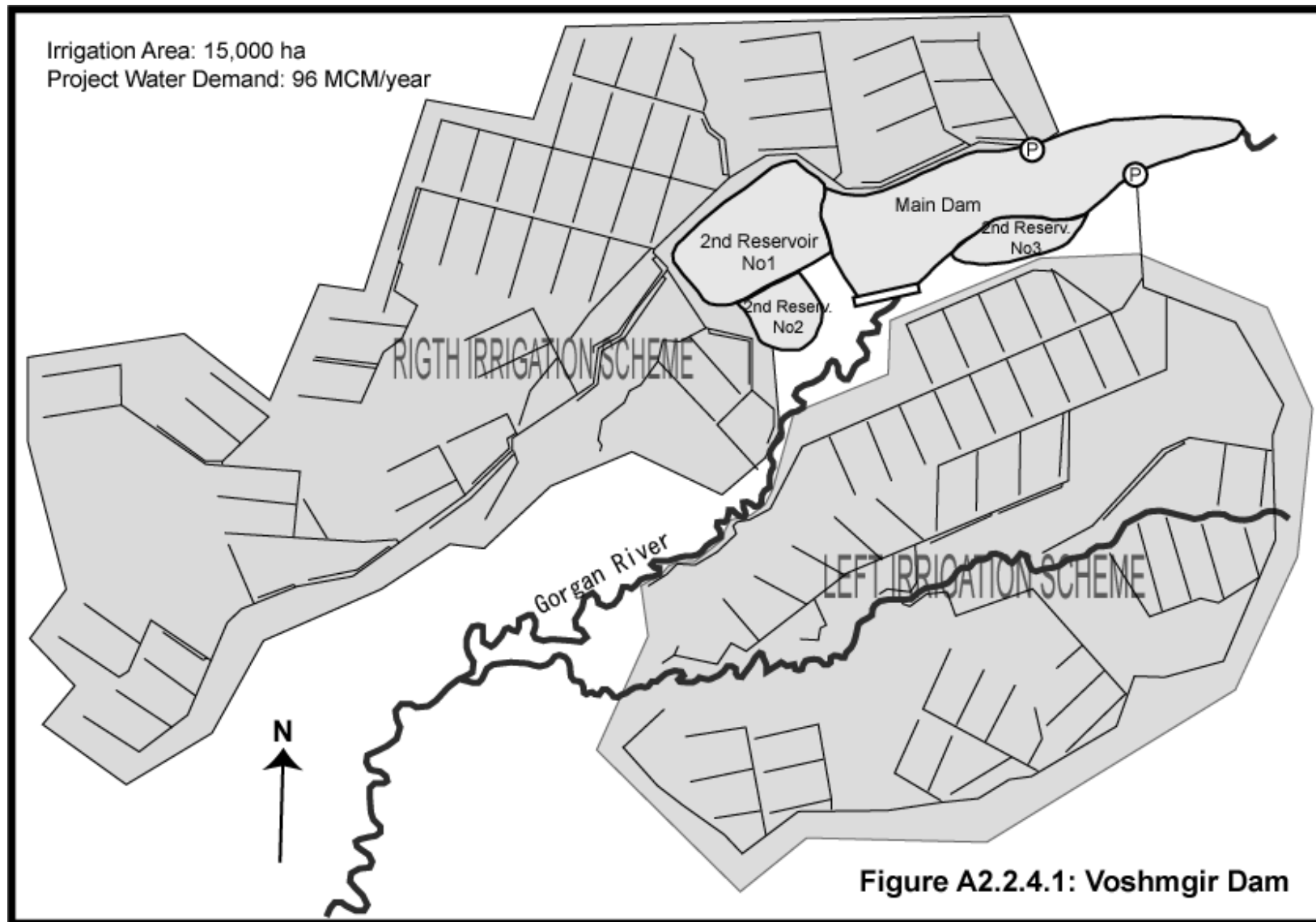


**Caspian Sea Water Level Variation**

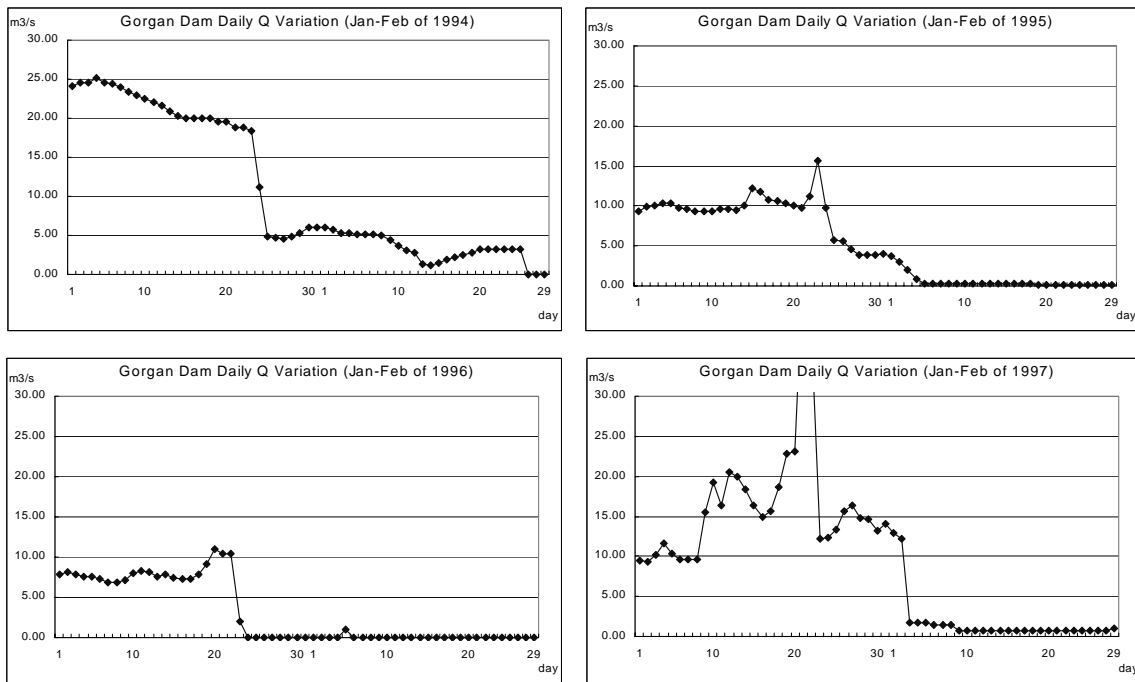
### A2.2.4 Existing Dams

#### (1) Voshmgir Dam

The Voshmgir dam (figure A2.2.4.1), in the Gorgan river, was constructed in 1970 and has a gross storage capacity of  $79 \times 10^6$  m<sup>3</sup> and an effective storage capacity of  $50 \times 10^6$  m<sup>3</sup>. The dam begins to store the water of the Gorgan river in January to February as shown in the following figures, to be used mainly for irrigation.

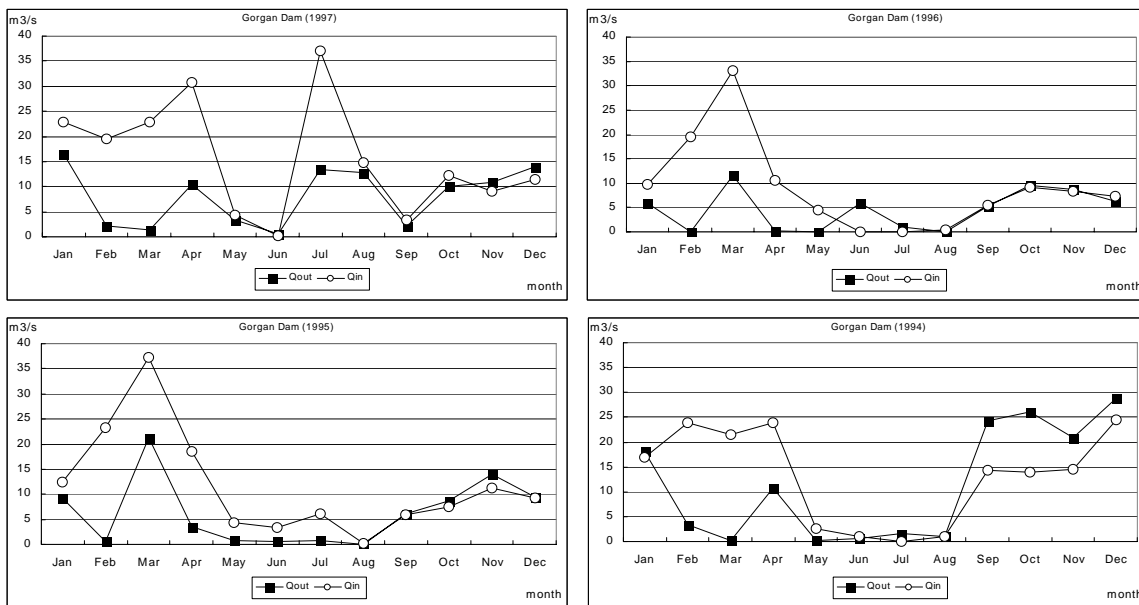


The figure shows that in 1994 the Voshmgir dam was closed on 25<sup>th</sup> of January. In 1995 it was closed on 24<sup>th</sup> of January, in 1996 in 23<sup>rd</sup> of January and in 1997 in 3<sup>rd</sup> of February.



**Voshmgir Dam Discharge to Downstream (Jan-Feb)**

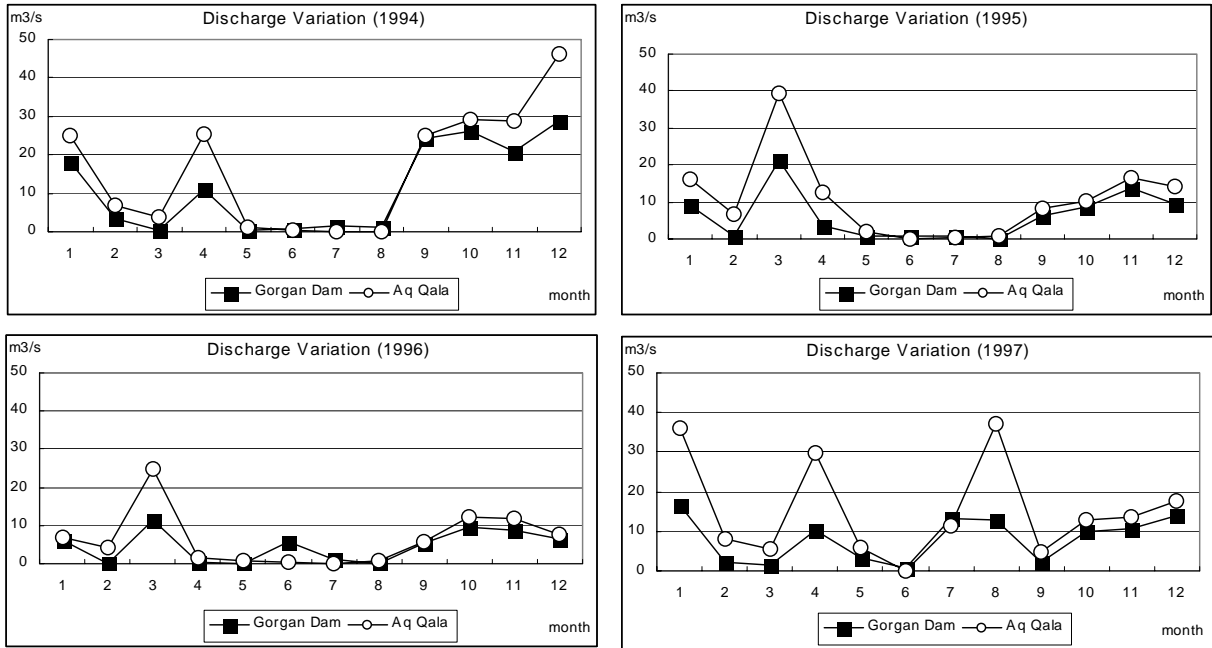
But on the other hand, the analysis of the monthly inflow (Gazzagly Station) and outflow (Voshmgir Dam) discharge show that the stored water is not discharged to downstream. It can be said that almost all water stored in Voshmgir dam is used in the upstream of the dam or in the irrigated lands that take water direct from the Voshmgir dam.



**Inflow and Outflow Discharge at Voshmgir Dam**

The Voshmgir dam has a severe problem of sediment accumulation decreasing its storage capacity.

The comparison between the Voshmgir Dam discharge and the Aq Qala station discharge shows that the discharge increases due to the tributaries and water from the catchment area situated downstream of the Gorgan dam, between the dam and the Aq Qala station, as shown in the next figures.



**Discharge from Voshmgir Dam and in Aq Qala Station**

## (2) Golestan Dam (Flood)

The Golestan dam (figure A2.2.4.2), in the Gorgan river, was constructed in 2000 and has a gross storage capacity of  $135 \times 10^6 \text{ m}^3$  and an effective storage capacity of  $86 \times 10^6 \text{ m}^3$ . It can be said that floods occurrence was solved in the dam's downstream, that includes all the study area, for floods smaller than the following one.

The last flood recorded occurred on 19 to 21 of August of 2001. The flood occurred after the construction of the Golestan dam. The Golestan dam retained most part of the flood water occasioning inundation only upstream of the dam. Before the construction of the dam, the damages always occurred also in the downstream part, mainly between the Gharasu and Gorgan rivers.

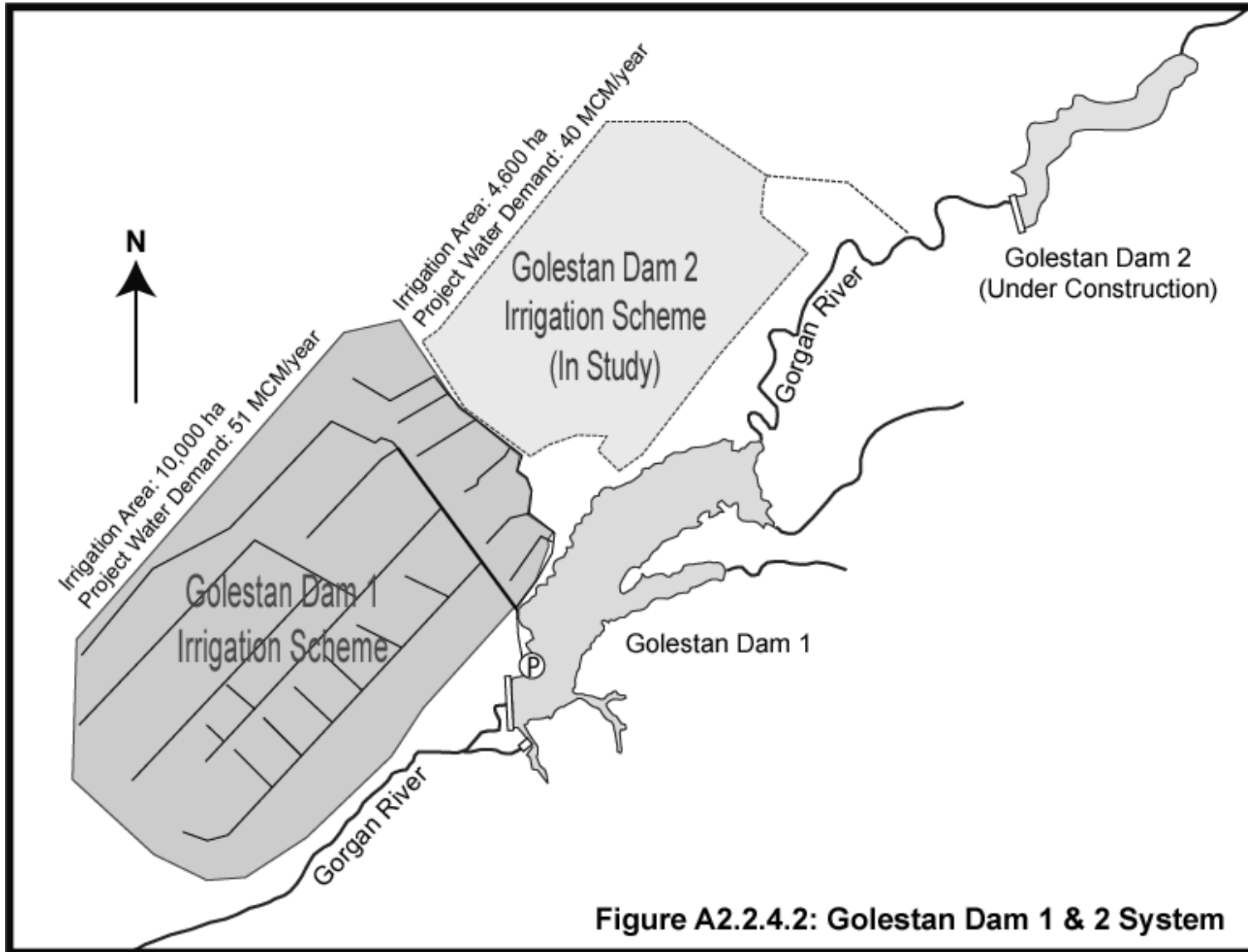


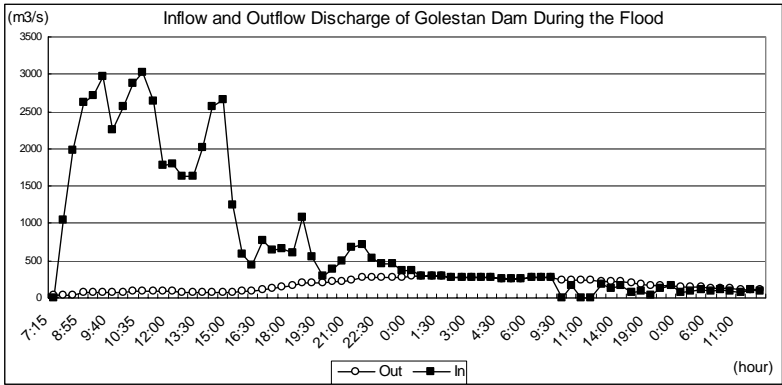
Figure A2.2.4.2: Golestan Dam 1 & 2 System

The characteristics of the rainfall for the flood in August of 2001 were as follows. The rainfall measured in Cheshmeh Khan and Dasht stations presented a return period of 10,000 years, Tangeh Rah station presented a 35,000 years return period and the Golestan Forest station indicated a rainfall that had a not measurable return period. The inundation area and rainfall are shown in figure A2.2.2.

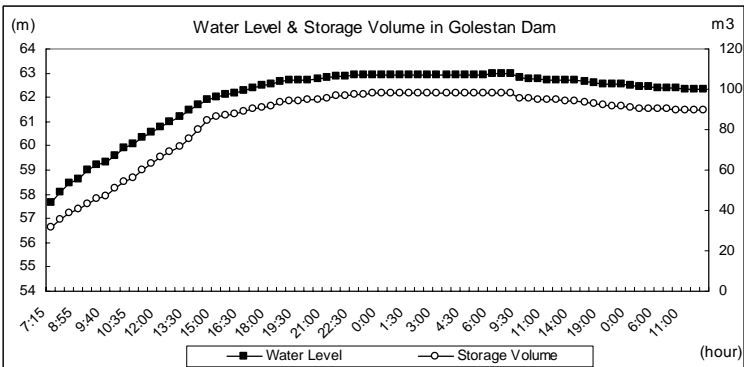
**Rainfall During the Flood**

Station	min. rainfall		max rainfall		Flood Rainfall (mm)	Return Period (year)
	mm	year	mm	Year		
Cheshmeh Khan	14	96-97	50	88-89	84	10000
Dasht	14	96-97	50	88-89	150	10000
Golestan Forest	32	79-80	81	91-92	450	
Tangeh Rah	32	79-80	81	91-92	150	35000
Galikesh	27	89-90	188	97-98	21	< 2
Nodeh	25	77-78	90	97-98	94	60
Ramian	46.5	92-93	110	91-92	118	60

The inflow and outflow of the Golestan dam during the flood were as follows.

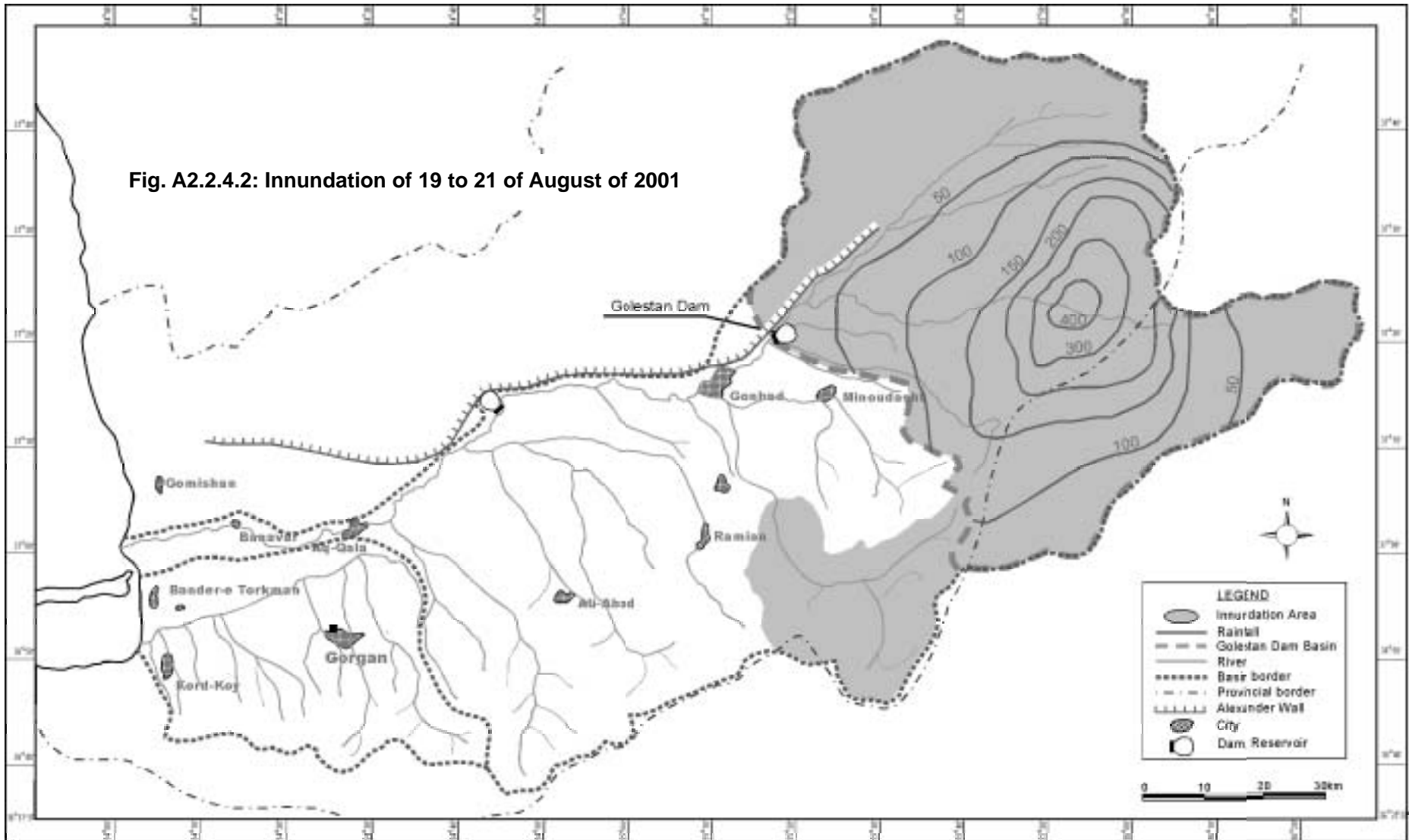


The relation between the stored volume and water level variation are as follow.



As both figures show, the Golestan dam stored most part of the flood water. The maximum stored volume reached 98.4 million m<sup>3</sup>. So, the Golestan dam has a capacity to prevent large floods and store water.

Fig. A2.2.4.2: Innundation of 19 to 21 of August of 2001



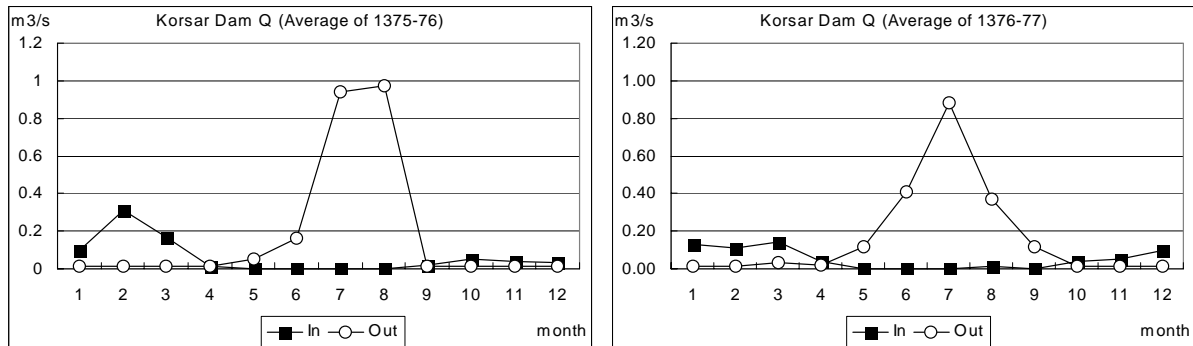
The following table shows the discharge variation in several locations of the Gorgan river during the flood, and a comparison between the past discharges characteristics.

**Discharge During the Flood**

Station	Recorded (m <sup>3</sup> /s)		During the Flood Qmax (m <sup>3</sup> /s)
	Qmax	Qmin	
Tangeh Rah	182.3	4.41	1650
Golestan Dam	400		3017
Gonbad	401	33.8	150
Ghazzagly	419	58	129
Gorgan Dam (Entrance)	373	14	40
Aq Qala	258	46	20
Basir Abad	273	51	10

### (3) Kowsar Dam

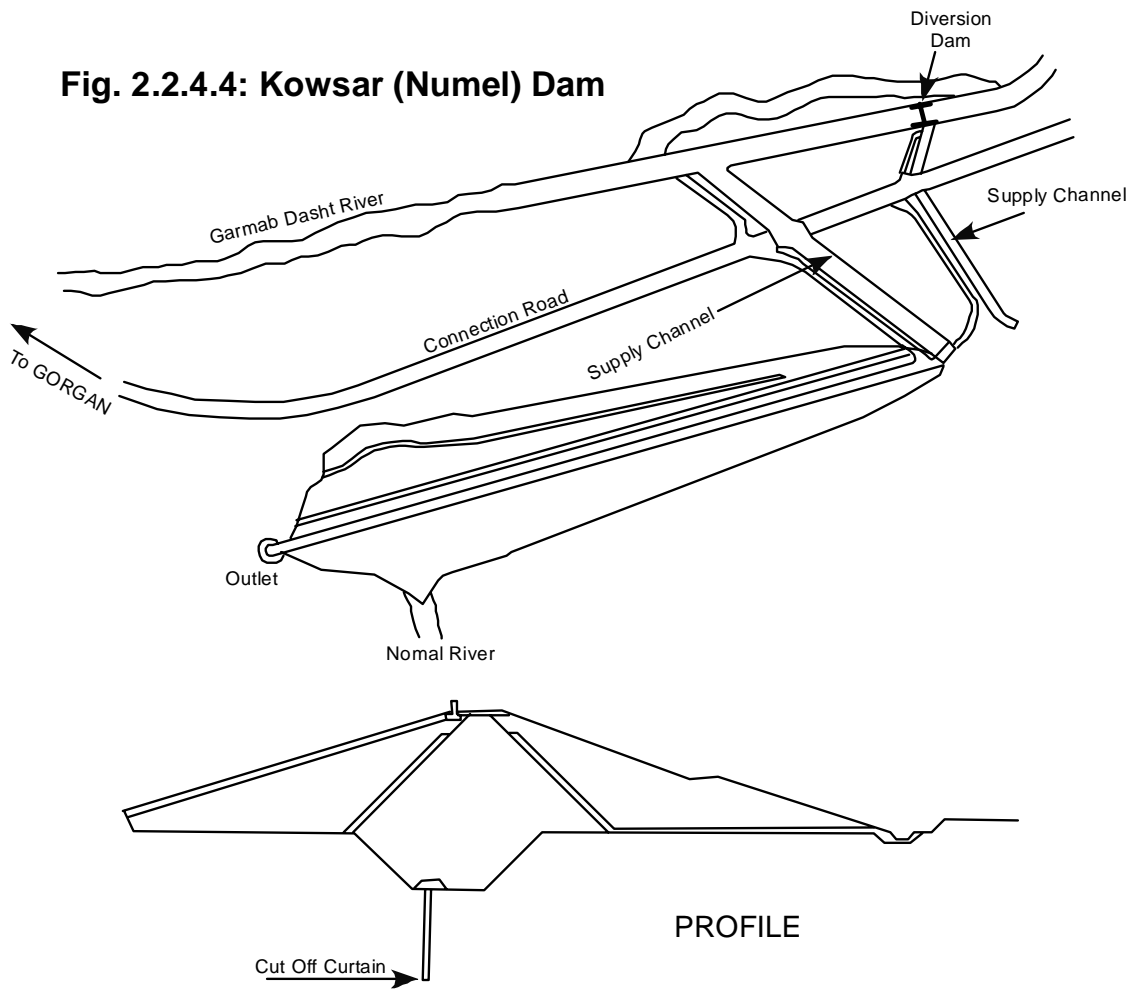
The Kowsar dam, in the Kowsar river of Gharasu river basin, was constructed in 1993 and has a gross storage capacity of  $7.5 \times 10^6 \text{ m}^3$  and an effective storage capacity of  $7 \times 10^6 \text{ m}^3$ . The dam begins to store the water of the Gorgan river in September to October as shown in the following figures. The dam begins to discharge the water between April to May as shown in the following figures.



**Inflow and Outflow Discharge of Kowsar Dam**



**Fig. 2.2.4.4: Kowsar (Numel) Dam**



TECHNICAL DATA

River	-----	Gharasu River
Location	-----	South East of Gorgan
Nearest City	-----	Gorgan
Type	-----	Earth Fill Dam
Construction Period	-----	1987-1993
Crest Length	-----	565 m
Height	-----	26 m
Volume of Construction Materials	-----	445,000 m <sup>3</sup>
Reservoir Gross Capacity	-----	7.5x10 <sup>6</sup> m <sup>3</sup>
Effective Capacity	-----	7x10 <sup>6</sup> m <sup>3</sup>