Recorded maximum daily rainfall in the Project Area is 262 mm observed at Mahmud Abad in October, 1971. On the same day, daily rainfall of 219 mm was recorded at Babolsar, and the daily maximum is also recorded at Babolsar. Daily rainfall is small in the irrigation period, but heavy in the non-irrigation period from October to December.

In the Project Area, probable daily rainfall is estimated at 130 mm once a ten-year period. Details on daily and hourly rainfalls are explained in Appendix A.1.

1.2.3. Hydrology

As shown in Exhibit 1.2.3, the major rivers related to the Project Area are the Haraz river flowing through the Area, the Babol river flowing along the easterly boundary and the Alesh Rud flowing along the westerly boundary. As for the other rivers than the above three, the Kari Rud flows to the east along the piedmont of the southern hilly range. The Kari Rud is an artificially improved river which is diverted from the Haraz river and serves as a primary irrigation canal. The Kari Rud joins the Garma Rud which flows down from the southern hilly basin. In the south of the Kari Rud, the Karan Rud flows into the Babol river after joining the Kela Rud.

The water resources of the Project Area depend mainly on the Haraz river. Groundwater and storage water in the irrigation ponds (locally called "Abbandan") are used as supplementary sources.

In the Project Area, the secondary irrigation canals run down radially to the Caspian Sea from the Haraz river and the Kari Rud. The features of the irrigation and drainage canals are described in the paras. 2.3.1 and 2.3.2 respectively.

(1) Rivers

1) River Basins and River Gaging Stations

The Haraz river has a drainage area of 4,086 sq.km at the Karehsang gaging station. The Haraz river originates in the Alborz Mountains, and the Lar river and the Nur river are its major tributaries. The Lar dam was constructed on the Lar river in 1981, to supply irrigation water to the downstream of the Haraz river and to supplement domestic water to Tehran, the Capital of Iran. However, the dam has not yet commenced full operation.

The Babol river originates also in the Alborz Mountains and has a drainage area of 1,430 sq.km at Babol gaging station, which is equivalent to one third of a drainage area of the Haraz river. Altitude of the Babol river basin is slightly lower than that of the Haraz river.

The Haraz river and the Babol river are provided with river gaging stations as shown in Exhibit 1.2.3 but there is no one for other rivers. In the Project Area, the Kari Rud and the Mahmud Abad river are also equipped with river gaging stations.

2) River Discharge

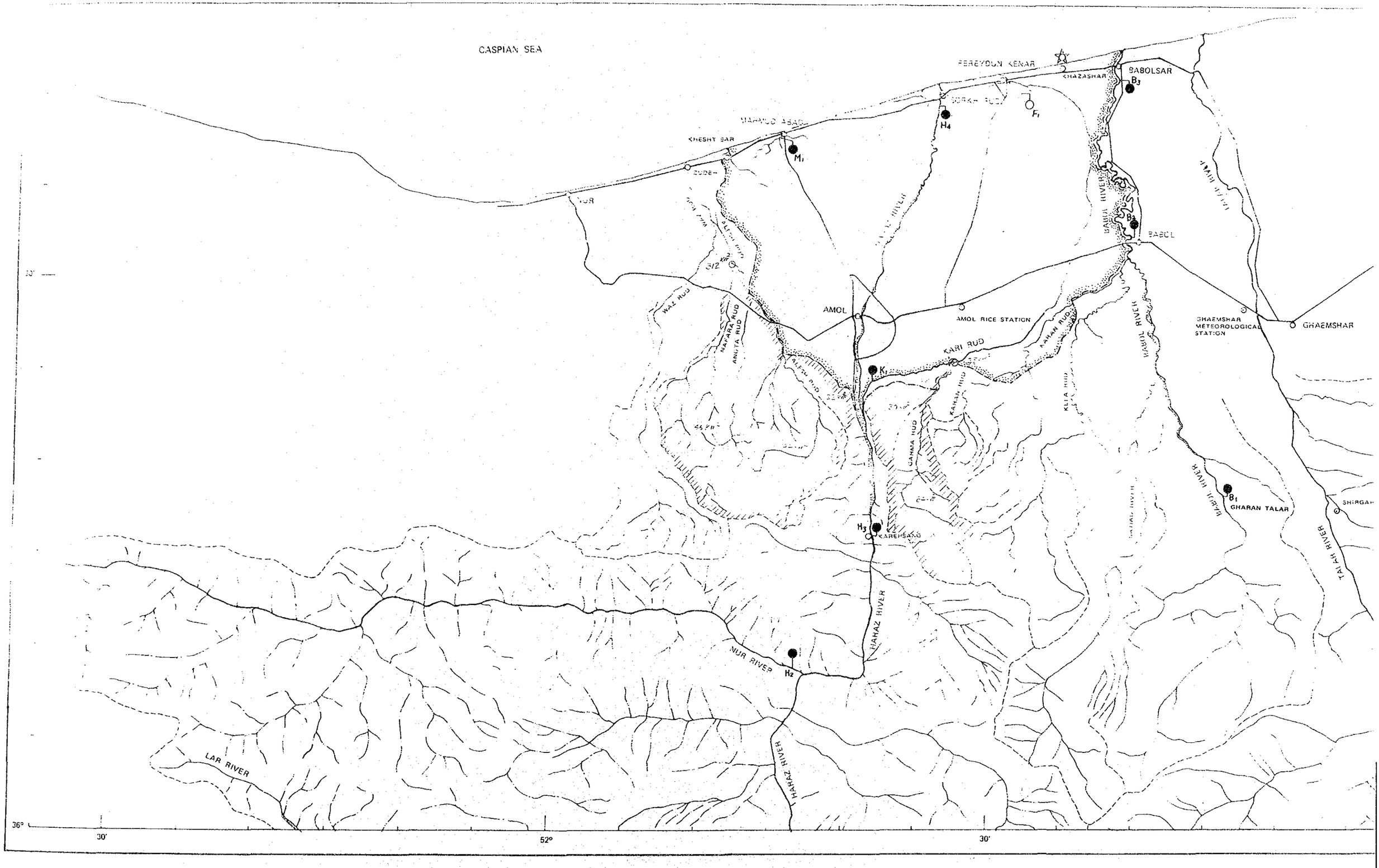
Runoff of the Haraz river is caused mainly by snowmelt water. As shown in Figure 1.2.2, discharge of the Haraz river increases rapidly in late March and reaches to the peak of about 80 cms in June. Thereafter, it decreases gradually to August. During a period from September to March, discharge is low but very steady at a flow rate of 20 cms more or less. This runoff pattern is not only stable but also meeting the irrigation requirement of paddy. Therefore, snow-mantle in the Alborz Mountains can be considered as a natural reservoir for irrigation. Runoff is so steady owing to snowmelt water at high-water discharge and groundwater discharge at low-water discharge so that irrigation water can be diverted easily and effectively to the field.

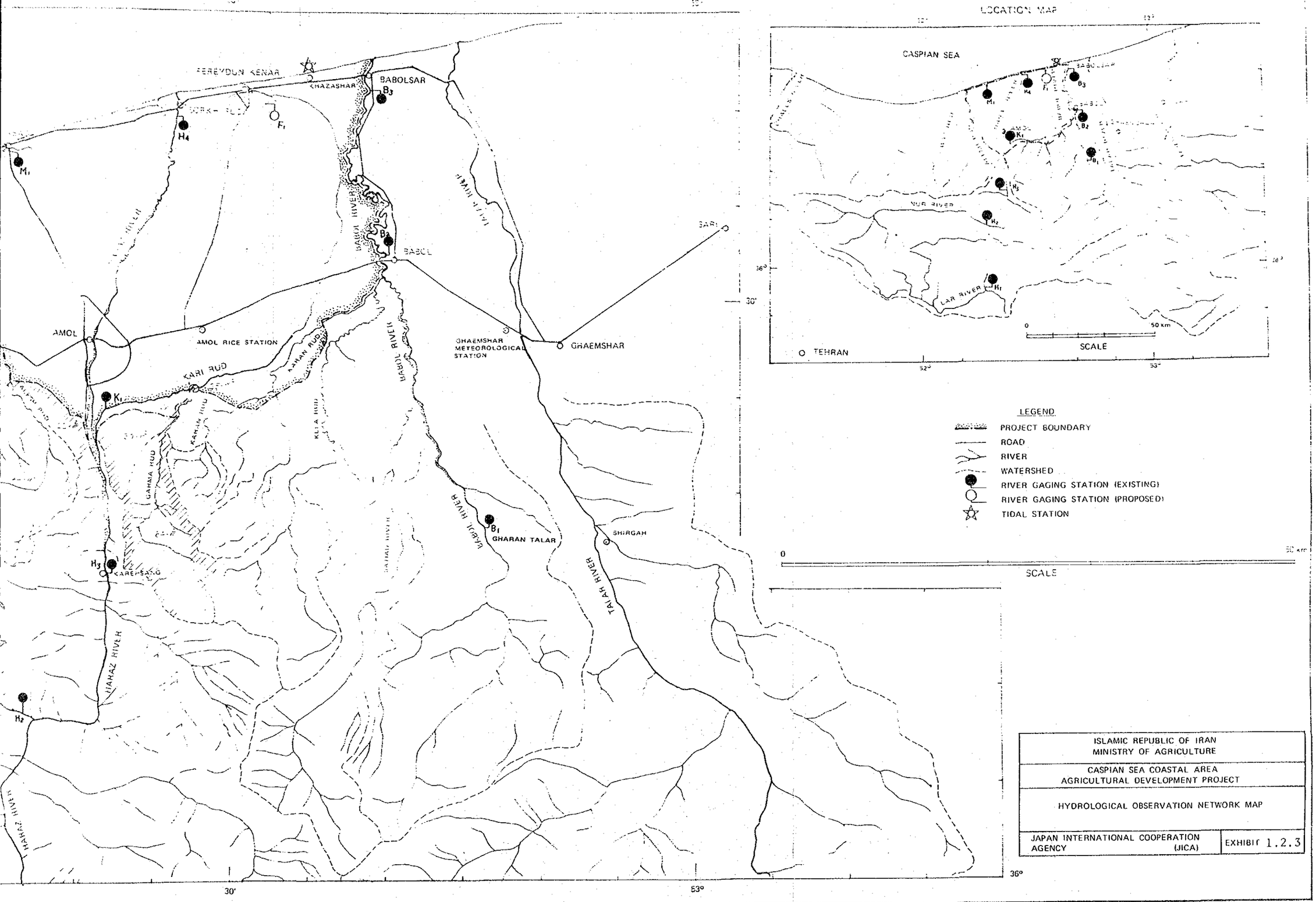
On the other hand, since runoff of the Babol river depends mainly on rainfall, discharge fluctuates unsteadily. As shown in Figure 1.2.2, high water discharge occurs twice a year in the periods from March to April and from September to October. It is supposed that the former high water discharge is caused by snowmelt water from the mountainous basin and the latter is caused by rainfall. From the viewpoint of water use, the Babol river has a difficulty due to decrease of discharge from May to August simultaneously with fluctuations on discharge.

Annual runoff and extreme discharge of major rivers can be summarized as below;

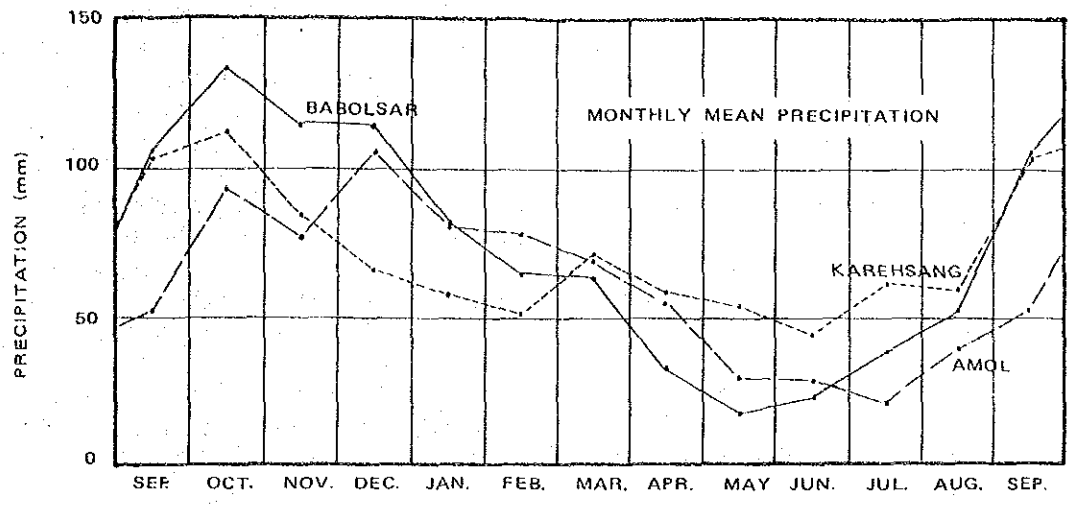
Table 1.2.2. River Regime

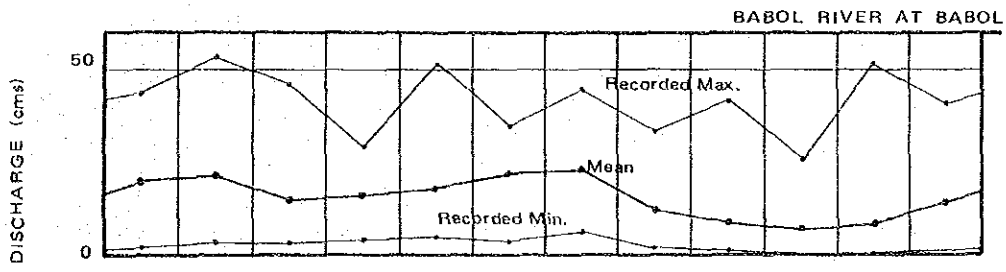
River	Gaging Station	Drainage Area (sq.km)	Annual Runoff (MCM)			Extreme Daily Discharge (cms)	
			Max.	Mean	Min.	Max.	Min.
Haraz River	Karehsang	4,086	1,810	1,062	570	311	8
Babol River	Babol	1,430	785	479	196	700	0
Alesh Rud	-	144	-	63	-	-	-
Garma Rud	-	84	-	37	-	-	-

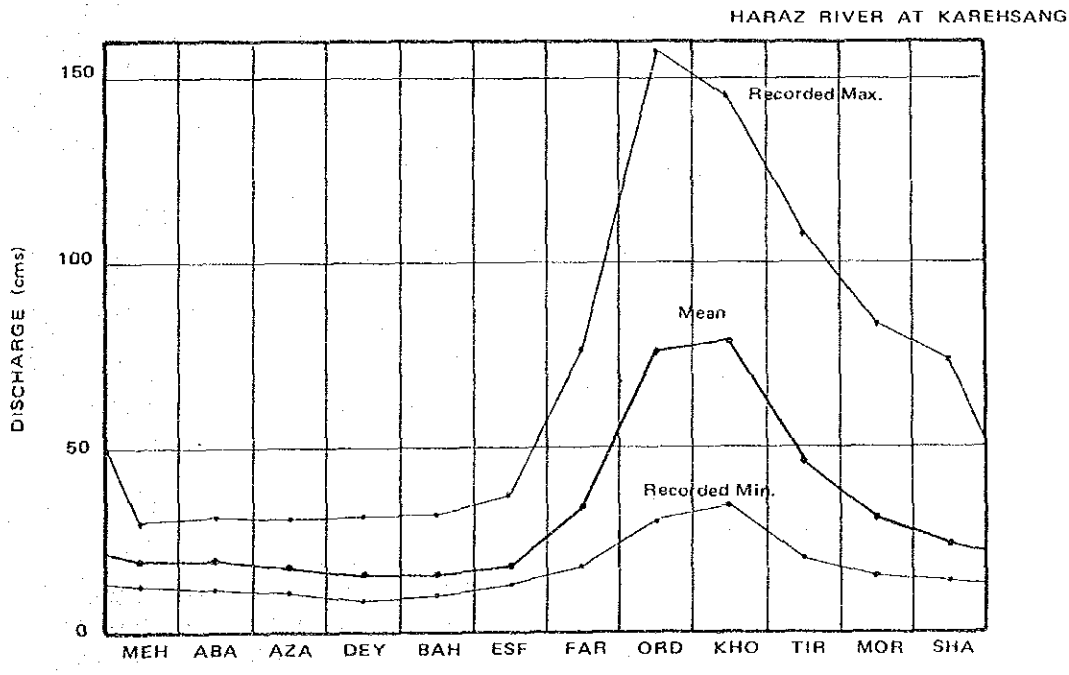

CASPIAN SEA
FEREYDUN KENAR
KHAZASHAR
BABOLSAR
B_3
H_4
F_1
MAHMUD ABAD
KHESHT SAR
M_1
SUDEH
NOR
S_{12}
AMOL
AMOL RICE STATION
BABOL
B_2
GHAEMSHAR METEOROLOGICAL STATION
GHAEMSHAR
KARI RUD
K_1
H_3
KAREHSANG
B_1
GHARAN TALAR
SHIRGAH
NUR RIVER
H_2
HARAZ RIVER
LAR RIVER
TALAR RIVER
BABOL RIVER
36°
30'
52°
30'



ISLAMIC REPUBLIC OF IRAN MINISTRY OF AGRICULTURE
CASPIAN SEA COASTAL AREA AGRICULTURAL DEVELOPMENT PROJECT
HYDROLOGICAL OBSERVATION NETWORK MAP
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) — EXHIBIT 1.2.3







ISLAMIC REPUBLIC OF IRAN MINISTRY OF AGRICULTURE
CASPIAN SEA COASTAL AREA AGRICULTURAL DEVELOPMENT PROJECT
MONTHLY MEAN DISCHARGE
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) — FIGURE 1.2.2

As shown in the above table, annual mean runoff is 1,062 MCM for the Haraz river and 479 MCM for the Babol river, and therefore, the Babol river has a bigger specific runoff of 0.335 MCM/sq.km than 0.259 MCM/sq.km of the Haraz river.

The recorded maximum flood discharge of the Babol river is 700 cms which is more than twice of 311 cms of the Haraz river. Since a flow capacity of the Babol river is only 300 cms at Babol gaging station, the recorded maximum flood has caused a large overbank flow to the Project Area. The Babol river causes an overbank flow once in five years, because its flow capacity is equivalent to the flood of 1/5 year. The Garma Rud and the Alesh Rud also cause flood damages in the Project Area. Details are shown in the Appendix A.2.4.

From a field investigation, it is supposed that the Haraz river has a flow capacity more than 1,000 cms at the uppermost of the Project Area, 500 cms nearby Amol and 150 cms at downstream nearby Sorkh Rud gaging station. Since a flood of the Haraz river is diverted to the Kari Rud and other irrigation canals with a capacity more than 140 cms, overbank flow has not been reported even at the recorded maximum flood.

The probable discharges of the Haraz river are summarized in the following table.

Table 1.2.3. Probable Discharge of the Haraz River

Probability of Exceedance	Mean Discharge(m^3/sec) Irrigation Period (Far-Mord) 1/	Annual	Runoff (MCM) Farv	Ordi	Khor	Tir	Mord	Far-Mord	Annual
10%	78.0	45.0	135	299	309	180	122	1,045	1,419
20%	67.5	40.3	117	259	267	155	106	904	1,271
50%	50.9	32.5	88	195	202	117	80	682	1,025
80%	37.9	26.3	66	145	150	87	59	507	829
90%	32.3	23.6	56	124	128	74	51	433	744

Note: 1/ ... Equivalent to the period from April to August.

3) Suspended Sediment

Concentration of suspended sediment of the Haraz river fluctuates from 100 ppm to 5,000 ppm by river discharges. Concentration is considerably higher in a rising period than in a recession period even at the same discharge. (see Figure A.2.4. Appendix A.2.)

4) Water Quality

The Haraz river has no harm for irrigation on its water quality. There is no harm of salinity, because an electrical conductivity is only 550 micro mhos/cm on an average.

However, the Garma Rud has a problem in water quality due to mineral springs in its basin. It causes severe problems in irrigation in its command area neighboring to the Project Area.

Paddy growing may suffer from cold water damage, because runoff water depends its source on snowmelt water during irrigation period. The MOA, therefore, started the observation of water temperature of the Haraz river. From the observation at the Kari diversion, water temperature reaches minimum of approximately 6°C in January and February, then increases to 10°C in early April, and exceeds 20°C from August to September, but decreases sharply from October. Water temperature is higher by 1°C to 2°C at 8 km downstream from the Kari diversion during the irrigation period.

(2) Groundwater

A large scale groundwater survey of the Mazandaran Province has been conducted for over almost 10 years, and has made a substantial contribution to the development of groundwater resources. The following are the analysis of groundwater discharge, groundwater balance, and water quality based on the data.

1) Groundwater Use at Present

It is reported that there are 70 springs and 37 artesian wells in the Project Area. The total discharge of them is assumed as 1.58×10^5 m^3/day.

There were 4,145 wells in the Project Area as of 1361, most of which were shallow wells under 15 meters in depth. A well discharge survey made by abstracting 10 percent of the existing total wells shows that average water quantiy available at a well is 5.32 lit/sec and the average operating hours amount to 1,342 hours. Therefore, the total irrigation water supplied from the wells is obtained as follows:

5.32 lit/sec x 3,600 sec. x 1,342 hr x 4,145 wells
= 106.5 MCM

2) An Estimate of Groundwater Discharge by Flow Net Analysis

Exhibit-A.3.3 (Appendix A.3) shows the groundwater equipotential lines in the wet season in April 1982 (1361 Farvardin) and in the dry season in September 1982 (1361 Ordibehest). The groundwater discharge in 1982 can be assumed as follows:

1.73×10^5 m^3/day : in April, 1982
1.71×10^5 m^3/day : in September 1982

The result means that the average discharge of groundwater from the Project Area to the Caspian Sea is $Qg = 1.72 \times 10^5$ m^3/day.

3) Groundwater Balance

The details of groundwater balance in the Project Area are given in A.3.5. of the Appendix. The total groundwater use in one irrigation period is estimated at 136.8 MCM. The total groundwater discharge to the Caspian Sea in the same period is about 18.1 MCM. Therefore, the possibility of further groundwater use is very limited.

4) Groundwater Quality

A survey of electrical conductivity (EC) was conducted to analyze water quality. Values of 3,000 micro mhos/cm were found in the north-eastern part and along the Babol river. However, the average electrical conductivity in the whole Project Area is below 1,000 micro mhos/cm and there is no indication of saline water intrusions. However, high electrical conductivity is found in the southern hilly range, and some of artesian wells show a considerably high electrical conductivity and a rather high temperature at 24°C. Such water can be considered as fossil water.

5) Conclusion

i) There was almost no change in groundwater storage over the year between September 1981 and September 1982 (h = 0.06 m) and the storage appears to be well-balanced in present conditions.

ii) There is no indication of saline water intrusions except in the eastern part of the Project Area presumably due to the predominance of groundwater discharge over the saline water intrusion.

iii) It seems possible to develop and utilize part of the groundwater that is presently discharged into the Caspian Sea. For that purpose, careful observation of saline water intrusion is necessary.

iv) At present, the construction of wells is restricted at the vicinity of Amol City to secure the domestic water. The water level in this area has been lowered by more than 15 m despite of the restriction. Although there is few problem of ground settlement because of a gravel soil layer, a special attention for maintaining groundwater balance should be paid to the future development around this area.

v) Infiltration discharge in the irrigation period is earger than that in the non-irrigation period. It is recommended that measurement of infiltration on every soil type should be carried out in the future groundwater development.

vi) Above-mentioned examinations were carried out in order to grasp an outline of the whole area. Therefore, it is necessary to get the aquifer constant on every classified area for future groundwater development and utilization.

(3) The Caspian Sea

The Caspian Sea is the largest inland lake in the world and has a salinity concentration of about 20,000 ppm. The Caspian Sea has a long term fluctuation of its sea level. The record shows that the sea level remained at EL-27.6 m PGD presently in 1984, but it fluctuated greatly after 1926. After it reached the highest level at EL-25.3 m PGD in 1929, it lowered to EL-28.5 m PGD by 3.2 m until 1977. From 1978 it began to rise again, and reached EL-27.6 m PGD in 1981. Since 1981, it has remained almost at the same level until recent years. Details are in the Appendix A.2.5.

As the major reason of recent rising of sea level, the transfer of the northern river basins to the Volga may be considered. However, it is not clear whether this rising has been caused by such change of the basins or by the long term fluctuation, because there are no sufficient data to analyse it. The transfer basin project was planned in 1973 to change the river courses of the northern rivers of Pechora, Sev. Drina and Onega to the Volga. This project was suspended in August 1986, because the project was considered to cause the environmental destruction in the surrounding areas. However, this project already commenced partically, although the scale of it cannot be reported due to lack of data on it.

The data of the U.S.S.R. suggest that the reason of recent rising of the sea level has not yet been made clear in this country. In their opinion, the inflow having been increased by the transfer of river basins is too small in quantity to raise the Caspian Sea level. They consider that the Caspian Sea shows a long-term fluctuation in the order of 100 years. However, they report that it is not clear whether the recent rising is caused by the long-term upwards fluctuation or not.

Apart from it, reportedly the annual inflow to the Caspian Sea has been decreased by 40,000 MCM due to the water resources development of the rivers flowing into the Caspian Sea. Under the circumstances, in addition to the recent rising, it is anxious that the lowering of the sea level which the Caspian Sea has never experienced might possibly take place in future.

Careful scientific attentions shall be paid to the fluctuations of the Caspian Sea level. It is anticipated that the water pollution prevention inclusive of salinity accumulation would be an important subject of studies in future.

(4) Total Water Resources

The total water resources in the Project Area is estimated under the following preconditions;

(i) Infiltration in the Project Area is predominant for groundwater recharge, and influxes from the southern hilly range and the river bed of the Haraz are negligibly small.

(ii) After full operation of the Lar dam, a water amount of 160 MCM will be transferred to Tehran from the Haraz basin for domestic water, and the irrigation water of 240 MCM will be ensured for the downstream of the Haraz river.

As shown in Table 1.2.4., water resources are estimated at 968 MCM during the irrigation period, which is about a half of 1,929 MCM of the total water resources. Water resources available in the irrigation period consist of 67% from river water, 19% from rainfall and 14% from groundwater.

Table 1.2.4. Total Water Resources in the Project Area

(Unit: MCM)

	Before Completion of Lar Project (Present)			After Completion of Lar Project (Future)		
Water Resources	Irrigation Period (Apr-Aug) (Far-Mor)	Non-Irrigation Period (Sep-Mar) (Sha-Esf)	Total	Irrigation Period (Apr-Aug) (Far-Mor)	Non-Irrigation Period (Sep-Mar) (Sha-Esf)	Total
Haraz River	717	345	1,062	638	264	902
Lar River	(319)	(81)	(400)	(240)	(0)	(240)
Residual Basin	(398)	(264)	(662)	(398)	(264)	(662)
Precipitation	186	649	835	186	649	835
Groundwater	137	55	192	137	55	192
Total	1,040	1,049	2,089	961	968	1,929

Note: Precipitation is estimated at 176.9 mm for irrigation period and 616.4 mm for non-irrigation period to the gross area of 1,052 sq.km.

1.2.4. Soil

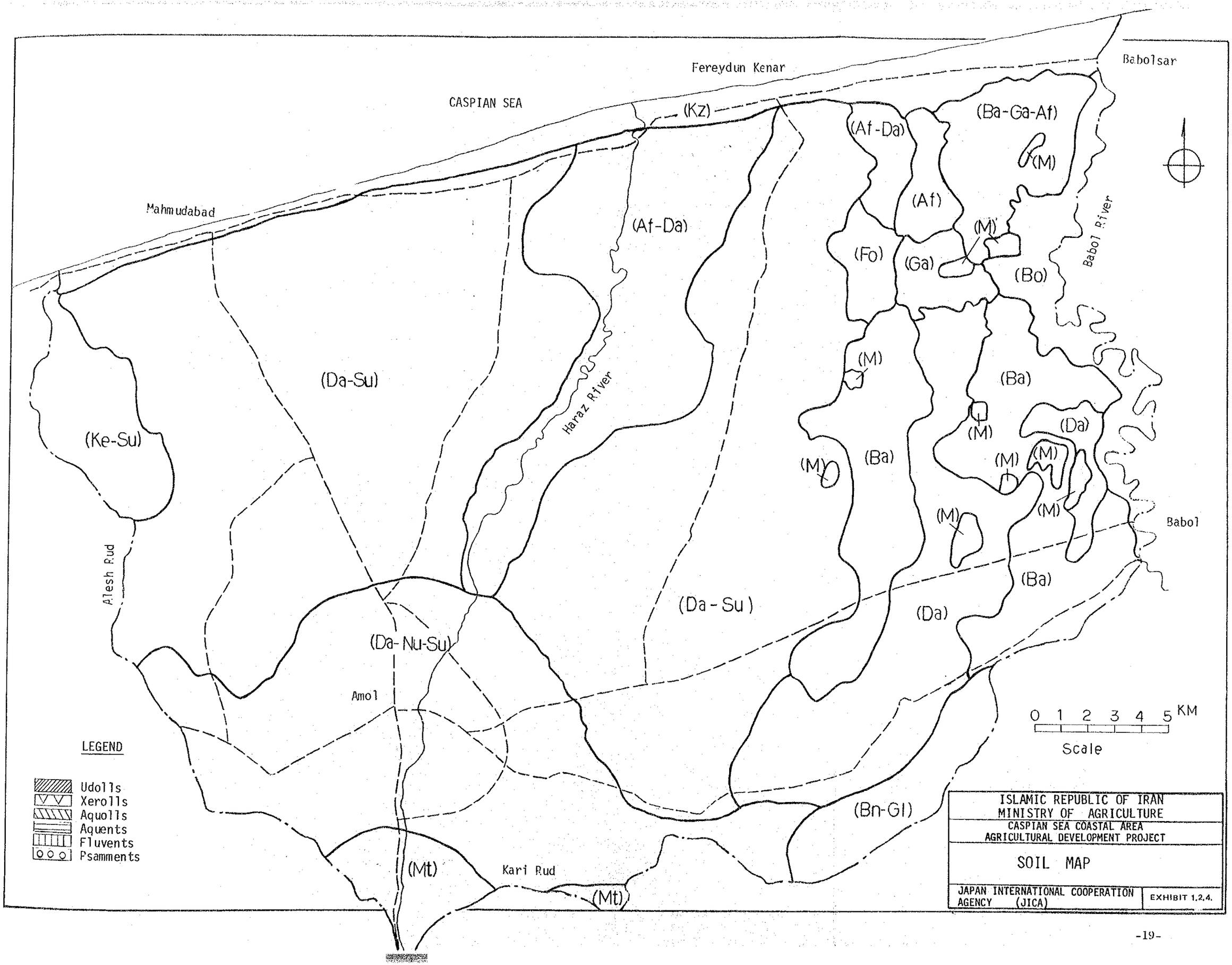
Mollic Fluvaquents and Fluventic Haplaquolls are distinguished in the Project Area, covering 85% of the area. These soils are distributed in floodplains or lower fringe of alluvial fans. They are wet and continuously saturated with water, therefore, gleyzation is the prominent process of soil formation.

Mollic Fluvaquents having loamy to silty clay texture with poor drainage are mainly found in the nearly level alluvial plains. They do not show the significant profile development and are similar to the loamy type of strong gley or gley soils in Japan. Rice regions in Asia has been developed on most Aquents, however, the general conditions of paddy cultivation on these soils are generally not so favourable. (Reference-14) Namely, rice suffocation and damage due to recurrent deep flooding are not rare on such alluvial plains. Frequently, zinc deficiency or iron toxicity occurs in these soils. the surface soils should be dried periodically to a sufficient degree so that oxidation can take place.

Fluventic Haplaquolls have medium texture of silty loam to clay loam but their drainability is also poor. These soils have been developed from basic parent materials under grassland or forest vegetation. They are characterized by having a thick, dark-colored, well-structured surface horizon with high humus content (mollic epipedon) and a high base saturation throughout the profile. Therefore, the inherent fertility is relatively high. These soils are saturated with water and deeply flooded periodically. It is said that the soils of the rice-growing areas in U.S.A. and U.S.S.R. belong to these soils. In calcareous Aquolls, moderate to severe zinc deficiency may occur as experience in the Philippines. (Reference-14)

In the paddy fields where land levelling was carried out without drainage improvement, the soils containing muck-like materials locally called as "lapar" are observed. They have been formed from the buried organic materials such as rice straw under unaerobic condition. It threatens inducing potassium deficiency (Akagare Type I).

The soil has been investigated physically in the area. The hydraulic conductivity is generally high ranging from 1×10^{-4} cm/sec. to 2×10^{-2} cm/sec. and lower in the high land. The permeable soils are extending in the area along the Babol river, where the lands are utilized as upland fields. (see Figure A.4.2. in Appendix A.4.) The soil bearing capacity is generally low excepting the high land. The soils of a bearing capacity lower than 2.0 kg/cm^2 extend widely, particularly in the middle land of the Kari Rud and the Haraz Right Bank Areas. (see Figure A.4.3. in Appendix A.4.)


Fereydun Kenar
Babolsar
CASPIAN SEA
(Kz)
Mahmudabad
(Af-Da)
(Ba-Ga-Af)
(Af-Da)
(M)
(Af)
(M)
(Fo)
(Ga)
(Bo)
Babol River
(Da-Su)
Haraz River
(M)
(Ba)
(Ke-Su)
(M)
(Da)
(M)
(Ba)
(M)
(M)
(M)
(M)
Babol
Alesh Rud
(Ba)
(Da-Su)
(Da)
(Da-Nu-Su)
Amol
0 1 2 3 4 5 KM
Scale
LEGEND
Udolls
Xerolls
Aquolls
Aquents
Fluvents
Psamments
(Bn-Gl)
(Mt)
Kari Rud
(Mt)
ISLAMIC REPUBLIC OF IRAN
MINISTRY OF AGRICULTURE
CASPIAN SEA COASTAL AREA
AGRICULTURAL DEVELOPMENT PROJECT
SOIL MAP
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
EXHIBIT 1,2,4.

1.2.5. Land Classification

Comparing with upland crops, paddy has a different critical range of limitations as below:

Paddy cultivation:

- Requires somewhat heavier soil texture,
- Allows shallower soil depth,
- allows wider range of soil pH,
- requires more level land (even overall slope of zero percent is allowable); and,
- allows somewhat poor drainage and is more tolerant to ponding or flooding than upland crops.

Considering the above difference, the lands are classified from three important limitative factors; they are, soil, topography and drainage. For paddy or for upland crops, the lands without limitative factors are classified into Class 1 and the land with some limitative factors are classified into Class 2 or Class 3 depending on the degree of limitation. Class 6 is non-arable land which does not meet the minimum requirements for other land classes.

In the Project Area, Class 1 lands which include neither limitation for paddy nor for upland crops (IR/IU) occupy about 22,000 ha, moreover, the lands which have no limitation for paddy but somewhat poor drainage restrains upland crops cultivation (IR/2Ud) occupy about 38,000 ha. These suitable lands for paddy sum up to about 60,000 ha, that is, about 60% of total Project Area. In addition, Class 2 and Class 3 lands where the poor drainage affects not only upland crops but also paddy cultivation (2Rd/2Ud, 2Rd/3Ud, 3Rd/3Ud) occupy about 36,000 ha. As a whole, these Class 1, Class 2 and Class 3 lands are considered to be much suitable for paddy rice than for upland crops and occupy nearly 90% of total Project Area.

On the other hand, the lands which have some limitations to paddy due to the coarse texture and steep slope (2Rs/1U, 2Rt/2Ut, 3Rs/1U) occupy about 5,000 ha in the upper alluvial fans and along the Babol river as well as in the vicinity of sand dunes. These lands are considered to be suitable for upland crop cultivation, though paddy can be cultivated.

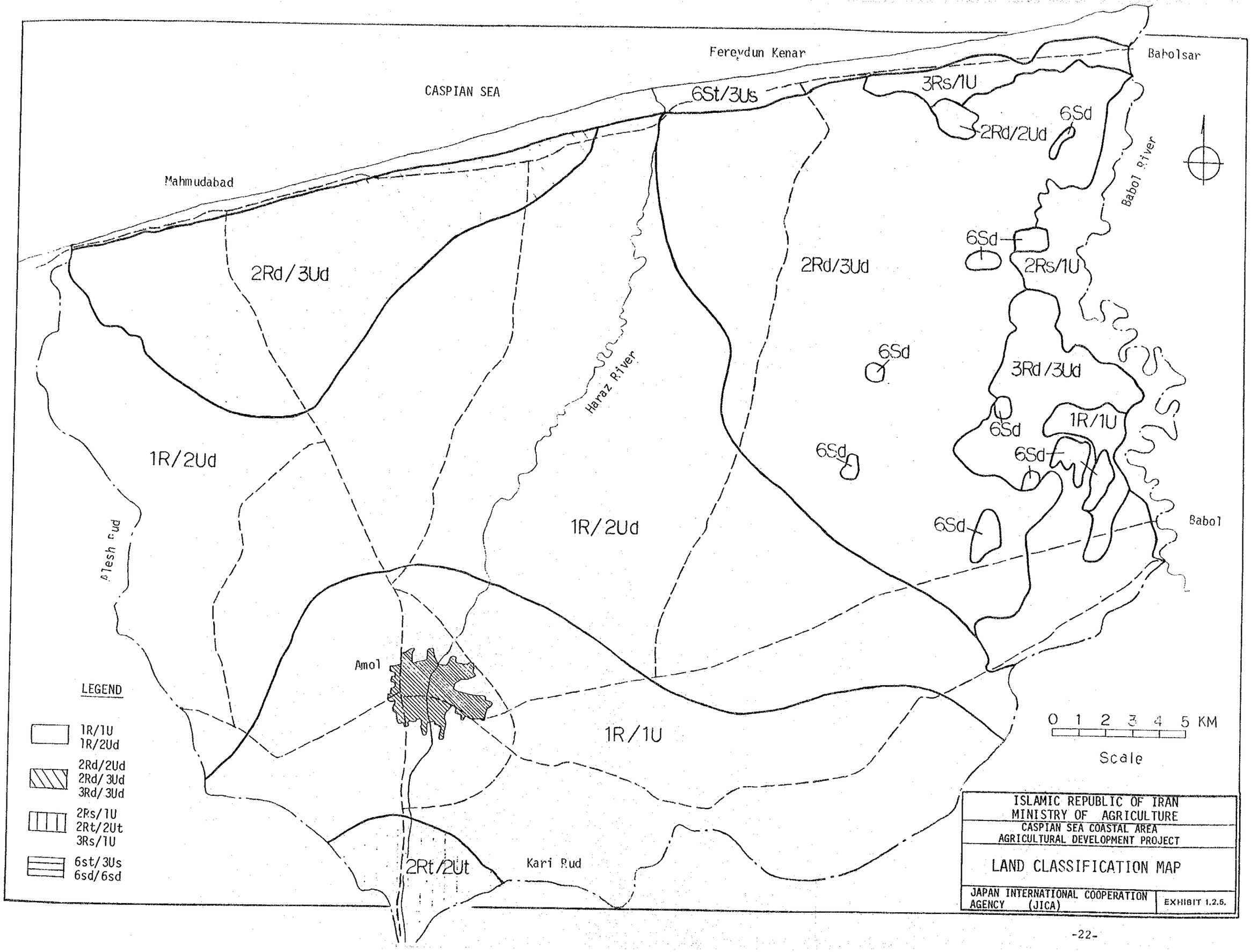
The rest is sandy lands near the coast line where paddy cannot be cultivated due to the sandy texture and excessive drainage as well as micro-relief (6st/3Us) and the scattered reservoirs and their surroundings where neither paddy nor upland crops are cropped due to poor soil and drainage conditions (6sd/6sd). These Class 6 lands total to about 4,000 ha. Though, the scattered reservoirs and their surroundings are presently used for reservoirs and pastures, and can be developed technically for paddy cropping with considerable investment to improve drainability and sub-soils.

The above-mentioned soils and land classifications are summarized in Exhibits 1.2.4 and 1.2.5 and Table 1.2.5. Details are described in Appendix A.4.

Table 1.2.5. Land Classification of the Project Area

	Area		For Paddy Rice			For Upland Crops		
Land Class	ha 1/	%	Class	ha 1/	%	Class	ha 1/	%
1R/1U	21,790	20.7	1R	60,150	57.1	1U	25,230	24.0
1R/2Ud	38,360	36.5						
		(57.2)						
2Rd/2Ud	170	0.1	2Rs	2,510	2.4	2Ut	1,930	1.8
2Rd/3Ud	30,950	29.4	2Rt	1,930	1.8	2Ud	38,530	36.6
3Rd/3Ud	4,740	4.5	2Rd	31,120	29.6			
		(34.0)			(33.8)			(38.4)
2Rs/1U	2,510	2.4	3Rs	930	0.9	3Us	3,020	2.9
2Rt/2Ut	1,930	1.8	3Rd	4,740	4.5	3Ud	35,690	33.9
3Rs/1U	930	0.9						
		(5.1)			(5.4)			(36.8)
6st/3Us	3,020	2.9	6st	3,020	2.9	6sd	820	0.8
6sd/6sd	820	0.8	6sd	820	0.8			
		(3.7)			(3.7)			
	105,220	100.0		105,220	100.0		105,220	100.0

Note: 1/ ... Including residential area, river and road/ canals.


Fereydun Kenar
Babolsar
CASPIAN SEA
6St/3Us
3Rs/1U
6Sd
2Rd/2Ud
Babol River
Mahmudabad
2Rd/3Ud
2Rd/3Ud
6Sd
2Rs/1U
Haraz River
3Rd/3Ud
1R/1U
6Sd
6Sd
6Sd
1R/2Ud
1R/2Ud
6Sd
Babol
Alesh Rud
Amol
LEGEND
1R/1U
1R/2Ud
2Rd/2Ud
2Rd/3Ud
3Rd/3Ud
2Rs/1U
2Rt/2Ut
3Rs/1U
6st/3Us
6sd/6sd
1R/1U
2Rt/2Ut
Kari Rud
0 1 2 3 4 5 KM
Scale
ISLAMIC REPUBLIC OF IRAN
MINISTRY OF AGRICULTURE
CASPIAN SEA COASTAL AREA
AGRICULTURAL DEVELOPMENT PROJECT
LAND CLASSIFICATION MAP
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
EXHIBIT 1.2.5.

1.3. Socio-economic Aspects

1.3.1. Administrative Characteristics of the Project Area

The Project Area belongs to Amol and Babol Shahrestans of Mazandaran Province. In accordance with the 1355 Census, Amol Shahrestan consists of 2 towns (Shahr) and 3 Districts (Bakhsh), and Babol Shahrestan stands on 4 towns and 3 Districts. Each District are divided into Village Districts (Dehstan); 13 Village Districts in Amol Shahrestan and 12 in Babol Shahrestan, but the Village District have no administrative function. As a head of Province, Shahrestan, town and District, the Ministery of Interior assigns Governor General (Ostandar), Governor (Farmandar), Mayor (Shahrdar) and Head of District (Bakhshdar), and most of the Ministries, except Ministry of Foreign Affairs, etc., have their provincial branches and branch offices of Shahrestan. The Governor General and Governor are coordinating among the activities of branches of Central Government, but the personnel and budgetary affairs are directly belonging to each Ministry; therefore, the administrative structure is deemed as central control type. Due to such structure, the coordination and cooperation among the Regional Directorates General or Shahrestan Offices of different Ministries are made not so smoothly. Moreover, some of the Ministries have different branches by the Departments of headquarters; therefore, lack of cooperation and/or confusion of duties are observed. For instance, in case of the irrigation facilities, the main canals are managed by the Ministry of Energy and the terminal canals are under the responsibility of the Ministry of Agriculture in accordance with the regulation, but the definition of Main Canal and Terminal Canal is not clear. In case of the roads, the Ministries of Roads and Transportation, Interior and Construction Jihad are related, but the coordination among them do not seem sufficient. The governmental procurement of rice is operated by the Ministries of Commerce and Agriculture separately, and some confusion of policy is also observed.

As mentioned above, the Project Area stretches in both the Amol and Babol Shahrestans, and, in accordance with 1355 Census Report, 2 Towns and 6 Dehstans of Amol Shahrestan are located in the Project Area as well as the northern half of Dashtsar and Bala Khiaban Litikuh Dehstans. As for Babol Shahrestan, the town of Feridon Kanar and 4 Dehstans are included in the Project Area as well as most part of Jalalazrak Junubi Dehstan and a few villages of Sasi Kolam and Ganji Afruz Dehtans, which are located in the southwest of Babol Shahrestan. A part of Babolsar town is also located in the Project Area. The total number of villages in the Project Area is reported in the above census report by 494, 357 in Amol Shahrestan and 137 in Babol Shahrestan.

In General, the boundaries of villages are not clear and the reason is considered to have close relation with the formation of villages as explained in the paragraph 2.6.4. Namely, in the Project Area, the spread type villages have been formed at the early

period, then the villages have been developed toward semi-collective type in accordance with increase in population and establishment of land ownership. Therefore the village formation is personal principle, and the boundaries of villages which show the community unit nowadays have not settled yet. For such reason, the boundaries of Dehstan, even the boundary of Shahrestan in some cases, is neglected in the administrative activities and/or formation of farmer's organization.

Exhibit-D.1.1 of Appendix shows the Administrative Boundary of Shahrestan, Dehstan, etc. based on 1355 Census Report and Table D.1.1 shows the outline of Administrative Organization.

1.3.2. Population and Its Distribution

The National Census reveals that the population of Project Area in 1355 was 304,710, of which 90,005 were urban inhabitants and 214,705 were rural inhabitants. (ref. Table D.2.1 of Appendix)

The rate of population growth was 2.96% in 1345-55 and it was higher than the national average of 2.71% in the same period. The rates of population growth at the urban area and main villages in the Project Area are shown below;

Area	Rate of Population Growth	Ratio of Population
Villages of Babol Shahrestan	3.05%/annum	25.2%
Feridon Kanar	5.22	4.6
Coastal Area of Amol Shahrestan (Dabu-Shomali, Harazpei Shomali and Ahlamrostagh)	3.12	21.1
Mahmud Abad	7.64	2.3
Inland Area of Amol Shahrestan	2.61	24.2
Amol	5.82	22.6
Total	2.96%/annum	100.0%

The rate of population growth was comparatively high in the urban areas, and the Dehstans at the coastal area were keeping the population growth rate similar to that of natural increase, but the inland Dehstans of Amol Shahrestan showed a clear trend of population outflow.

There are not any reliable data to assume the present population, but the Child/Woman Ratio in 1345 and 1355 Census by regions are shown in the following table which can suggest the general trend of population growth.

Table 1.3.1. Child/Woman Ratio by Region

Year	Whole Country			Mazandaran		
	Total	Urban	Rural	Total	Urban	Rural
1966	851	746	921	912	762	961
1976	733	604	855	758	629	824

Year	Amol Shahrestan			Babol Shahrestan		
	Total	Urban	Rural	Total	Urban	Rural
1966	994	792	1,059	903	694	1,000
1976	754	620	824	717	540	810

As shown in the above table, the Child/Woman Ratios of Rural areas of both Amol and Babol Shahrestans were higher than the average of Country and Mazandaran, and the total of Shahrestans was also higher than the national average showing the potentiality of high rate of population growth in 1345-55 period, but the ratio in 1355 had become lower than national average showing the lower population reproduction trend, but, considering many changes in social structures after the revolution of 1357, it is rather doubtful if the decreasing trend of population growth has been maintained. On the other hand, the result of the whole village survey by the Ministry of Agriculture for the development scheme in 1364 (hereinafter referred to as Village Survey-1364) shows the rural population of the Project Area as 324,194, of which 205,398 are in Amol Shahrestan and 118,796 in Babol Shahrestan. Therefore, the population growth rate in 1355-64 was as high as 4.9% per annum. The data shows many incompleteness but the comparison of representative villages by Dehstan also shows the rate of population growth of 2.9 - 4.5% and the mean rate is 3.7%. (ref. Table D.2.2 of Appendix)

Note: In accordance with a tentative announcement of 1365 Census, total population in Babol and Amol Shahrestan are 485,000 and 335,000, respectively, therefore their rates of population growth are 3.35% and 3.72% per annum.

Family size was reported in 1355 Census as below:

Table 1.3.2. Distribution of Family Size by Area

(Unit: %)

Area \ Family Size (person)	1	2	3	4	5	6	7	8	9	10	Mean
Amol Shahrestan	3.7	6.8	9.5	12.8	14.9	15.4	14.0	10.0	5.8	7.1	5.8
Rural Area	3.6	5.6	8.0	11.7	14.2	15.6	15.1	10.8	6.7	8.9	6.1
Amol	3.5	9.0	2.2	15.2	16.3	15.3	12.2	8.4	4.2	3.7	5.3
Mahmud Abad	6.7	8.2	12.3	13.0	15.5	13.3	11.8	9.0	4.7	6.5	5.4
Babol Shahrestan	5.0	9.1	11.4	13.2	14.5	14.3	12.5	9.1	5.5	5.5	5.4
Rural Area	3.9	6.9	9.5	12.0	14.3	15.1	14.0	10.7	6.7	6.9	5.8
Feridon Kanar	10.5	11.4	12.7	14.6	15.2	12.0	9.8	5.9	3.4	3.6	3.7

As the above table shows, except the town of Feridon Kanar, the average family size is 5 - 7 persons in the rural area and 4 - 6 persons in the urban areas, and the family size of Amol Shahrestan is larger than that of Babol Shahrestan. The same trend is shown in the result of Village Survey-1364 (ref. Appendix F). The urban inhabitant ratio was 29.5% in 1355 Census and this ratio was rather low comparing with the national average of 47.0% in the same period, but the surrounding villages of Amol city and western villages of Babol city in the Project Area are showing extinguished trend of substantial urbanization. Therefore, taking into account the existence of rural inhabitants with their subsistence basis in nearby urban area, the actual urbanization rate is rather high.

1.3.3. Employment and Man-power

The employment situation in the Project Area can be learnt as below from Employment Status and Classification of Employed Population at the Census of 1355 and Job Distribution of Head of Household at the Village Survey-1364.

Firstly, the ratio of economically active population in the age group of over 10 years in Amol Shahrestan was 35.3% and that of Babol Shahrestan was 44.5%, but the ratio in the age group of 15 - 55 years old was 44.2% in Amol and 55.0% in Babol. The reason of the high ratio of economically active population in Babol Shahrestan is due to the difference in economically active female population, which is 3.7% in Amol and 30.4% in Babol (both over 10 years old population). The ratio of employed population in the economically active population was 62.8% in Amol Shahrestan and 36.8% in Babol Shahrestan for the age group of over 10 years old, but that of the rural inhabitants was 47.5% in Amol and 17.7% in Babol. In case of the age group of 15 - 55 years old in the rural area, the ratio was reported by 49.0% in Amol and 18.2% in Babol. (ref. Table D.3.1 of Appendix)

As for the employment by sector of industries, the highest ratio was reported as Manufacturing/Transportation in the Shahrestan basis; 39.3% in Amol and 41.8% in Babol. In case of the rural area, Agriculture/Fishery was 41.3% and Manufacturing/ Transportation was 34.0% in Amol, and those of Babol were 27.8% and 43.7% respectively. (ref. Table D.3.2 of Appendix)

On the other hand, the Job Distribution of Head of Household shown in Table D.3.3 of Appendix reports that the ratio of landowner farmers including non-resident landowners is considerably different between the ratio of employed population by sector reported in 1355 Census. Such difference is considered due to classification of employment status at the Census, viz., most of farmers have been classified as non-employed population in the Census because of working situation in the Census time of Aban month.

1.3.4. Situation of Social Infrastructure

The situation of social infrastructural preparation in the Project Area is summarized as follows taken from the Village Report in 1355 Census and the Village Survey - 1364.

Table 1.3.3. Situation of Social Infrastructure in Rural Area

Village Size (household)	10 less than 10		11 - 15		51 - 100		101 - 200		200 more than 200		Total	
Year of Survey	1355	1364	1355	1364	1355	1364	1355	1364	1355	1364	1355	1364
No. of Village by Size	37	6	196	130	162	166	77	113	22	68	494	483
Electricity	3	4	40	124	37	166	28	12	17	68	125	474
Piped Water	2	-	5	18	7	34	5	38	2	27	21	117
Public Bath	1	1	104	79	144	136	75	05	22	64	346	385
Primary School	1	-	105	75	137	118	69	01	21	66	333	360
Secondary School	-	-	4	4	7	21	5	32	7	44	23	101
High School	-	-	-	-	1	2	-	8	1	7	2	17
Mosque	13	3	172	94	160	136	77	06	22	66	444	405
Clinic	1	-	-	1	1	13	4	12	4	23	10	49
Physician	1	-	1	1	1	9	3	6	4	12	10	28
Nurse/Mid Wife	-	-	2	-	4	2	5	3	2	3	13	8
Veterinarian	1	-	29	-	47	1	24	-	7	4	108	5
Post	-	-	-	1	2	-	4	2	3	15	9	18
Telephone	-	-	1	1	-	3	-	3	1	15	2	22
Fuel Distributor	-	-	6	3	17	5	15	21	10	30	48	69
Bank	-	-	-	1	2	2	4	4	6	16	9	25
Cooperative Shop	-	-	8	4	20	20	16	28	8	29	52	77

The above 2 surveys have some differences in the surveying method, therefore, the accurate comparison is rather difficult. As a general trend, however, the social infrastructure in the rural area has been developed rapidly in the Project Area. Especially, such facilities which do not need intensive services after installation as electrification, water supply, etc. have been developed remarkedly, and most of villages have been electrified so far. But such facilities which need intensive services as educational and medical facilities etc. in spite of increase in number, still low in ratio per village, and the provision of telephone networks is very slow in the progress. In respect to the road networks, the national highway to connect the main cities of the surrounding area and the main roads between the towns in the Project Area have been provided and their maintenance conditions are also acceptable (ref. Appendix D.6). But the village roads to connect the villages in the Project Area are so narrow that even a small track can pass with difficulty, and the maintenance is also not sufficient. The farm roads which connect the village roads and paddy fields are very scarce, and only few roads are running along the irrigation canals or in the paddy fields.

1.4. On-going Development Projects

Early 1340s, the proposed Project Area was developed rapidly under the impact by two completed projects of the Land Reform and the Construction of Road between Tehran and Amol. In other words, the tenant-turned land owner farmers reclaimed or developed the unreclaimed land and the fallow land, and the necessary measures were taken for securing the irrigation water.

On the other hand, the completion of the road has allowed traffics to link between Tehran and Amol in the possibly shortest time at present, Amol to become a center of traffic networks and the coastal area to grow rapidly as a resort site owing to convenience in transportation. On the basis of those conditions given as above, various development projects have been planned and implemented, and the major projects among them are referred to as follows.

1.4.1. Water Resources Development Projects

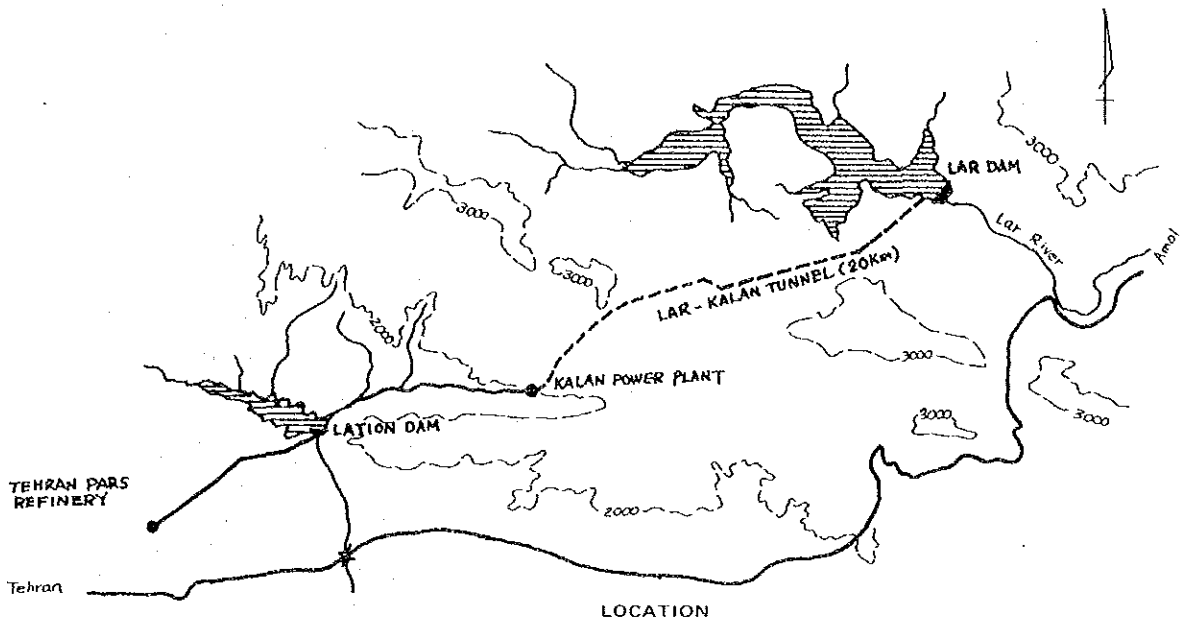
The survey works conducted by Sir Alexander Gibb & Partners in the latter half of 1330s were the very beginning of the development of the Haraz river; however, the main purpose of their consulting services did not lie in the development of the proposed area of this Project but in studying the water balance to secure the water sources for the Tehran municipal water supply and irrigation of the right bank tract of the Babol river. For the purpose, the feasibility study on water resources development of the Haraz river basin was started in 1337, when the Parliament approved the Act for construction of the Lar dam and the Latian dam, together with the vested water right in the Project Area.

In other respect, the regional groundwater investigation was also commenced in parallel with the groundwater yield survey for ensuring the water sources for domestic water supply in the Project Area and its vicinity, and also for agriculture. These projects are outlined as follows.

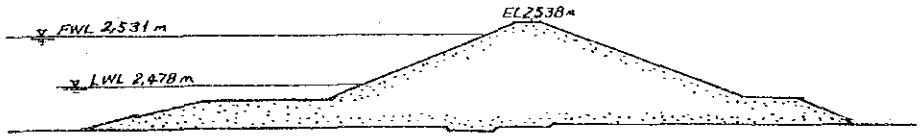
(1) Lar Dam Project

Lar dam was constructed in 1360 to supply municipal water to Tehran and irrigation water to the downstream area of the Haraz river. Lar dam is an earthfill dam having a total storage capacity of 960 MCM. This project was planned and designed by Sir Alexandar Gibb & Partners and the design was completed in 1351. The construction of the dam was started in 1354 and constructed in spending seven years. (see Exhibit 1.4.1)

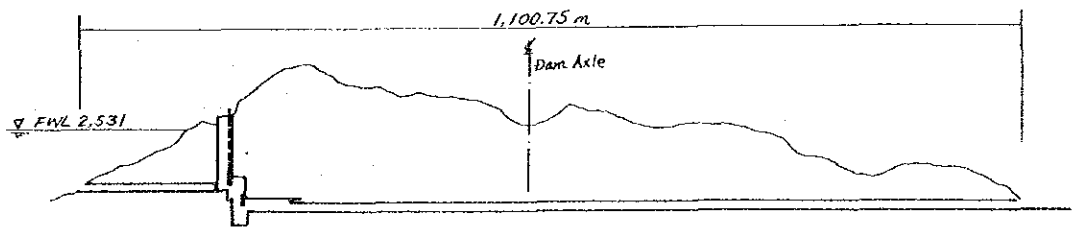
Storage has been started since completion, but not reaching the full storage even at present due to leakage of 10 cms at the right bank of the reservoir. The outlets of leakage are found at two sites and flow into the Haraz river. The Government has been making additional grouting for leakage in expecting to complete in Mehr 1365.



LOCATION



DAM SECTION



SECTION OF MAZANDARAN IRRIGATION TUNNEL

ISLAMIC REPUBLIC OF IRAN MINISTRY OF AGRICULTURE	
CASPIAN SEA COASTAL AREA AGRICULTURAL DEVELOPMENT PROJECT	
LAR PROJECT	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	EXHIBIT 1.4.1

Major dimensions of the dam are as follows;

Dam Type	Earthfill Dam
Dam Height	105 m
Dam length	1,500 m
Dam Crest Elevation	EL.2,538 m (PGD)
Full Water Level	EL.2,531 m (PGD)
Earth Volume	21 MCM
Catchment area	675 sq.km
Reservoir Area	29 sq.km
Total Storage Capacity	960 MCM
Effective Storage Capacity	860 MCM
Water Allocation 400 MCM/year	Tehran Water Works 160 MCM/year
	Haraz Irrigation 240 MCM/year
Spillway	1,100 cms (1/1,000 year)
Right Bank	120 cms
Left Bank	980 cms (overflow depth 4.7 m)

Since the Lar Dam Project has a direct relation of the water allocation to the Project Area, it is necessary to establish the future land use and the water management plan in the Project Area in accordance with the operation and water allocation plan of the Lar dam. The result of water balance in the Project Area studied in the para. 2.3.5 has to be fully discussed in the Coordinating Committee between the MOA and the MOE.

Though full operation of the Lar dam has not been commenced yet, it has released irrigation water of 197 MCM per year in the irrigation period since 1360. The released amount was very close to the proposed amount of 240 MCM in 1360, 1363 and 1364.

Table 1.4.1. Irrigation Water Released from the Lar Dam

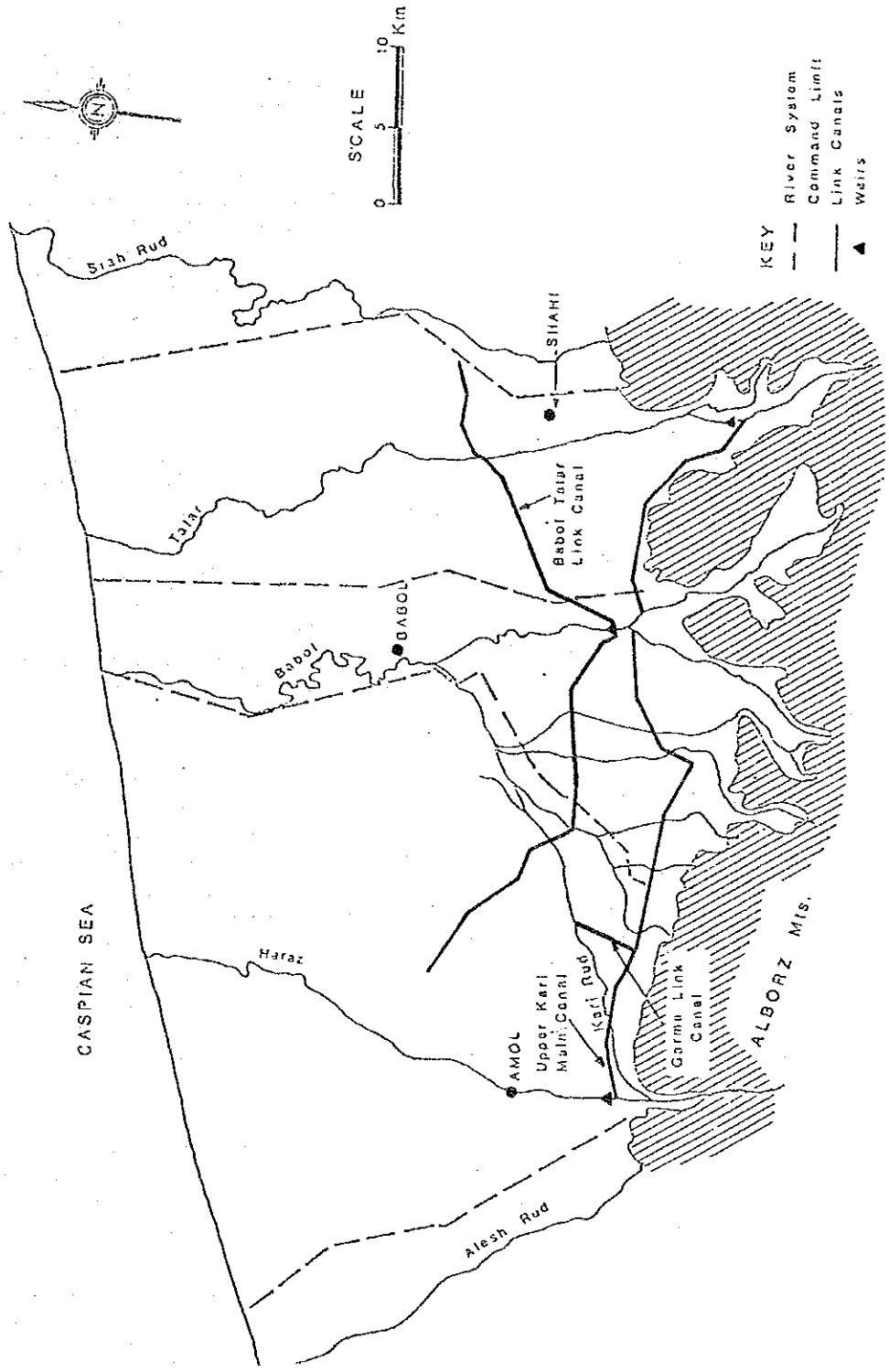
(Unit: MCM)

Month	1360 (1981)	1361 (1982)	1362 (1983)	1363 (1984)	1364 (1985)	Average
Far (Apr)				22	10	16
Ord (May)				67	72	70
Kho (Jun)	(no informations)			61	69	65
Tir (Jul)				38	38	38
Mor (Aug)				29	29	29
Total	222	185	141	217	218	197

Note: Amount including leakage water
Data Source: Mazandaran Regional Water Board

(2) Link Canal Project

There have been not so large scale water resources development projects as the Lar Dam Project in the region. As a future development plan, the Link Canal Project was proposed by Sir Alexandar Gibb & Partners.



ISLAMIC REPUBLIC OF IRAN MINISTRY OF AGRICULTURE	
CASPIAN SEA COASTAL AREA AGRICULTURAL DEVELOPMENT PROJECT	
LINK CANAL PROJECT	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	EXHIBIT 1.4.2

It is proposed in this project to transfer the flood of the Talar and Babol rivers to the downstream area of the Haraz river for farming during the irrigation period by constructing the link canals and the weirs across the Haraz, Babol and Talar rivers. The transfer of flood also aims to convey the surplus storage of the Lar dam to the downstream areas of the Babol and the Talar rivers for effective water use. (Reference 9)

When this project is implemented, a considerably large amount of water will flow into the eastern part of the Project Area, and it may inundate the paddy fields, even in a short period. This problem should be studied carefully.

It can be also pointed out that this project should be decided only after the study of the possibility to construct reservoirs in the Babol and Talar river basins. (Reference 1)

(3) Haraz - Babol - Talar River Water Resources Development Project

The contract was concluded between the MOE and MAHAB GHOTZ for the study on the water resources development in the subjected three river basins for accelerating the aforesaid Link Canal Project.

The study was started in Mehr, 1363, and took three years for its finishment. The study aimed to have thorough knowledge of the water resources available in the three river basins, to forecast the future water demand in the related areas and to formulate an optimum water allocation including an allocation to Tehran metropolitan area. The major issue in the water allocation plan is on the amount of water transferable from the Haraz river to those areas in the right bank tract of the Babol river basin and the downstream area of the Talar river.

The scope of works defines the study as follows in brief.

The study is carried out;

1) to make inventory of the rivers in the three river basins and to select suitable construction sites of dam or headworks;

2) to look into the possibility of intertransfer of the water among three river basins;

3) to analyze the availability of groundwater in the plain areas of the three river basins and to look into the possibility of combined use of groundwater and surface water;

4) to formulate a plan of establishing the irrigation/ drainage canal networks in the three river basins;

5) to review the plan for the Link Canal Project;

6) to check the alternatives proposed in the Link Canal Project and their possibility to realization; and

7) to look into technical soundness and economical feasibility of the alternatives to give their priority.

The Interim Report of the study prepared in Esfand 1364 shows the following brief descriptions of the findings and results obtained so far by the study as well as the outline of the on-going studies.

1) In the Haraz river basin Mangol site has been selected as a possible damsite for the main stream development in stead of Karehsang site which has a geological problem. Mangol site is located at just upstream of Karehsang site.

2) In the Haraz river, the headworks will be constructed and the main irrigation canals will be constructed to the Kari Rud on the right bank with the total length of 6 km and capacity of 40 cms, and to the left bank area with the capacity of 18 cms so as to link with the secondary canals in the high lands.

3) Other than in the Haraz river, the possible damsites are selected by one site on the Garma Rud, one on the Kela Rud and two on the Babol river, and the studies are made for each site. There have been no promising damsites found on the Talar river. A study is made on the effective utilization of the water resources of the Haraz river by linking the Haraz at Mangol with those of the Garma Rud and Kela Rud through tunnels.

4) At present, there is no substantial plan for a large scale improvement of the canal networks, and the facilities of the secondary canals and their terminals will remain unchanged in principle. Drainage improvement is also studied and a feasibility study will be carried out both on irrigation and drainage improvements.

Therefore, this study has a close relation with the development of the proposed Project Area, and the promotion of the Project will require full coordination with the MOE and MOA through the Coordination Committee.

(4) Flood Control and River Training

The Babol river has caused flood damages to the Project Area once in five years, but no flood control facilities are provided so far.

The Alesh Rud also has caused flood damages to the paddy fields in the western part of the Project Area due to its small flow capacity. For this problem, the Amol District Water Office completed the diversion channel to divert flood water to the adjacent Waz Rud and the river training of the Waz Rud in 1363. And the flood damages have been slightly alleviated in the downstream area of the Alesh Rud, but not satisfactorily.

The flood damages should be mitigated to the economically proper level in accordance with future land use plan.

1.4.2. Agricultural Development Projects

The studies on agricultural development in the Project Area have been conducted in relation with the water resources development, but some agri-business were also established in accordance with the relative regulations of lease of nationalized forest land and of loan supply to the agri-business which were enacted in the later period of 1340s, and the study of Mazandaran Agricultural Pole Scheme, including the Project Area, was also executed in accordance with the Law for Agricultural Pole Establishment enacted in 1354.

Other than the above, the Irano-Taiwan technical cooperation scheme on the paddy cultivation had been executed between 1348 - 50 in the Project Area.

The summary of those development projects are as explained below;

(1) Rice Production Increase Scheme

This scheme has been commenced since 1347 as a part of extension services activities, and the seed paddy of recommended variety, chemical fertilizer, etc. have been distributed under this scheme. At the early period, the variety of Mehr, Firuz, etc. were recommended, then the recommended variety has been changed from Amol-1, Amol-2 to Amol-3, and suitable cultivating practices have been extended to the farmer. This scheme has been contributing greatly to the increase of yield/ha, and been continuing as 5 years and 10 years Rice Self-sufficient Supply Scheme since 1361. The progress of rice production increase scheme and the annual plan of Rice Self-sufficient Supply Scheme are shown in Appendix.

(2) Irano-Taiwan Technical Cooperation Scheme on the Rice Cultivation

This scheme was implemented in Amol and its surrounding areas in Mazandaran according to the agreement exchanged in 1348 between the two countries, but the scheme was terminated and the agreement was cancelled in 1351 due to the establishment of diplomatic relationship between the Iranian Government and the Government of People's Republic of China.

The agreement consisted of the following five main items;

i) Preparation and management of Demonstration Farm, which includes the services related to cultivating practices from seed selection-nursery preparation to harvesting.

ii) Establishment of extension farm, which includes land consolidation, irrigation and drainage facilities, and extension services therein.

iii) Training of Iranian specialist for seed improvement and improvement of cultivating practices at the Amol Rice Research Station.

iv) Cultivating test of cash crops after paddy harvesting.

v) Upbringing of Iranian Specialists

The cooperation scheme was executed in the cultivating seasons of 1349 and 50, and the know-how in nursery preparation, lined transplantation, pest and insect control, weeding, etc. were transferred in using such varieties of paddy as Taichung 65, Mehr, 346, etc., and about 100 extension farms were established in Amol, Babol, Ghaemshahr and Sari Shahrestans executing the land consolidation works. As for second crops to paddy, test cultivation of Chinese cabbage and other vegetables was performed.

After the Chinese experts left the country, those trials have not been continued, and the introduced practices have not been settled in acceptable extent, but it might be appraised that the trials had given considerable impact on the rapid increase in unit yield of paddy in Amol area.

(3) Lar-Mazandaran Pole Project

This project study was made as preparatory works for enacting the law for establishing agriculture pole proposed in 1355. The pole project aimed to establish suitable cropping pattern in the selected 20 regions to which the higher priority of development has been given among the whole country, and different consultants firms have been entrusted with the studies of water and land resources, socio-economic aspects, marketability of agricultural products, etc. for each pole.

At the Caspian Sea Coastal Area, three regions of Sefidrud, Lar and Gorgan have been selected as the Pole, and the Project Area is included in the Lar Pole. The Lar Pole area includes about 230,000 ha of Amol and Babol Shahrestans, and the main crop is paddy, but encouraging cultivation of winter crops such as wheat and fodder crops beside of soybean, and livestock farming promotion, mainly milk cow, has also been recommended. The cost of the project was estimated at 2,300 million Rls. in expecting the internal rate of return by 17.8%.

(4) Agri-business Scheme

The law to use the beneficial area of a dam for establishing enterprises was enacted in 1347 aiming to develop parts of the nationalized forest and pasture land where productivity was expected to be low as forestry, and the establishment of agri-enterprises had been tried. In the Project Area, such trial was also introduced and five enterprises were established after 1354 using about 2,300 ha of nationalized forest land.

Those agri-business were settled to receive loan from the Agricultural Development Bank or the Khazar Development Bank (ref. para. 3.3.4) as a part of their capital, and in the Project Area, about 670 million Rls. of loan was agreed for the five enterprises. 190 million Rls. of which were paid in the period of 1354 - 57. The purposes of establishment of those enterprises were mainly for paddy culture with 470 ha and for livestock farming of milk cow in 1,800 ha, and 4 for paddy cultivation completed the reclamation before 1357 and commenced their productive operation, but the agri-business system has been abolished after the revolution, and the reclaimed lands were distributed amongst the farmers of surrounding area in rental basis (ref. Table D.5.9 of Appendix).

1.4.3. Other Development Projects

The development schemes implemented in the Project Area other than Water Resource and Agriculture Development cover two major items of improvement of social infrastructure of public investment and tourism, development by the private enterprises and some special groups. As for the former, the following schemes have been implemented. As for the latter, those resort towns of Daria Kanar, Khazar Shahr, Khoneh Darya, etc. are promising and some hotels have been built since early 1350s, and most part of coastal areas have been brought into a resort area.

(1) Improvement of Road Network

The road networks in the Project Area before the completion of Tehran - Amol highway were rather limited to those main roads running Babol, Mahmud Abad and Nur centering around Amol, excepting coastal highway passing through the Project Area, and other roads were at the same level as the village roads. Since the later part of 1340s, the Ministries of Road, Housing and Development, etc. executed the new construction, pavement and/or widening of roads and completed most of the present road networks. The improvement of village roads is now in progress by the Construction Jihad and/or Agriculture, Rural and Tribal Service Center after 1358. There are not any long term road improvement plans, but improvement is made from time to time as required. Although vehicle-passable roads are connecting most of villages, the improvement of their width and the manner of pavement is left as future problems.

(2) Rural Water Supply

There was not any systematic scheme for rural water supply, but the Ministries of Housing and Development and/or Cooperatives and Rural Affairs of the time provided the facilities upon the request of village inhabitants, who bore a part of expenditure. After the Revolution, the water supply for the villages with less than 150 households is provided under the responsibility of Construction Jihad and the Environmental Sanitary Office is in charge of water supply for the villages larger than 150 households. In case of the Project Area, most of water sources for the rural water supply depend on the wells, but after occurring of water shortage or finding unsuitable water quality for drinking, a systematic rural water supply plan with pipeline distribution was proposed by the Environmental Sanitary office in 1362 (ref. Appendix D.6.).

(3) Rural Electrification

As for rural electrification, a country-wide Master Plan was provided in the early 1340s. And the electrification in the Project Area has been urged since the beginning of 1350s. the distribution networks are, at present, covering most of the villages; therefore, no systematic plan for rural electrification is requested for the remaining villages and the electricity is distributed upon the request of the inhabitants.

(4) Improvement of Telecommunication System

The social infrastructure most delayed in development in the Project Area is the telecommunication facilities and there were only two villages having telephones in 1355, but the National Telephone Company is endeavouring to expand the telecommunication networks at present. A plan is made to set telephone in 19 villages of Amol Shahrestan in 1364 - 1366, and the facilities installation for four villages was commenced in 1364.

CHAPTER 2.

PRESENT AGRICULTURE

CHAPTER 2. PRESENT AGRICULTURE

2.1. Present Land Use

The land use of the Project Area has been established in the close relation with such natural conditions as topography, availability of water resources, soil properties, etc. as well as the influence of changes in socio-economic conditions.

The present land use map shown as Exhibit C.1.1 has been prepared using the topo-maps prepared in 1345 (scale 1:20,000), in referring to the data and information available by interpretation of the aero-photo prepared in 1347 (scale 1:6,500) and the results of field investigation.

The results of the measurement on the said land use map can be summarized as follows, and the details are referred to in Table C.1.2 and 3 of the Appendix.

Table 2.1.1. Present Land Use by Acreages

(Unit: ha)

	High land	Middle land	Low land	Total
Paddy Fields	21,180	28,790	22,640	72,610 (69.0%)
Upland Fields	470	1,590	1,690	3,750 (3.6)
Orchards	590	490	930	2,010 (1.9)
Sub-total	22,240	30,870	25,260	78,370 (74.5)
Forests	1,320	1,370	1,000	3,690 (3.5)
Reservoirs	10	1,450	2,370	3,830 (3.6)
Others	5,250	6,160	7,060	18,470 (17.6)
Sub-total	6,580	8,980	10,430	25,990 (24.7)
River Land				860 (0.8)
Total	28,820	39,850	35,690	105,220 (100.0)

The paddy fields, occupying about 69 percent of the Area, are supplied with water from the Haraz river through many canals. The plot-to-plot irrigation has been carried out at on-farm level for paddy monoculture. The paddy fields so widely extend from the highly elevated piedmont and mountain valleys to the low-lying plain areas. And there are many small pieces of terraced paddy fields observed in the valleys. Besides, the fallow land, which is spreading over the Project Area, are included into the category of the paddy fields.

The upland fields, occupying some 3.5 percent of the Area, extend in the well-drained land near the residential areas cropping various kinds of vegetables in a small scale, and barley/wheat are

also cropped at the area where irrigation water is not sufficiently available. The high land along the left bank of the Haraz river and the terraces developing along the Babol river are occupied with upland crops like vegetables as a major crop in considerably wide areas. The upland fields along the Babol river, however, have recently been turned to the paddy fields to some extent owing to well diffusion of the pumping irrigation in the Area.

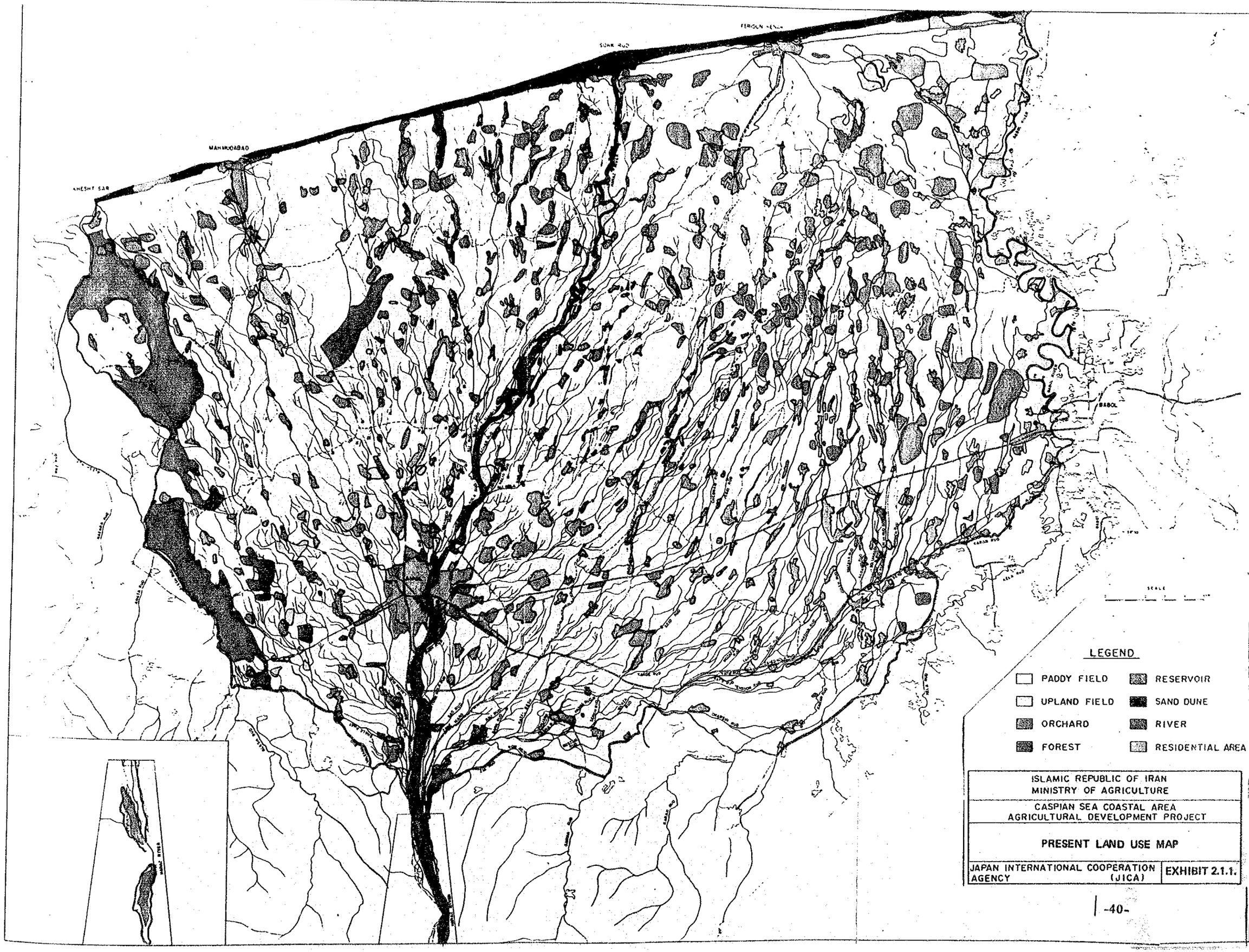
The orchards are found mainly in the fan areas and citrus fruits are considered as major crop. In the relatively well-drained areas, the paddy fields have been turned to the orchards (mainly mandarin orange) which is more profitable than the paddy culture.

The forest areas account for about 3.5 percent of the Area. Even after the Land Reform (1341), the local farmers continued to cut-down the forest trees considerably in the Area, and currently, there remain only some plain forests along the eastern side of the road between Amol and Mahmud Abad (about 320 ha) and the natural forest with broadleaf trees as major species in the western part of the Project Area (around the boundary with Nur Shahrestan) as the national forests, although the productivity is low.

The reservoirs (abbandans), accounting for some 3.6 percent of the Area, are mostly located in the middle and low lands. These reservoirs play an important role as supplemental water sources for paddy culture in the surrounding paddy fields. Some reservoirs have served as the habitats for fish and birds, and some of the local people are gaining cash income by means of fishing and hunting.

In the peripheral areas of the cities of Amol and Babolsar, there have been residencial areas and commercial/industrial areas expanding gradually. Many villages are dotted throughout the Project Area. Most of the villages are surrounded by small scale orchards; however, the extremely small ones are not classified into orchards but into the village areas. The total area of the small scale orchards is estimated at 480 ha.

The sand dune and beach are used as part of the resort places in the summer season, although some parts are used as for animal grazing or growing upland crops like wheat in small scale. In some part of the river channel of the Haraz river, the paddy fields are found at its broader portion in the high land. Since these paddy fields, however, are considerably small in acreage, they have not been classified into the category of paddy fields but river bed.


FERIDUN KENAR
SUNK RUD
MAHMUDABAD
BABOL
SCALE
LEGEND
PADDY FIELD
UPLAND FIELD
ORCHARD
FOREST
RESERVOIR
SAND DUNE
RIVER
RESIDENTIAL AREA
ISLAMIC REPUBLIC OF IRAN
MINISTRY OF AGRICULTURE
CASPIAN SEA COASTAL AREA
AGRICULTURAL DEVELOPMENT PROJECT
PRESENT LAND USE MAP
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
EXHIBIT 2.1.1.

2.2. Land Ownership

2.2.1. Change in Land Ownership

There is not any written record which shows the change of land ownership in the Project Area, but the Marasian History written in 17th century AD described that the powerful families of the area were living in the high land of Larijan (Amol Shahrestan) or Savad Kuh (Babol Shahrestan) in 15th century AD. In that time, the Project Area was mostly covered with flat land forest and swamps, and the villages were dotted among them. It is assumed that the land ownership has been established with the expansion of paddy fields which became important from the viewpoint of the regional economy. The Pahlavi denasty was established at the beginning of 20th century and the first king of the denasty, Reza Shah, was native of Savad Kuh, therefore he possessed large manor in the Project Area. The royal manor had occupied mainly the north-west and south east of the Project Area, and the remaining area had been owned by the big landowners of the old families who were living in Amol, possessing some village units land and the medium or small landowners who were mainly living in villages. The dealing of farmland was also rather active in 1330s.

Before the Land Reform in 1340s, the farmers were classified as below;

(a) Tenant Farmer ..... landless farmer who paid fixed percentage of products to the landowner.

(b) Landowner Farmer ... the farmer who cultivated his own land.

(c) Land Borrowing Farmer ..... landless farmer who paid fixed amount (or fixed quantity of products) to the landowner

The country-wide agricultural census in 1339 shows the land ownership in the Second Province (Mazandaran and Semnon Provinces at present) as below:

Table 2.2.1. Farmland Area by Ownership

	No. of Household	Area (ha)	Area per Household
Tenant Farmer	55,844 (26.6%)	165,389 (19.4%)	2.94 ha
Land Borrow Farmer	70,787 (33.7)	296,519 (34.9)	4.19
Tenant/Borrow	9,111 (4.3)	22,878 (2.7)	2.51
Tenant/Owner	4,639 (2.2)	20,040 (2.4)	4.32
Tenant/Owner/Borrow	450 (0.2)	1,024 (0.1)	2.28
Owner/Borrow	11,260 (5.3)	77,263 (9.1)	6.86
Land Owner Farmer	58,233 (27.7)	267,475 (31.4)	4.59
Total	210,324 (100.0%)	850,588 (100.0%)	4.04 ha

Table 2.2.2. Farmland Area by Size of Farming

Size	No. of Household	Area (ha)	Average Household
less than 1.0 ha	69,005 (32.8%)	31,195 (3.7%)	0.45 ha
1.0 - 3.0 ha	74,312 (35.3)	133,994 (15.8)	1.80
3.0 - 5.0 ha	30,337 (14.4)	116,699 (13.7)	3.85
5.0 - 100 ha	24,532 (11.7)	158,710 (18.6)	6.47
100 - 200 ha	7,556 (3.6)	94,086 (11.1)	12.45
200 ha over	4,582 (2.2)	315,403 (37.1)	68.84
Total	210,324 (100.0%)	850,588 (100.0%)	4.04 ha

As shown in the above tables, 64.6% of farming families had not owned their own land, but cultivated 57.0% of the farmland. In other words, more than 57.0% of land had been possessed by the landowner who did not perform farming activities. And, more than 68.1% of farming families had managed less than 3.0 ha in sharing 19.5% of the total farmland areas.

In the Project Area, the ratio of landowner farmers is assumed less than the figures quoted in the above Table 2.2.1, and the land borrow farmer type was more popular than tenant farmer type. As for the Land Reform in 1340s, the maximum land ownership had been decided as 50 ha in case of the Project Area.

2.2.2. Present Land Ownership

According to the result of Village Survey - 1364, the present land ownership is assumed as below:

Table 2.2.3. Number of Farming Household by Land Ownership

	Size of Land Ownership (ha/household)							
	0	-0.5	0.5-1.0	1.0-2.0	2.0-3.0	3.0-5.0	0.5-	Total
Amol Area Household	8,036	3,582	5,704	8,639	5,019	2,989	842	34,811
(%)	(23)	(10)	(16)	(25)	(24)	(9)	(2)	(100)
Babol Area Household	3,357	2,381	3,976	4,307	2,681	1,296	403	18,404
(%)	(18)	(13)	(22)	(23)	(15)	(7)	(2)	(100)
Whole Project Area Household	11,393	5,963	9,683	12,946	7,700	4,285	1,245	53,215
(%)	(21)	(11)	(18)	(24)	(15)	(8)	(2)	(100)

Table 2.2.4. Farmland Area by Size of Land Ownership

	Size of Land Ownership (ha/household)							
	0	-0.5	0.5-1.0	1.0-2.0	2.0-3.0	3.0-5.0	0.5-	Total
Amol Area	-	1,723.0	4,242.6	15,131.4	11,222.3	1,874.9	6,280.3	57,574.5
(%)		(3)	(7)	(26)	(19)	(33)	(11)	(100)
Babol Area	-	916.3	2,843.0	5,957.5	6,412.4	4,794.5	5,338.5	26,262.2
(%)		(3)	(11)	(23)	(24)	(18)	(20)	(100)
Whole Project Area	-	2,639.3	7,085.6	21,088.9	17,634.7	23,769.4	11,618.8	83,836.7
(%)		(3)	(8)	(25)	(21)	(28)	(14)	(100)

From the above two tables, the total number of farming households is assumed as 53,215, and 11,393 of which have not owned land.

On the other hand, the total of owned land is 83,837 ha, and therefore, the average land holding is about 2.0 ha, but that of Babol area is 1.7 ha while 2.1 ha in Amol area.

The actual dealing or inheriting of farm land after the Land Reform of 1340s are not recorded, and there are some illegal occupation or borrow of the nationalized land, but the actual situation is not clear.

2.3. Agricultural Infrastructure

The agricultural infrastructure is generally classified into three categories such as 1) irrigation facilities, 2) drainage facilities and 3) farm roads from the viewpoint of service. They are also divided into 1) main facilities and 2) terminal facilities by their size and the manner of management.

Since the agricultural infrastructure in the Project Area has been provided as irrigation-cum-drainage system for the traditional paddy cultivation, they have many inconveniences which do not meet the requirement of advanced farming practices.

2.3.1. Main Irrigation Facilities

Irrigation water depends mostly on river water of the Haraz river. Irrigation water is supplied only to the paddy fields for five months from nursery period in April to August just before harvest. The amount of irrigation water diverted from the Haraz river is estimated at about 600 MCM in an irrigation period. Groundwater is also used for irrigation and its amount is estimated at about 137 MCM. Groundwater is pumped mostly from shallow wells and used as supplemental irrigation water at terminal level.

As the main irrigation facilities, 1) water source facilities and 2) main irrigation canals are operated and managed by the MOE. Furthermore, 3) 241 irrigation ponds (abbandan) are provided in the low land below 10 m PGD to store supplemental water against water shortage.

The Project Area is divided into two command areas of main irrigation systems, the Haraz Command and the Kari Rud Command as shown in Exhibit 2.3.1. Present irrigated areas are estimated at 68,120 ha (paddy fields) from the land use survey.

Table 2.3.1. Present Irrigated Area

Total Irrigated Area	:	68,120 ha
Haraz Command	:	38,740 ha
Left Bank	:	(25,100 ha)
Right Bank	:	(13,640 ha)
Kari Rud Command	:	29,120 ha

(1) Water Source Facilities

As the source for irrigation water, the Lar dam was constructed on the Lar river which is one of the tributaries of the Haraz river. The dam is scheduled to release irrigation water of 240 MCM per annum to the Haraz river to meet the demand in the downstream. (ref. para. 1.4.1.) Wells, springs and pumped-up river water are also used as supplemental water sources in the Project Area.

The available water resources can be estimated at 830 MCM for a irrigation period and the facilities are summarized as below:

Table 2.3.2. List of the Water Source Facilities

Facilities	Number of Facilities	Water Amount during Irrigation Period	Remarks
Haraz River		398 MCM	Runoff from the residual basin other than the Lar dam.
Lar Dam		240 MCM	
Springs	locating at the tail alluvial fan	24.6 MCM	
Wells	6,877 wells	112.2 MCM	
Abbandans	241 abbandans	57 MCM	Effective depth = 1.5 m Total area = 3,800ha
River Pumps	22 pumps	nil	8 pumps on the Karan Rud, 9 pumps on the left bank of the Babol river and 5 pumps at the lower reaches of the Haraz river.
Total		831.8 MCM	

Note: Precipitation is excluded, because it is counted in computation of the irrigation water demand. (see Table 1.2.4.)

From the Village Survey - 1364, the Haraz river irrigates 84% of irrigated land and the groundwater irrigates 16% as seen in the table below:

Table 2.3.3. Irrigation Areas by Water Sources

Water Source	Haraz Left Bank		Haraz Right Bank		Kari Rud		Total	
	ha	%	ha	%	ha	%	ha	%
Haraz River	21,560	86	11,400	84	24,200	82	57,160	84
Canal Command	(19,230)	(77)	(10,140)	(74)	(19,000)	(65)	(48,370)	(71)
Abbandans	(1,280)	(5)	(640)	(5)	(3,310)	(11)	(5,230)	(3)
Return Flow	(1,050)	(4)	(620)	(5)	(1,890)	(6)	(3,560)	(5)
Springs	1,860	7	1,000	7	1,050	4	3,910	6
Wells	1,680	7	1,240	9	4,130	14	7,050	10
Total	25,100	100	13,640	100	29,380	100	68,120	100

Note: Details are described in Table B.1.1, Appendix B.1.

(2) Main Irrigation Canals

The irrigation system of the Project Area is composed of the Haraz Command and the Kari Rud Command which are operated and managed by the Amol District Water Office and the Babol District Water Office respectively. However, since there is no accurate irrigation networks map, the irrigation systems are operated empirically by mirabs, water masters, with rough irrigation networks map covering irrigation areas.

The irrigation canals are classified into three ranks from the primary canal to the tertiary canal.

The primary canals are composed of two rivers which are the Haraz river and the Kari Rud. The Haraz river is diverted to the Kari Rud at an intake constructed with river-bed materials but without diversion weir. The intake changes its location frequently and needs repairing every year. At the intake, flow of the Haraz river is supercritical flow due to high velocity exceeding 2 m/sec in shallow depth. Since irrigation water is diverted under supercritical flow, diversion ratio is kept at considerably steady ratio. Diversion ratio of the Haraz river and the Kari Rud is fixed at 7:5 respectively and its ratio is kept up to the maximum discharge of 130 cms.

Irrigation water reaches the terminal level through the tertiary canal. As the irrigation networks shown in Exhibit 2.3.1, the main canals run radially to the Caspian Sea. Since the ground slope is steep (1%) and the flow is high (approximately 2 m/sec) in the alluvial fan above EL.20 m PGD, the secondary canals are incised. On the other hand, there exist no incised canals in the alluvial plain below EL.20 m PGD, because the land slope is gentle of about 0.15 to 0.3%. Since most secondary canals are following the natural streams on the higher relief formed by sedimentation in the alluvial plain, they are serving as exclusive irrigation canal.

As seen in Table 2.3.4, the secondary canals are composed of 94 canals with 695 km in total length, and there exist 22 canals in the Haraz Command and 72 canals in the Kari Rud Command. The average irrigation area per canal is only 340 ha in the Kari Rud Command, being considerably smaller than that of 1,500 ha in the Haraz Command.

The total length of the tertiary canals is estimated at 2,036 km, and the main canal length is 2,731 km totally including the secondary canals. Therefore, the canal density is 48 m/ha to the irrigation area of 57,160 ha which are irrigated by river water, and the density is considerably high.

The terminal level system is divided into 510 blocks, and one terminal block has an irrigation area of 112 ha on an average.

Table 2.3.4. List of the Irrigation Canal Facilities

Command Area		Haraz Left Bank	Haraz Right Bank	Total of Haraz Command	Kari Rud Command	Total
River Water Irrigation Area	(ha)	21,560	11,400	32,960	24,200	57,160
Number of Secondary Canals		12	10	22	72	94
Average Length of a Secondary Canal	(km)	17	17	17	4.5	7.4
Total Length of Secondary Canals	(km)	203	170	373	321	695
Average Irrigation Area of a Second Canal	(ha)	1,800	1,140	1,500	340	610
Canal Density of Secondary Canals	(m/ha)	9.4	14.9	11.3	13.3	12.2
Total Length of Tertiary Canals	(km)	774	373	1,147	889	2,036
Canal Density of Tertiary Canals	(m/ha)	35.9	32.7	34.8	36.7	35.6
Number of Terminal Blocks		186	98	284	226	510
Average Irrigation Area of a Terminal Block	(ha)	116	116	116	107	112

Note: Details are described in Table B.1.2 to B.1.4 in Appendix B.1.

In the Haraz Command, all secondary canals are diverted from the Haraz river without any weirs to stabilize an intake amount. The intake discharge is controlled by intake width to the secondary canal. The standard discharge are set at 0.5 cms to 4 cms (see Table B.1.3, Appendix B.1) in accordance with size of irrigation area at the time when irrigation water is not adequate. However, since the standard discharges are not entirely corresponding to the irrigated areas, unit water duty differs by canal sytems. The total of the standard discharges is 41.25 cms (see said table in the Haraz Command), and the unit water duty is 1.25 lit/sec/ha to the river water irrigation area of 32,960 ha. This unit water duty is too small in comparing with the required unit water duty of 2.0 lit/sec/ha (see E.1.1.1. (3), Appendix E.1) at the latter period of puddling. Therefore, it is necessary to adjust the present unit water duty together with the differences by canal systems.

In the high land of the Kari Rud Command, there are not any permanent weirs provided on the Kari Rud for stabilizing diversion to the large secondary canals, and the temporary weirs made of earth and brushwood are provided when droughty. In the low land area, concrete weirs equipped with stop-logs are provided at the lower reaches of the Kari Rud and the secondary canals to raise water level for irrigation. Those canals serve as irrigation canal during irrigation period and as drainage canal during non-irrigation period. In the Kari Rud Command, since there is no standard discharge during drought, diversion discharge is empirically controlled by mirabs. Furthermore, since secondary canals (such as Juleh Rud) have sharp water fluctuation at the middle and lower reaches where many return flows come in from upstream, these canals are in difficulty and disadvantage on water management. Therefore, water shortage occurs frequently and concentrates to the low land due to improper operation. (see Exhibit 2.3.2)

2.3.2. Main Drainage Facilities

Since the Project Area is drained by the irrigation-cum-drainage system which is one of the most remarkable physical features of the Project Area, there is no exclusive drainage canal except at the lowest area along the coast.

The drainage networks are divided into two; the Haraz Left Bank Drainage Area and the Haraz Right Bank Drainage Area. The Haraz Right Bank Drainage Area is composed of the Haraz Right Bank Command and the Kari Rud Command. As shown in Exhibit 2.3.1, the Haraz Left Bank Drainage Area drains into the Caspian Sea through the drainage channels located at Khesht Sar and Mahmud Abad, and between Mahmud Abad and Sorkh Rud. On the other hand, the Haraz Right Bank Drainage Area drains mostly into Feridon Kanar.

In the high land, excess water is drained to the secondary irrigation canals after plot-to-plot drainage and flows down to the lower area. Since the secondary irrigation canals are incised deeply, excess irrigation water is easily drained without causing any inundation. Furthermore, there is no problem on subsurface groundwater table, because the subsurface groundwater table is rather low in comparing with the low and middle lands. Since no inundation is observed even in the wet season after paddy cultivation, the land use rate increases recently by introducing berseem as a second crop and mechanization has been started for paddy harvesting.

In the middle land, drainage of excess water is rather difficult, because the secondary irrigation canals are shallow and its canal-bed elevation is close to that of the paddy field. During irrigation period, almost of all paddy fields are ill-drained and the poor drainage causes inundation of 20 cm to 40 cm depth in the areas where the roads and the tertiary irrigation canals are closing. On the other hand, the same phenomena are also observed in winter, and heavy rain causes inundation. Furthermore, the subsurface groundwater table is also high being 20 to 60 cm from the ground surface in November, therefore, it is impossible to introduce second crops and mechanization in the paddy field.

In the low land, drainage problem is more severe than in the middle land. There takes place not only poor drainage but extensive inundation with long duration due to several causes such as excess water from the upstream, raising the water level in canals for irrigation, insufficient capacity of drainage canals, floods from the Babol river and the Alesh Rud, and the blockage of drainage canals by sand dunes along the sea coast. Subsurface groundwater reaches almost to the ground surface. It is, therefore, impossible to introduce second crops and mechanization in the paddy field as well as in the middle land.

According to the Village Survey - 1364, poor drainage is extensively reported centering at the middle and low lands in the Haraz Right Bank Drainage Area as shown in Exhibit 2.3.3. Hydraulic conductivity is rather high being about 5 x 10^{-3} cm/sec (described in B.2.2 in Appendix B.2), and the observation is necessary on it.

The area of the ill-drained paddy fields is estimated at 51,130 ha or 75% of the total paddy field as shown in Table 2.3.5.

Table 2.3.5. The Areas of Ill-Drained Paddy Field

Topographical Division	Land Classification 1R/2Ud	2Rd/3Ud	3Rd/3Ud	Total
High Land	6,070	0	0	6,070
Middle Land	17,750	6,740	3,210	27,700
Low Land	4,800	16,240	320	21,360
Total	28,620	22,980	3,530	51,130

Note: Details are in Table B.2.2 in Appendix B.2.

2.3.3. Terminal Facilities and Farm Roads

(1) Terminal Irrigation Facilities

The irrigation water to the fields is usually supplied from tertiary canals. The standard size of a terminal irrigation block is about 110 ha. The irrigation ditches which distribute water to every plot or field are provided so poorly that most of plots are irrigated by plot-to-plot irrigation system.

The diversion works to the terminal irrigation canals are usually made of earth, brushwood or stop-log to raise the level of water but they do not work efficiently.

There are 241 irrigation ponds in the middle and low land areas. Most of them are constructed in low places surrounded by roads and embankments and are shallow in depth with small storage as compared with the their water surface areas. The water of the ponds is supplied through irrigation ditches to the paddy fields just below the ponds.

The conditions and problems of irrigation canals in the Area are shown in the following table.

Table 2.3.6. Conditions and Problems of the Terminal Irrigation Canals

Conditions	Problems
A. Plot-to-plot Irrigation System	1. Inundation damage is quite common.
	2. Effective and fair water allocation can not be realized during a drought to prior water use at upstream.
	3. Excess water is apt to cause inundation in the downstream fields during a wet period.
	4. Surface flow is apt to wash away applied chemicals and fertilizers.
	5. It is impossible to control water by each plot.
	6. It is difficult to harvest early matured rice when different rice varieties are planted together.
B. Dual-purpose Canal	1. There are ill-drained fields and poor-irrigated fields.
	2. It is a big obstacle to mechanization and the introduction of second crop cultivation.
	3. Buried organic materials such as rice straw under unaerobic condition threaten to induce potassium deficiency (Akagare Type I) in poorly-drained condition.
C. Irrigation boundaries are not clear.	1. It is impossible to distribute water properly due to lack of capacity.
D. Division works are insufficient and incomplete.	1. It is difficult to divert water properly.

(2) Terminal Drainage Facilities

There are almost no terminal drainage canals and excess water is drained by plot-to-plot drainage system. As mentioned in para. 2.3.2, fields in the middle and low land areas of alluvial plain are poorly-drained.

Many fields are inundated when it rains, even in a non-irrigation period. Such inundation has prevented to introduce the second cropping.

Lack of soil bearing capacity due to poor-drainage condition is also one reason for preventing advanced farm mechanization. (ref. Table B.3.2 of Appendix.)

(3) Roads

As mentioned in the above para. 1.3.4., the farm-roads have only about one to two meters in width; therefore, the farmers are forced to pass through other farmers' field lots to access to their own fields for working. The village roads are in poor condition and light trucks are only vehicles passable therethrough. In the villages the houses and canals are constructed too closely to the roads and therefore, it is difficult for vehicles to pass by.

(4) Size and Shape of Fields Lots

The field lots are generally small and irregularly shaped in the fan area elevation more than 20 m PGD. The average size is about 3 - 20 ares. The field lots in the Area below 20 m PGD are rather large, about 5 - 30 ares on an average, and the shape is generally rectangular along the topographical contour line.

In the low land area, the block enlargement has been carried out extensively and the average size is 20 ares and maximum size of 90 ares. But sub-borders have been set in a plot of more than 20 ares to give uniform water depth. (ref. Table B.3.3, Fig. B.3.1 and B.3.2 of Appendix).

(5) Present Situation of Land Consolidation

The block enlargement has been carried out in the Project Area in the past 20 years for the introduction of tillers and the improvement of irrigation efficiency. The enlargement has been carried out in a small scale for improvement within farmers' owned lands. But, the real land consolidation, which includes the separation of irrigation and drainage canals and improvement of farm roads and other terminal facilities, has not been implemented.

The farmers who have already implemented the simple block enlargement are now realizing the importance of all-round improvement of terminal facilities, land consolidation works, because of progressing farm mechanization to recover the shortage of labour in the busy farming season (ref. para. 2.5.4). A subsidy system for improvement of terminal facilities was made by the Government three years ago, but most of actual works have been carried out by farmers' own expenditure because of shortage of governmental budget for this purpose (ref. Table B.3.4 of Appendix).

2.3.4. Water Management

(1) Water Management Organization

The Mazandaran Regional Water Board (RWB of Mazandaran) is responsible for operation and maintenance of the main irrigation facilities in the Project Area. The irrigation section of the Amol and the Babol District Water Offices actually operate and maintain the facilities under the RWB of Mazandaran. Their responsibilities are as follows:

	District Water Office	Responsible Irrigation Command	Mirabs
RWB of Mazandaran	Amol	Haraz Command	23 persons
		Alesh Rud Command	14 "
	Babol	Kari Rud Command	17 "
		Babol Command	20 "

The water management organization of each district water office is shown below;

District Water Office				Village Level
Irrigation Manager	Chief Mirab (1 person)	Assistant Mirabs (3 person)	Mirabs	Village Mirabs

The terminal facilities at village level are operated and managed by farmers themselves through village mirabs. Responsibility of each mirab is as follows:

The chief mirab controls all of the field works for the water distribution and management. Under the chief mirab, the assistant mirabs are responsible to operate the intakes from the primary irrigation canals to the secondary canals and instruct the mirabs for operating the secondary canals and the Kari diversion. The mirabs are responsible to operate the Kari diversion and distribute water to the secondary canals. The village mirabs are responsible to distribute water to the downstream of tertiary canals.

These mirabs have been seasonally employed, but recently the chief and the assistant mirabs are permanently employed on the monthly salary basis of 31,500 Rls. for maintaining the irrigation facilities during the non-irrigation period. Other mirabs are seasonally employed for four months on the monthly salary basis of 26,400 Rls. only during the irrigation period. The village mirabs are also seasonally employed by farmers during the irrigation period, and each village employs one or two village mirabs. Salaries are paid by farmers to the village mirabs out of levy on paddy of 30 kg/ha/year as standard. About 450 village mirabs are employed in total in the Project Area. In other words, 300 village mirabs in the Haraz Command and 150 village mirabs in the Kari Rud Command are employed respectively.

The district water office collects from farmers 300 Rls./ha/year for the paddy fields with water right from farmers as water charge, and supplies minor materials such as nails and lashings and occasionally heavy earth-moving equipment for re-establishment of the Kari Rud intake.

Labour is provided by all villages. For example, it needs annually some 200 man-days for re-establishment of the Kari Rud intake and 200 man-days for repair of a large secondary irrigation canals. The maintenance remains, however, at low level, because existing facilities such as the intakes and the division are mostly temporary works.

Consequently, the district water offices are promoting to replace the temporary division works with the permanent ones. The replacement, however, is limited by 5 to 10 division works per annum. The RWB of Mazandaran has a plan to construct head works at the Kari diversion.

(2) Water Management Cost

Water cost is very low only at 300 Rls./ha/year and collected by the district water offices as water charge from the farmers having registered irrigated lands with water right.

However, the total water management cost becomes 6,000 Rls./ha/year in case of the surface gravity irrigation, including labour wages for maintenance of the irrigation facilities and the salaries to the village mirabs. The breakdown of cost is 4,500 Rls./ha/year for maintenance, 1,200 Rls./ha/year for water distribution and 300 Rls./ha/year for irrigation water.

On the other hand, the total water management cost is increased to 10,000 Rls./ha/year in case of the pump irrigation from rivers and to 13,000 Rls./ha/year in case of the pump irrigation from wells.

From the viewpoint of the whole Project Area, the total water management cost is estimated at 492,500,000 Rls. per annum, of which 449,000,000 Rls. (91%) are borne by farmers and 43,500,000 Rls. (9%) are borne by the Regional Water Board.

Table 2.3.7. Annual Water Management Cost in the Project Area

Farmers	49,000,000 Rls.
Regional Water Board	43,500,000
Water Charge	(-12,300,000)
Salaries of Mirabs	(6,500,000)
Replacements	(49,300,000)
Total	492,500,000 Rls.

(3) Water Right

The paddy fields are classified into the land with water right and the land without water right. The water right is registered in the district water offices and controlled by the MOE. The water right is a principle acreage not only for collecting water charges but also for distributing irrigation water. The water right has been given to the land which have been already paddy fields since more than a decade ago and not given to the paddy fields newly reclaimed.

The water right is given to the paddy fields irrigated by canals, abbandans and springs, but not to the paddy fields irrigated by wells and river pumps. The paddy fields with water right are registered by 41,110 ha in 1364, which is equivalent to only 67% of the paddy fields of 61,070 ha irrigated by canals, abbandans and springs.

Table 2.3.8. Registered Water Right

	Haraz Command	Kari Rud Command	Total
Number of Villages Registered	279	150	429
Paddy Fields Irrigated by Canals, Abbandans and Springs (ha)	35,820	25,250	61,070
Registered Paddy Fields with Water Right (ha)	22,014	19,097	41,111
Registered Ratio (%)	61	76	67

Note: Data from the Amol and the Babol District Water Offices

The responsibility of water management under the water right is not placed on the district water offices but on village mirabs, who are responsible for water management in villages and employed by farmers. Irrigation water is distributed equally to all lands in a wet year; however, water supply is severely restricted only to the land with water right in a drought year.

For promoting the land consolidation programme, it is necessary to give an attention to this matter from the viewpoint of water allocation to the lands without water right, especially in an area where the paddy fields have been newly reclaimed or transferred from the upland.

It is considered that the wells are one of the permitted water rights, because the digging of wells needs a license from the district water office. In case of shallow wells, most wells have been dug without any license. The RWB of Mazandaran completed the survey to clarify the present situation of wells either with or without the license in 1364.

The MOA has to control and manage the water right in accordance with the water distribution law, but the MOA has not concerned yet with this.

2.3.5. Irrigation Water Balance

The water balance has been studied and evaluated under the present conditions of the land use and water resources, and those in future.

(1) Irrigation Demand

Though the present cropping pattern is described in the para. 2.4.2, the proposed cropping patterns are as follows taking future changes in land use into consideration. The second crops will not need any irrigation water because berseem, the main second crop, can be grown without irrigation water and other second crops are not sharing large area. The irrigation demand is evaluated on various cropping ratios of Amol-3 and Tarom which are representative improved and local paddy varieties.

The overall irrigation efficiency is estimated at 67.5 percent for the surface water and 90 percent for the groundwater, and accordingly the total overall irrigation efficiency becomes 71 percent considering the usage ratio of the surface water and the groundwater.

Table 2.3.9. Irrigation Demand by Cropping Pattern

	Cropping Area (ha)		Irrigation Demand (MCM)					
Land Use	Amol-3	Tarom	Apr.	May	Jun.	Jul.	Aug.	Total
Present	40,870 (60%)	27,250 (40%)	27	185	216	201	87	716
Future (1)	54,500 (80%)	13,620 (20%)	27	185	215	210	116	753
Future (2)	68,120 (100%)	0 (-)	27	185	213	220	144	789

Note: Details are in Table B.1.7 in Appendix B.1.

As the cropped area with Amol-3 increases, the irrigation demand will increase especially in the latter half of the irrigation period. Since the latter half in the irrigation period is the recession period of the Haraz river, it is necessary not only to give careful attention to the availability of the water resources but also to control the river flow of the Haraz river in this period.

(2) Water Sources and Amount Available

The water sources for irrigation are 1) the Haraz river, 2) the groundwater and 3) the abbandans. The available amount of these sources is summarized in Table 2.3.10. The future available amount of water of the Haraz river is to be allocated by the water committee.

Table 2.3.10. Water Sources and Amount for Irrigation

Water Sources	Water Amount		
	Present	Future	
Haraz River	682 MCM	Lar Dam	240 MCM
		Residual Basin	398 MCM
Groundwater	137 MCM		137 MCM
Abbandans	57 MCM		57 MCM
Total	876 MCM		832 MCM

Though there will be some possibility to use water of those rivers of Babol, Alesh Rud, Garma Rud, Karan Rud and Kela Rud, most of them are proposed to be developed as water resources and to allocate the water developed to other areas than the Project Area. Consequently, available water of these rivers is limited only to flood water which is not able to be controlled.

The available amount is, therefore, limited to the amount shown in Table 2.3.10. Though the future available amount will decrease to 832 MCM from 876 MCM, the Lar dam will bring considerable benefits to the Project Area by controlling the river flow of the Haraz river and increasing the river flow for a drought year by over year storage.

(3) Water Balance

The water balance has been studied at 10 days interval for 32 years from 1329 to 1360 (1950 - 1981) with the available water amounts at present and future after the Lar dam in full operation. The water balance has been also examined on possibility to increase the cropped area of Amol-3 in both cases. (see Appendix B.1.3) Furthermore, for evaluating the effects of the abbandans, the study has been conducted in assuming that abbandans would not be available.

The results are summarized in the table below.

Table 2.3.11. Water Balance of Irrigation Water

Conditions of Abbandans	Frequency of water Shortage					
	Before Lar Dam (Present)			After Lar Dam (Future)		
	Present Land Use	Future Land Use (1)	Future Land Use (2)	Present Land Use	Future Land Use (1)	Future Land Use (2)
Abolished	1/1.1 yrs	1/1 yrs	1/1 yrs	1/5 yrs	1/3 yrs	1/2.3 yrs
Continuance (1)	1/1.3	1/1.1	1/1.1	1/32	1/11	1/3.5
Continuance (2)	-	-	-	1/8	1/3.5	1/3

Note: Continuance (1): Abbandans operated under the schedule release, namely as same operation at present.
Continuance (2): Abbandans operated only when the Lar dam being empty.
- : not studied.

As seen in the above table, water shortage occurs almost every year at present. Since water shortage concentrates on the latter half of the irrigation period, it gives serious damages on paddy yield due to occurrence in heading stage, especially the booting stage of Amol-3 which is vulnerable to drought, especially in late July. According to the Village Survey - 1364, it is reported that water shortage occurs every year in the middle and the low lands of the Kari Rud and the Haraz Right Bank Commands and in the low land of the Haraz Left Bank Command.

On the other hand, when the Lar dam is in full operation, water shortage will occur only once in 11 years even if Amol-3 is increased to 80 percent of cropping ratio. Water shortage, however, will take place more frequently by once in 3.5 years when Amol-3 is cropped fully in the Project Area. Consequently, optimum cropping ratio of Amol-3 is limited by 80 percent. And, it is clearly understood that abolishment of the abbandans will cause the decrease of the cropping areas due to increase of water shortage.

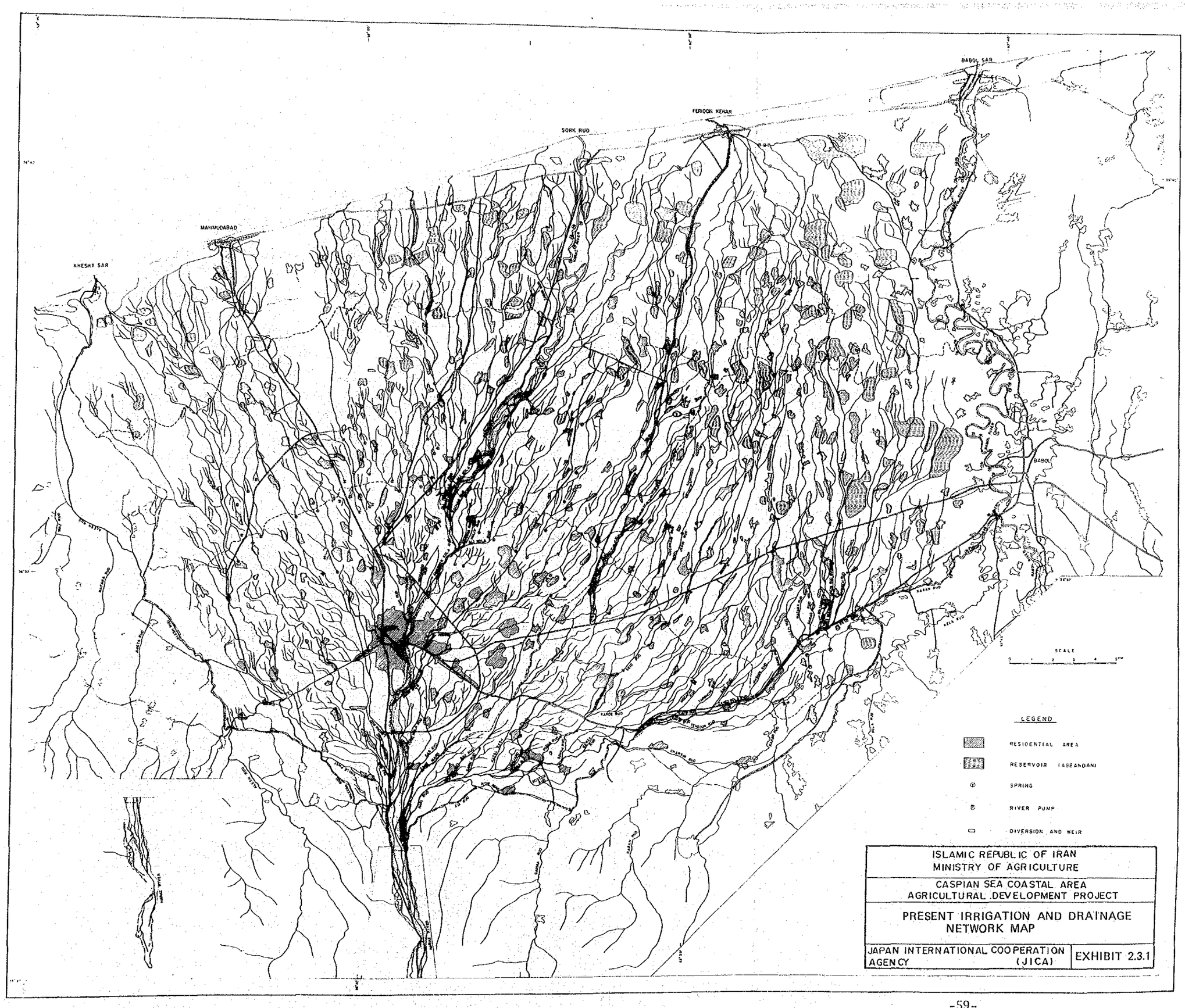

BABOL SAR
FERIDON KENAR
SORK RUD
MAHMUDABAD
KHESHT SAR
BABOL
SCALE
LEGEND
RESIDENTIAL AREA
RESERVOIR (TASBANDANI)
SPRING
RIVER PUMP
DIVERSION AND WEIR
ISLAMIC REPUBLIC OF IRAN
MINISTRY OF AGRICULTURE
CASPIAN SEA COASTAL AREA
AGRICULTURAL DEVELOPMENT PROJECT
PRESENT IRRIGATION AND DRAINAGE NETWORK MAP
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
EXHIBIT 2.3.1

EXHIBIT 2.3.2. PRESENT IRRIGATION CONDITION MAP

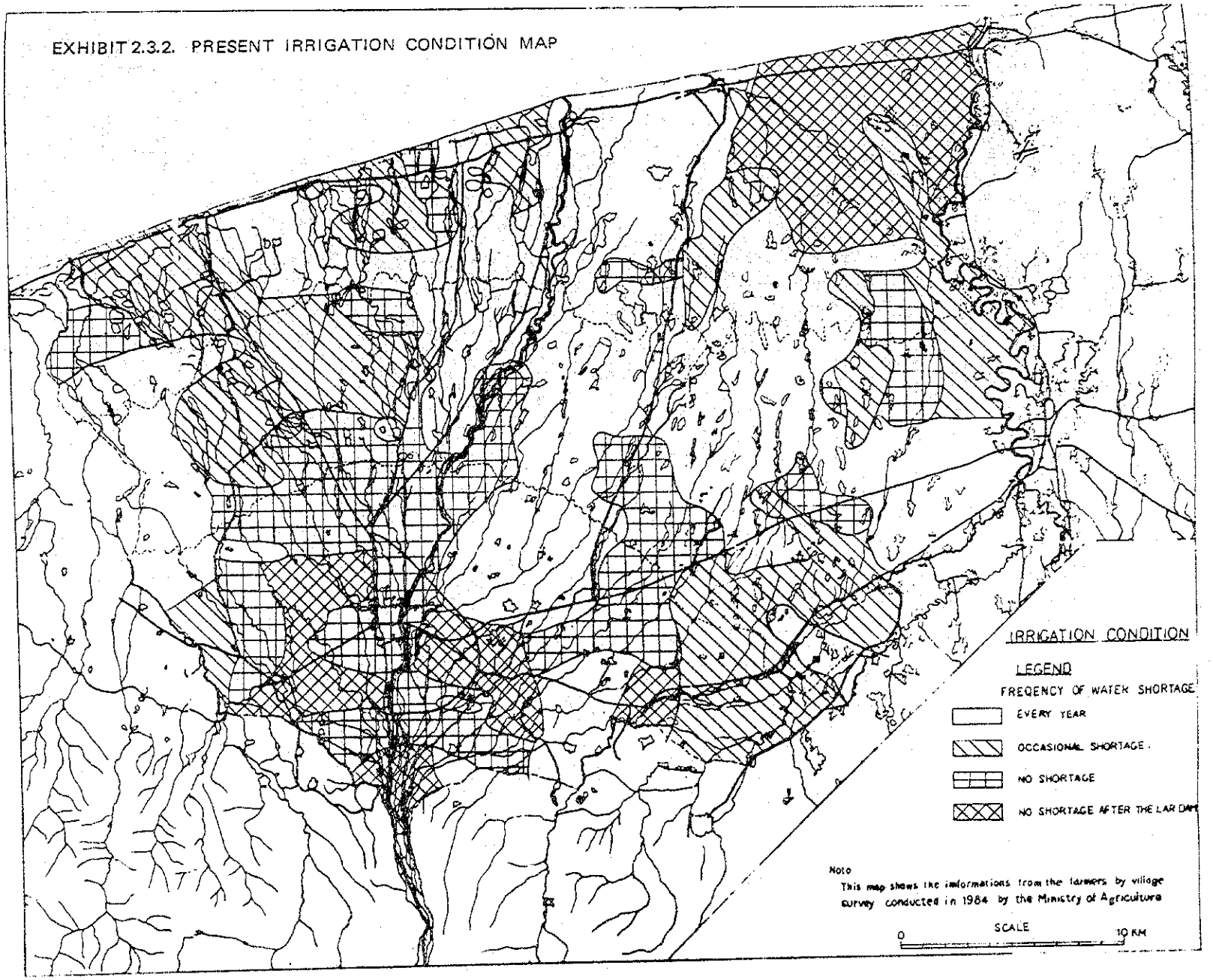
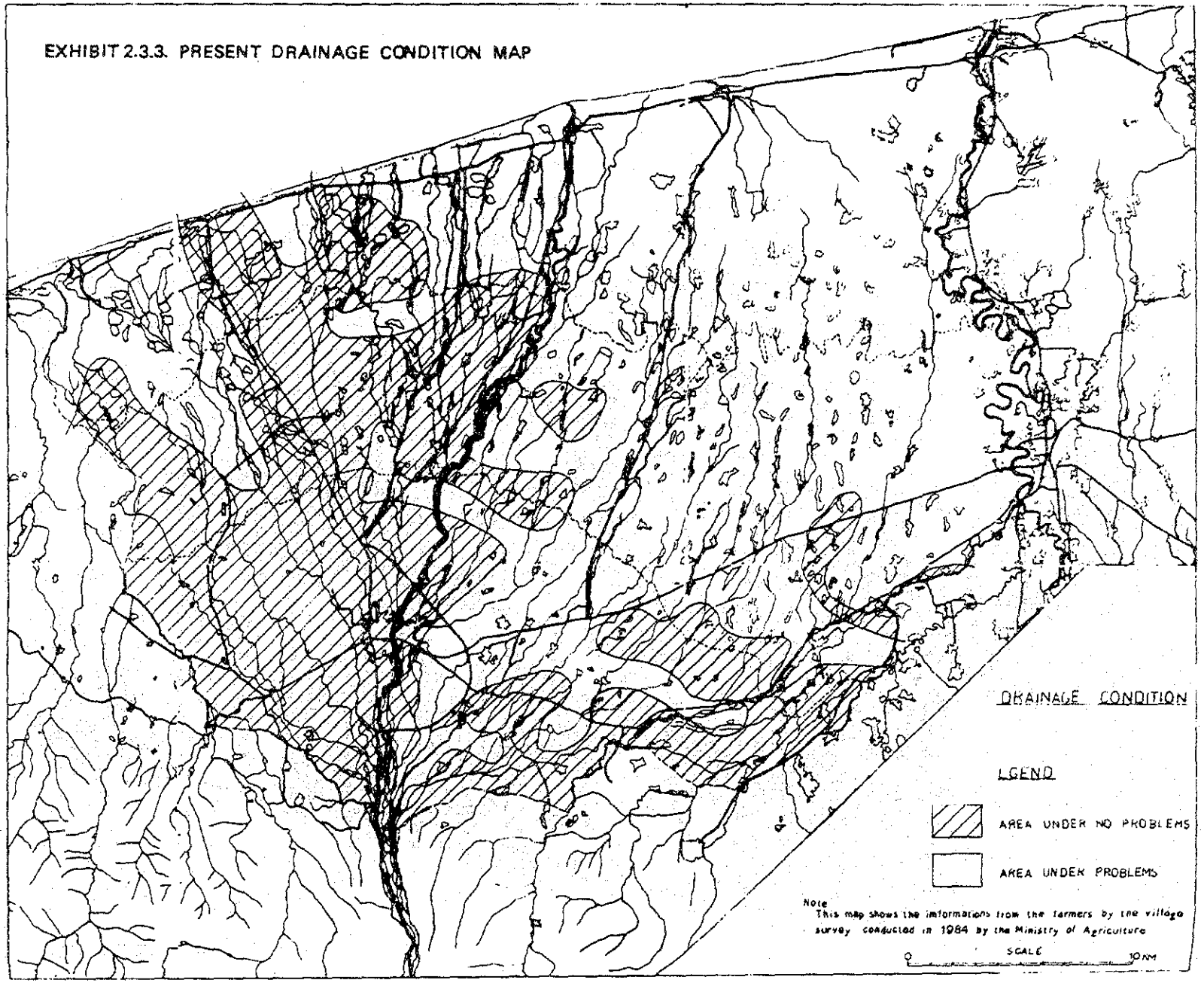


EXHIBIT 2.3.3. PRESENT DRAINAGE CONDITION MAP



2.4. Agricultural Production

2.4.1. Agricultural Production and Yield

In 1982, according to the Agricultural Statistics by the Iran Statistic Center, 90 percent of the arable land in Mazandaran Province had been under cultivation counting area of 886,600 ha which shared 6.0 percent of total cultivated land in the country despite of the share of acreage of the province in total land of the country is only 2.9 percent. In this cultivated area the paddy fields are 169,100 ha which share 42.6 percent of the national total in playing the role as one of the major paddy producers of the country as well as the neighbouring Gilan Povince. (Refer to Tables C.2.1. and C.2.2. in Appendix.) After 1361, the paddy fields in Mazandaran Province had been expanded year by year in line with the high price, and thus its area reached to 200,000 ha in 1365.

The paddy cropping acreages in Amol and Babol Shahrestans where the Project Area is located, were 55,000 ha and 57,000 ha, respectively, in 1364, and the total acreage of both accounted for more than 55 percent of the paddy cropping acreage in Mazandaran.

The cropping acreages in Amol and Babol increased annually by 3.1 percent and 4.5 percent on an average, respectively, for five years from 1359 to 1363. (Ref. to Table C.2.3 in Appendix) In 1364, the cropping acreage in Amol increased by 5.8 percent as compared with the acreage in 1363, however the acreage in Babol decreased by 5.8 percent. It is considered that the decrease in Babol was caused by the water shortage of the Babol river.

The existing arable land acreage in the Project Area is about 78,000 ha, of which about 74,000 ha are actually cropped and about 4,000 ha, the remainders, are the fallow land.

The two-croppings per year are carried out in the fields of about 2,300 ha, accounting for about three percent of the total paddy cropping area. The acreages by crops in the Project Area can be summarized as follows according to the result of Village Survey-1364.

Table 2.4.1. Cropping Acreages by Crops in the Project Area

Crop	1362	1363
Paddy	67,920 (90.0%)	68,120 (89.2%)
Wheats	650 (0.0)	670 (0.9)
Pulses	410 (0.9)	320 (0.4)
Clovers	870 (1.1)	1,380 (1.8)
Vegetables	3,150 (4.2)	3,340 (4.4)
Tree-crops	2,480 (3.3)	2,490 (3.3)
Others	10 (0)	10 (0)
Total	75,490 (100.0%)	76,330 (100.0%)

Paddy cultivation occupies about 90 percent of the all cropping acreage in the Project Area, which is equivalent to about 34 percent of the paddy cropping area in Mazandaran Province. The main varieties cultivated in the Area are the local variety as Tarom, and the improved varieties as Amol-3 and Amol-2. The cropping ratio is 43 percent, 29 percent and seven percent in 1362, while 27 percent, 54 percent and three percent, respectively, in 1363. (ref. to Table C.2-.5 in Appendix.)

Since these two years, however, the cropping acreage of the high yielding variety of Amol-3 has been increasing rapidly to meet the national policy of food production increase. Under the circumstances, in 1364, delay in the Government purchase of Amol-3 in the previous year caused the relevant paddy price to decrease and seemingly the farmers to expand the cropping acreage of Tarom at higher market price in spite of lower yield than that of Amol-3. In 1363, the cropping ratio of Tarom and Amol-3 in Amol Shahrestan was 31 percent and 50 percent, while in Babol Shahrestan 17 percent and 63 percent, respectively. The aforesaid figures show that the cropping ratio of the improved varieties is higher in Babol Shahrestan than in Amol Shahrestan, owing to more active extension services of ATRSC of Babol for one reason.

Tarom is popular more in low land than in other lands, and as the elevation becomes higher, the cropping area of Amol-3 is increasing more (ref. to Table C.2.5 in Appendix). This will be because of the irrigation water which is allocated to the paddy fields in high land with higher priority from the Haraz river, while Tarom with the earlier maturing than Amol-3 is found in the fields in low land due to insufficient allocation of the water.

The unit yields of Tarom and Amol-3 are estimated at 3.62 - 3.74 t/ha and 6.45 - 7.34 t/ha respectively in paddy. (Ref. to Table C.2.7 and 8 in Appendix). For information, there has been no clear difference observed in unit yield by district, therefore, the fluctuation of yield is considered due to the difference of applied practice by farmer. Haraz is expected to be a promising variety in future, although not yet introduced to the local farmers. The variety of Haraz has been developed by breeding at the Amol Rice Research Station with high yielding as well as higher palatability than that of Amol-3. This variety, having growing period of 105 days after transplanting, can be grown with less irrigation water. In the both views of marketability and effective use of water resources, Haraz will be introduced into the Project Area as a major variety in future.

The cropping areas of vegetables occupy about four percent of the total cropping acreage. Summer vegetables are grown in 920 ha, while the winter vegetable in 2,420 ha. In the Project Area, lettuce, raddish, spinach, etc. are grown as the second crops of the paddy cultivation. Both of wheat and pulses are grown in less than one percent of the cropping area to the total mainly in the fields with poor irrigation conditions.

Clovers are grown in the fields by about two percent of the total cropping acreage. Since berseem is recommended by Mazandaran General Department of Agriculture as the second crop of the paddy culture, the cropping acreage has been increasing gradually. The reasons why berseem has been introduced are as follows:

- Berseem can feed animals as highly nutrient food, and is available for 55 - 60 t/ha by three harvestings.
- Berseem cropping can improve the soil fertility and physical features, and rhizobia can work to fix nitrogen in the air and save the nitrogen fertilizers for the paddy cultivation in the following year.
- At the same time when berseem is harvested, the residual paddy hills in the fields can be sickled away, and such operation can kill chrysalises of stem borers and other harmful insects.

The orchards occupy about three percent of the total cropping acreage. Most of these fruit trees are mandarin oranges and some are other citrus fruits. The fruit tree crops are grown mainly in the high land.

2.4.2. Cropping Pattern and Cropping Calendar

According to the interview survey conducted in the field investigation, the cropping calendar of the major crops grown in the Area can be illustrated as Figure C.2.1 of Appendix. For paddy as the main crop, seeding is carried out in the nursery beds in Farvardin (end of March to beginning of April) when temperature rises more than 10°C, and the young seedlings are transplanted between the middle of Ordibehesht (end of April) and the beginning of Khordad (end of May). For Tarom with short growing period (90 days from transplanting to harvest), harvesting is made between the middle of Mordad (beginning of August) and the middle of Shahrivar (beginning of September), and ratooning is also observed in some parts of the Area. Amol-3 is harvested about one month later than that of Tarom.

The average temperature in early spring is approximately 2.0°C lower in the western part of the Project Area than in the eastern part. Therefore, the transplanting is practised one or two weeks later in the western part than in the east.

In other respect, there is about two or three weeks difference in transplanting between in the high land and in the low land due to difference in temperature, and harvesting is carried out in different time in starting from the low land to the high land. Low temperature in early spring will affect the young seedlings in delay in their growth in the nursery beds. In case of Amol-3, the

rainfall from autumn to winter will seriously affect harvesting works or other various works. For such problems, the protected upland rice-nursery has been recently employed instead of the ordinary flooded nursery so as to practise appropriate farming works for meeting the seasons. Consequently, vinyl-covered upland nursery beds are applied by those farmers at the low and middle lands who are requested to prepare nursery in the earlier season for due reason as well as by the farmers at the highland where the temperature is lower than the low and middle lands.

The present major cropping pattern in the Project Area is shown as follows:

Summer		Winter
(1) Paddy	+	Fallow land
(2) Paddy	+	Fodder crops (Berseem, Sillage Barley, etc.)
(3) Paddy	+	Vegetables (Spinach, Lettuce, etc.)
(4) Vegetables (Tomato, cucumber, etc.)	+	Vegetables (")
(5) Vegetables (")	+	Wheat (Wheat, barley)
(6) Tree-crops		

More than 90 percent of the farmland in the Project Area are applying the aforesaid cropping pattern (1) as paddy mono-culture, and the paddy fields after harvesting have been utilized as grazing land for animals. The cropping pattern (2), which is recommended by the GDA of Mazandaran, has been applied to the well-drained land in the Project Area. Berseem is sown in the paddy fields four to five days before paddy harvesting, and is plowed into the soils in the following spring. Most of the land cropped with berseem in the Project Area is utilized as pasture for the domestic animals.

The field investigation has confirmed no full-time upland cultivation farmers in the Project Area. In the high land, some farmers enjoy considerable high farm income resulting from intensive three-cropping per year with cucumber, paddy and spinach. And also there are some farmers observed, who have intercropped vegetables and fodder crops in the orchards so as to raise the cropping rate of farm.

2.4.3. Present Cultivation Techniques

(1) Rice

The present paddy cultivation in the Project Area is outlined hereunder based on a survey interviewing 45 rice cultivating farmers, while detailed in Appendix C.5.

Seed selection is mostly carried out by winnowing and with water, and only a very few farmers practise seed selection by specific gravity. Seed disinfection is not carried out, and seeds are soaked in the flowing water for five to seven days to be sown.

In general, the farmers in the Project Area employ the lowland rice nursery. The acreage of the nursery to be prepared for one hectare of a paddy field is 180 to 300 m^2, and the larger nursery is prepared in the low land. According to the above survey, vinyle sheet covered protection nursery is becoming popular in the high land as countermeasure against cold weather. And, it is reported that such protection nursery is also becoming popular in the part of middle and low lands where irrigation water supply is in shortage due to water resources and farmers cultivate early maturing varieties.

The sowing season lasts from late March to late April, and more than half of the farmers in the Project Area carry out the sowing work in early April. The sowing in late April is observed in the high land. The amount of seeding ranges from 170 to 330 gr/m^2, which is equivalent to 54 kg to 60 kg for one hectare of a paddy field.

Most of the farmers start plowing in the middle or late January, and plow a field by a tiller every 30 to 40 days. Some farmers in the high and middle lands operate large-size tractors for plowing those fields which turn dry during winter. The plowing depth is between 20 to 25 cm and plowing frequency and depth are deemed ideal.

Basal-dressing is carried out prior to puddling. Urea (N-46%) and diammonium phosphate (DAP) (N-18%, P_2O_5-46%) are mainly used as basal fertilizers, and no potassium is dosed. The amount of fertilizers dosed is quite different by farmers. The average amount of basal fertilizer is estimated at 140 - 300 kg of urea, 140 - 370 kg of DAP per hectare. The farmers in the high land dose much, whereas those in the low land a little. This phenomenon may result from the flowing irrigation and much dosing of urea as main fertilizer. There is a standard of basal fertilizer recommended by the Soil and Water Research Institute in Sari which is 100 kg/ha of urea and 100 kg/ha of DAP for local varieties, 200 kg/ha of urea and 100 kg/ha of DAP for improved varieties. And a comparison of the standard with the actual dosing amount reveals that the farmers in the high land dose a remarkably large amount of fertilizer.

Transplanting is exclusively practised by random planting, although not much variant is observed in transplanting density. The transplanting ratio is mostly between 12 hills and 15 hills per square meter.

In terms of water management, rice is wholly cultivated under the flowing irrigation. The flowing irrigation has many defects, although it has some advantages. It is deemed advantageous that this method can abundantly retain the oxygen contents in the soils and curb soil temperature to rise in the summer season, while deemed defective that the method results in waste of water, difficulty in water depth control, wash-away of fertilizer components, reducing efficacy of herbicides, etc.

Most of farmers carry out top-dressing. Urea is the main fertilizer for top-dressing, and about 30 percent of the farmers surveyed uses DAP only or together with urea. The average amount of fertilizer dosed for top-dressing is surveyed as 150 - 180 kg/ha of urea, and 110 - 170 kg/ha of DAP. The top-dressing is commonly practised in one application only or in divided application by two or three times, but most of the farmers do it in one application. And the top-dressing is most commonly carried out within 20 days after transplanting, although carried out around 45 days after transplanting by some farmers.

Only eight kinds of weeds are found in the paddy fields of the Project Area. The most popular weed in the Area is Panicum Crus-Galli L., which grows autogenetrically or transplanted from nursery beds together with paddy seedlings. Besides the above, there are found some marsh-loving perenial weeds like Sagittaria Triflolia, Alisma Plantago-aquatica and Scirpus Juncoides. And wide distribution of these weeds suggests that many paddy fields in the Area are under considerably wet conditions even in winter. The herbicides most popular in the Area is Ronstar, although some farmers in the low land use Saturn. These herbicides, however, have not been used so efficaciously as expected, and some manual weeding works are unavoidably required.

As for disease, rice blast is considered most serious one in the Area, drawing careful attention of the farmers. Besides the above, the farmers have been interest to control such diseases as rice plant brown spots disease and stripe disease. Many farmers use Hinozan for disease control.

Rice stem borers give more serious damage to paddy than any others, and then, the damages by plant hoppers, rice green worms follow this. The insecticides most commonly used in the Area are Diazinon, DDT, and Linden.

Ponding water release for harvesting is carried out mostly 10 to 20 days before reaping, although some farmers in the high land five to seven days before reaping and some in the low land 30 days before reaping.

Harvesting is mostly carried out by manual reaping, but large-size combines are becoming popular for harvesting in the high land. Paddy is cut at 20 to 30 cm high and laid on the stubbles for

one or two days for sun-dry. And then, dried paddy is bound to be hauled to threshing site. Threshing is carried out by threshers with tillers as mover.

As mentioned above, since the works other than plowing, puddling and threshing are carried out by manpower, it causes labour peak for transplanting and harvesting works. Therefore, the farmers employ the hired labour for those works.

Table 2.4.2 shows the amounts of input materials for growing Tarom and Amol-3. This table is based on the farm economic survey detailed in Table C.2.9 in Appendix.

Table 2.4.2. Amounts of Input Materials for Paddy Cropping

(Unit: kg/ha)

Varieties	Amount of Seeds	Fertilizers		Agri-chemicals	
		Urea	DAP	Diazinon	Ronstar
Tarom	51	144	141	43	3.8 */
Amol No.3	54	259	243	63	3.3

Note: */ lit./ha

(2) Upland Crops

For upland field cropping, the comparatively large-scaled farm households with more than one hectare carry out plowing and land levelling commonly by large-size tractors on the hired basis. The vegetable growers adopt compost as basal fertilizers by 25 - 40 tons/ha besides chemical fertilizers. Vegetables are grown in open fields without ridge formation, thinning works and picking works. There are large differences among farmers in amount and frequency of fertilizer dosing and chemical spraying. And the vegetable cropping pattern has not been firmly established yet in the Project Area.

(3) Tree Crops

The mandarin orange is the main citrus in the Area, with the local variety trees as stocks and the trees can bear the fruits from three years after grafting. The trees grafted recently have been planted in the space of 4 - 6 m x 4 - 6 m. The pruning and fruit thinning have not been practised in the Area, nor the pest control have been sufficiently.

2.4.4. Farming Labor and Farm Mechanization

(1) Present Farm Labor

According to the Village Survey - 1364, the total population of the Area is 324,194 and the number of the households is 54,664. A

family consists of 5.9 persons on an average. Among the above, the landowner farm households count at about 40,000, and the population of such farm households can be estimated at 236,000 taking the average number of one family by 5.9 persons. Table 2.4.3 shows the farming family composition by age group.

Table 2.4.3. Farming Family Composition by Age Group

Population of Forming Family	Young than 15 Years Old	15 - 65 Years Old	Elder than 65 Years Old
236,000	117,500 (49.8)	113,000 (47.9)	5,500 (2.3)

Note: Estimated on the basis of composition ratio in Mazandaran Province, resulting from the Agriculture/ Forestry Census in 1349.

From the workable population (15 - 65 years old) illustrated in Table 2.4.3, the economically active population (50.7%) in both Amol and Babol Shahrestan is estimated at 60,000 in reference to the result of the population census in 1355.

In the assumption that all the estimated people would be engaged in agriculture, the farming population is 60,000 in the Project Area. In other respect, the farm economy survey shows that the number of the working days of the farm family members are some 410 days per farm household in conversion to those per male adult. Furthermore, since the chief of the farm management will work about 200 to 250 days annually, the working population per farm household can be estimated at two in conversion to the male adult. Accordingly, the farming population in the Project Area is estimated at 80,000, taking the number of farm households in the Area by 40,000.

Since paddy cultivation is prevailing in the Project Area, the extra labor employment is inevitable, according to the farm economy survey, for about 220 - 260 hours per hectare for supplementing the labor in the peak of transplanting and harvesting works. In other words, the extra employment of about 20 persons is required to successfully cover the peak time.

While the agriculture with paddy cropping as major farming in 70,000 ha of the Project Area will provide the employment opportunity to a great extent with those people in and around the Area, such extra labor works adversely to increase the paddy production cost as a whole.

(2) Farm Mechanization

Since the beginning of 1340s, power tillers have become popular for plowing and puddling in paddy farming in the Caspian Sea Coastal Area, and since 1350, the engines of power tillers have become commonly used as movers for threshers. On the other hand, the farmers in the Gorgan and the Khorassan areas are recently employed with their large-size tractors or combines on the hired machines basis for plowing, harvesting and threshing of paddy in the areas where have suitable working land conditions within the Project Area.

According to the Village Survey - 1364, the present ownership of the farming machines in the Project Area can be tabulated as Table 2.4.4.

Table 2.4.4. Present Ownership of Farming Machines

(Unit: unit/s)

Kind of Machines	Tillers	Tractors	Thresher	Pump for Wells	(Pick-up)	(Motor Bicycle)
No. of Machines	16,768	236	11,741	6,955	2,610	2,898
100 Household in Total	42	-	29	17	7	7
100 Land Owners	52	1	37	22	8	9

The power tillers have become well diffused in the Area as well as the power threshers, and the diffusion rate is about 42 units per hundred farm households for the whole farmers, whereas the land-owner farmers have the power tillers at the rate of one unit per two households. The farm economy survey shows that some farmers have two machines per household.

The actual number of the farming machine owned by the farmers in the Project Area can not be clarified due to lack of data and records; however, the records of the sales by Construction Jihad in Mazandaran Province for five years of 1360 to 1364 show that 14,221 units of power tillers, 266 units of tractors (more than 45 ps), 9,983 units of power sprayers and 18 units of combines were sold to the farmers in the province, while the Farming Machinery Development Public Corporation marked for eight years of 1356 to 1363, the sales of 6,937 units of power tillers, 5,500 units of tractors 5,000 units of pumps, and 300 units of combines. These records of the sales suggest that there has been a tendency for the farmers to purchase not only power tillers but the large-size machines like tractors and combines, and such tendency has currently been observed only among the upland cropping farmers. On the other hand, however, the mechanized farming works have been introduced more and more into the paddy farming works on hired machines basis. Under the circumstances, there comes a sign that the paddy cultivation farmers will positively employ the large-size machines sooner or later unless any external influence should work adversely upon the tendency.

Shortening the working hours for paddy cultivation, decreasing the paddy production cost, encouraging the multi-management in farming and promoting the intensive use of paddy fields as limited land resources available will require the further farm mechanization in paddy cultivation, particularly in those works for transplanting, harvesting and threshing through prudent and careful study in terms of employment and financial problems of the nation.

2.4.5. Animal Husbandry

(1) Number of Livestock in Iran

There are the statistics available on the number of livestock in 1359 and 1361 in Iran. According to these data, about 5.1 million heads of cattle and 34.6 million heads of sheep and 18.66 million heads of goats, 2.02 million heads of donkies were mainly bred in 1361. The Holsteins and hybrid species and local species are included in the cattle group on statistics but details are not clarified.

The annual increasing rate in number is 19 percent for cattle and 5.7 percent for sheep and 3.7 percent for goats, respectively. Details are shown in Table C.3.1 in Appendix C-3.

(2) Production of Animal Products in Iran

In the statistics, red meat production is shown but the trend of dairy products production is not clarified. There is an inclination to increase in beef and lamb production, especially annual growth rate of beef production is very high by 17.1 percent on the average, similarly, 2.9 percent for lamb and 11.8 percent for goat meat production, respectively.

The number of slaughtered livestock in Iran which has relation with a trend in the meat production is 520 thousand heads of cattle and 27 thousand heads of buffalo and 4.8 million heads of sheep, 1.53 million heads of goats in 1361. Besides cattle, the slaughtered number of other livestock shows an upward trend.

In spite of an upward trend in animal products production, the amount of imported animal products has increased remarkably at the annual rate of 32.8 percent for red meat and 27 percent for poultry meat on the average for a period from 1350 to 1358.

The details on the amount of animal products production and the number of slaughtered livestock are shown in Tables C.3.2 and C.3.3 in Appendix C-3.

(3) Number of Livestock in the Project Area

Some statistics are available on livestock in Amol and Babol Shahrestans but the particular situation of the Project Area is not able to read therefrom. Therefore, the results of the Village Survey-1364 is the only source available on the number of the livestock in the Project Area, showing that there have been 90,686 heads of cattle, 88,700 heads of sheep and 5,889 heads of goats in the Area at the time. It is difficult to know the tendency in the number of livestock from the aforesaid Village Survey but considered that the number of local cattle has been decreased with increase in slaughtering due to shortage of forage, etc. in the Project Area. On the other hand, the number of hybrid species and pure species of Holstein have a tendency to increase in number because the Government has promoted an improvement of local species by crossing with pure bull Holstein.

The average number of livestock per livestock farming household in the Project Area is estimated at 2.1 heads for cattle and 74.3 heads for sheep and 5.8 heads for goat, 8.1 birds for poultry. As for the poultry husbandry, there are 111 industrial and modernized poultry farms.

(4) Animal Products Production in the Project Area

Table C.3.6 in Appendix C-3 shows the number of slaughtered livestock in Amol and Babol Shahrestan. As there are no statistics available on production in the Project Area, the tendency can be assumed only from the data in the two Shahrestans. In 1362 about 30 thousand heads of cattle and 136 thousand heads of sheep, 59 thousand heads of goats are slaughtered. As mentioned before, slaughtering has been done to moderate the shortage of forage, and meat production has been increased accordingly.

(5) Animal Husbandry in the Project Area

1) Performances of Livestock

The local species cattle in Iran is generally small and milk producing capacity is low. To improve the productivity of local cattle, cross breeding by using bull Holstein has been promoted. In the Project Area as well, these three types of cattle; local, hybrid and pure Holstein species, are seen but the number of the hybrid species and pure Holstein is only 9,639 heads at present.

The following shows the performances of cows:

		Holstein	Hybrid species	Local species
Live Body Weight	(kg)	500-550	400-450	200
First Calving	(month)	24-28	30-33	42-48
Calving Rate	(%)	80	70	50
Milk Production	(kg)	4,000	1,800-2,000	500-600
Lactation Period	(month)	10	7	6
Milk Fat	(%)	3.0-3.5	3.5-4.0	4.0-4.5
Calving Interval	(month)	15	17	23-24

Live body weight of adult sheep is 35 - 40 kg per head and about 1.5 kg wool is produced annually. Adult goats with 32 - 35 kg of live body weight produces only a little amount of milk, which is mainly processed into cheese.

Local chicken lay 120 to 130 eggs in a year. Broilers which are kept in the industrial poultry farms are marketed at 42 days old and 1.4 kg of body weight, and the breeding rotation is three to five times in a year.

2) Feeding

The farmers in the Project Area keep more or less animals. But due to their small-scale management and a little amount of production, and lack in marketing system, a greater part of animal products have been used for family consumption. And also, the cultivated land in the Project Area is almost occupied by paddy fields, which means a shortage in forage resources. Paddy straw and wild grass along the road are the main feeds of the animals. This results in malnutrition and low productivity of the animals. Artificial insemination has been done but at present natural insemination is more popular because of lack in veterinarians and traffic facilities.

Generally, the farmers keep cows for milk production, and male calves are slaughtered for meat at 10 months old after birth.

(6) Animal Health

Services for animal health are rendered by the Veterinary Office. Only two veterinarians are serving in Amol Shahrestan and four in Babol Shahrestan and 22 in Mazandaran Province at present. Therefore, it is considered insufficient for them to serve for the farmers.

In the Project Area, there has been animal diseases such as tick fever, liver distoma and other diseases related on the lungs and stomach. Especially diseases caused by parasites are very commonly found. As for the infectious disease, anthrax, foot and mouth disease, rinder pest, brucellosis, tuberculosis and new castle, fowl chorela and so on are observed. Among these diseases, preventive injections for brucellosis and tuberculosis are obligated.

If a farmer's house locates near the veterinary center, a veterinarian goes to the farm household directly to diagnose and give a medical treatment. But if it is far from the center, the farmer has to transport livestock to the veterinary center or the clinic. Under these circumstances, the major constraints in the prevention of epidemics are shortage in veterinarians and transportation facilities such as cars and motor cycles.

(7) Feed Resources

As mentioned before, the cultivated lands in the Project Area is almost occupied by paddy fields; therefore, the main feed resources are paddy straw and wild grasses, though agricultural by-products such as rice bran, beet pulp, cotton seed cake, etc. are also used.

According to the farm economy survey conducted in the Project Area, the seasonal feeds for cattle are natural grazing, paddy straw and rice bran during May to August, the rice cropping season, while stubble grazing on paddy fields, beet pulp, brans, etc. for the period from September to April. Paddy straw is commonly fed as the main feed throughout the year.

In order to develop animal husbandry in the Project Area, feeding depending upon paddy straw has to be improved. For the purpose, Ministry of Agriculture has been trying to solve the problems on feeds and feeding by cropping berseem (Egyptian Clover or Trifolium Alexandrinum) in paddy fields as the second crop. But at present it is estimated that cropped areas with berseem are only about two to four percent of all paddy fields in the Project Area. Additionally, distributed berseem seeds (175 rials/kg) in the Project Area by the Rural Service Center and the Agricultural Office in 1363 were only 53 tons in Amol and 22 tons in Babol. This is due to poor drainage of paddy fields (specially, in the lowland area) and insufficiency of extension services, necessity of fence surrounding paddy fields cropped with berseem for preventing stranger cattle intrusion. In the some portions having good drainage condition, berseem cropping is more often observed than the low and middle land areas.

Generally, berseem is sown directly in September on the paddy fields before harvesting paddy and mainly used for grazing up to April in the following year.

In case of soiling use, berseem is cut three times until plowing into paddy fields.

(8) Farm-gate Prices of Animal Products

The data of the farm-gate prices of animal products and input materials for production such as feeds are collected from the Animal Husbandry Office and Veterinary Office and livestock farming survey. Concentrates such as compound feeds and cotton seed cakes have been distributed through the Animal Husbandry Office in official prices and also these are sold in free market at higher prices.

Table C.3.9 in Appendix C-3 shows the data on farm-gate prices collected in the survey.

(9) Marketing of Animal Products

As clarified by the farm economy survey, cow milk which is the main animal products in the Project Area is almost used for family consumption and distributed very little in Amol and Babol city. This is due to absence of milk processing factories and milk collecting system in the Project Area.

Outside the Project Area there is only one milk factory with a capacity of 10 tons per day, located in Sari city which is the capital of Mazandaran Province and about 60 km far to the east from Amol city.

As for the marketing of live animals, there is no animal market, and so buying and selling have been made directly between buyers and sellers.

There are one public slaughterhouse in Amol city and usually 400 heads of sheep and 40 heads of cattle are treated daily but the capacity is insufficient, specially in the summer.

The following shows roughly the existing marketing channel of animal products:

Milk	:	Farmers	———	Shops (Fresh Milk) (Yoghurt)	———	Consumers
Eggs	:	Industrial Farms	——	Shops controlled by Government	——	Consumers
		Farmers	———	Local Market	———	Consumers
Live Animals:		Farmers	——	Butchers —— Slaughter-house	——	Meat Shop —— Consumers

(10) Extension Services Organization for Animal Husbandry

The organization for extension services for animal husbandry is divided into two, Animal Husbandry Office and Veterinary Office, in Mazandaran Province. There are 12 branch offices of the Veterinary Services for medical treatment and prescription, artificial insemination in Babol at present, but veterinary services are insufficient due to shortage in veterinarians. In Amol Shahrestan, the veterinary services such as artificial and natural insemination, preventive injection and diagnosis have been conducted by the Agricultural Office which has some facilities for medical treatment, although only two veterinarians are assigned.

The Animal Husbandry Office has given technical services on animal husbandry, grassland improvement/development, poultry and honey bee industry.

(11) Twenty-year Plan for Animal Husbandry

In 1361, the Livestock and Pasture Committee prepared the so-called "20 Year Plan for Animal Husbandry" to forecast animal husbandry in Mazandaran up to the year 1381 and to increase self-sufficiency rate of animal products. The report points out that the most remarkable constraints in development of animal husbandry are the shortage of forage resources and low productivity of livestock. And also the report says that the shortage of forage resources results in disproportion between the number of livestock and the amount of available forage, and low productivity of livestock is due to the native performances of the race and insufficiency of forage in quality and quantity, influence of parasites and so on. To solve these problems, the committee recommends the following countermeasures:

- Forage Resources
  - ° To improve natural grassland. This is also useful significantly in the aspect of prevention of soil erosion at slope land and preservation of natural environment.
  - ° To keep sheep and goats which compete with cattle in forage use, in the mountainous area at elevation of 1,800 to 3,000 m.
  - ° To crop berseem as the second crop in paddy fields.
- Improvement of Animal Productivity
  - ° To improve nutrient conditions of animals by betterment of present feeding.
  - ° To improve local cattle by distributing quality bull Holsteins to every five to 10 villages.
  - ° To increase poultry production by establishment of industrial farms.

2.5. Farm Economy

2.5.1. Income and Expense of the Farmers

The Farm Economic Survey has been conducted on the paddy cultivating farmers in the Project Area in 1364. Table 2.5.1 shows the actual situation of farm economy by management scale based on the above.

Many of paddy cultivating farmers, besides rice production, raise a few cows, small animals such as sheep, etc. and poultry for self-sufficiency and dispatch these products to their livelihood. It goes without saying that their method of raising is extensive: they give feeds in grazing their animals in the paddy fields with residural long rice-straw and with some purchased compound feeds. And the cows are mainly local or hybrid species.

Table 2.5.1 The Actual Situation of Farm Economy by Management Scale (per household)

(Unit: Rls)

Items	1.0-2.0 ha	2.0-3.0 ha	3.0-5.0 ha	5.0- ha
Agricultural income	1,043,500	1,684,000	2,496,300	2,755,600
Non-agricultural income	164,400	286,700	264,000	1,542,600
Farm household income	1,207,900	1,970,700	2,760,300	4,298,200
Owing interest	20,000	185,000	96,300	60,000
Tax	-	-	6,200	30,000
Disposal income	1,187,900	1,785,800	2,657,800	4,208,200
Household expenses	1,059,900	1,311,000	1,880,600	1,785,800
Farm household economy surplus	128,000	474,800	777,200	2,422,400
Average scale	1.4 ha	2.3 ha	3.5 ha	8.5 ha
Number of family member (per household)	7 persons	9 persons	8 persons	10 persons
Agricultural income	149,100	187,100	317,000	275,600
Disposal income	169,700	198,400	337,500	420,800
Household expenses (per a member of the family)	151,400	143,700	238,800	178,600

Table 2.5.1 shows that farmers with land from 1.0 to 3.0 ha gain agricultural income of the one million Rls and, in order to gain income of the two million Rls farming scale should be over 3.0 ha.

As to non-agricultural income, there is not any remarkable income found in the farm economy of management scale of 1.0-5.0 ha. The agricultural income amounts to 90 percent of the farm household income, therefore, it can be regarded as only the source of earnings. The non-agricultural income is found in the farm economy

of management scale over 5.0 ha, together with running mills or transportation business by investing their own funds, or leasing land of their own to tenant farmers aiming at use of labour as tenant.

Moreover, it is worthy of noticing in this Farm Economic Survey that the farmers having 1.0-2.0 ha and 2.0-3.0 ha cover their expenses and gain some surplus in farm economy somehow or other, and that especially, the farmers with 2.0-3.0 ha cover expenses only by agricultural income and gain some surplus. Household expenses per one person of these farmers amount to about 150 thousand Rls, and in considering that those large-scale farmers with over 3.0-5.0 ha gain about 200 thousand Rls, it may be said that these farmers with 2.0-3.0 ha enjoy the minimum favorable living standards.

This phenomenon has resulted from the Government policy for high price of rice and at the same time, it becomes one of the major reasons that working days per annum of the land holders of 1.0-2.0 ha and 2.0-3.0 ha are consumed mostly by paddy production activity.

According to the result of the Village Survey - 1364, the number of farmers in the Project Area is about 53 thousand, and the percentage of farmers having 1.0-2.0 ha is 24 percent, and those having 2.0-3.0 ha is 15 percent. Therefore, the number of the farmers of the both accounts for 39 percent in total. And the land which they own covers about a half (46 percent) of total agricultural land as already shown in para. 2.2.2. Consequently, the future direction of agricultural development will depend greatly on their farm economy, intension on farming and will on development.

2.5.2. The Present Labour Requirement and Production Cost for Paddy Production (per hectare)

According to the result of the Farm Economic Survey, the present labour requirement and production cost by paddy varieties per hectare are shown in Table 2.5.2 and Table 2.5.3.

(1) Labour Requirement

For cropping of Amol-3 (an improved variety), 1,274 man-hours are required and 1,013 man-hours of which are supplied by family labour and 261 man-hours by hired labour. And in local variety of Tarom, the harvesting time comes one month earlier than that of Amol-3; accordingly, labour requirement is less than that of Amol-3 by 155 man-hours, so that 1,119 man-hours are required. 903 man-hours of those are supplied by family labour and 216 man-hours by hired labour. In both cases, about 20 percent of labour requirement has to be supplied unavoidably by hired labour, and the working period which requires hired labourers is principally concentrated on transplanting and harvesting. Especially in transplanting, the hired labour of about 115 man-hours is required for both varieties.

(2) Production Cost

The production cost of Amol-3 amounts to 450,858 Rls and that of Tarom is 402,457 Rls. For both varieties, labour cost accounts for about 77 percent of production cost, and so labour cost weighs heavy on production. Therefore, in order to reduce the production cost, it is necessary to promote farm mechanization so as to save manpower.

Table 2.5.2 Labour Requirement for Paddy Production (per hectare)

(Unit: hour)

Variety	Amol 3			Tarom		
	Family	Hired	Total	Family	Hired	Total
Operation						
Seed Bedding	24	-	24	28	2	30
Plowing	157	20	177	111	11	122
Leveling	37	8	45	34	7	41
Transplanting	119	73	192	140	45	185
Weeding	223	18	241	158	17	175
Fertilizing	17	1	18	12	1	13
Spraying	24	2	26	17	2	19
Water Management	80	-	80	90	-	90
Harvesting	213	116	329	207	114	321
Threshing	104	22	126	99	16	115
Transporting	15	1	16	7	1	8
Total	1,013	261	1,274	903	216	1,119

Table 2.5.3 Paddy Production Cost (per hectare)

(Unit: Rls)

Variety	Amol 3	Tarom
Expenses		
Fertilizers	4,532	2,987
Pesticides	13,672	9,899
Agri-machines	32,873	29,625
Hired Labour	117,209	103,658
Others	45,498	39,796
Sub Total	213,784	185,944
Self Supporting Cost		
Seeds	7,134	12,174
Family Labour	229,940	204,339
Sub Total	237,074	216,513
Total	450,858	402,457

2.5.3. Reward for Family Labour in Paddy Production

The varieties of paddy which are cultivated in the Project Area are mainly improved variety of Amol-3 and local variety of Tarom. Especially, Amol-3 is cultivated in about 60 percent of paddy cropping area, owing to the effort of the Government for increasing paddy production by its high yield, though it is lower quality in taste.

According to the Farm Economic Survey, the present yields of the both varieties of Amol-3 and Tarom are 7.1 t and 4.1 t per hectare respectively, and the present prices are 190 - 200 Rls and 320 - 360 Rls per kilogram, respectively.

The reward for the family labour in paddy production has been calculated from the above results of the Farm Economic Survey as shown in Table 2.5.4.

Table 2.5.4 Reward for Family Labour in Paddy Production (per hectare)

Items		Amol 3	Tarom
Family Labour per hectare	(hr)	946	824
Gross Production Value per hectare	(Rls)	832,027	898,357
Production Cost per hectare	(Rls)	450,858	402,457
Family Labour Cost per hectare	(Rls)	229,940	204,339
Production Cost Excluding Family Labour Cost per hectare	(Rls)	220,918	198,130
Reward for Family Labour per hectare	(Rls)	611,109	700,227
per hour	(Rls)	646	850

Notes: Family labour is calculated as man-hours which are converted into an adult man's. (labour as 1.0 unit)

As shown in Table 2.5.4, the reward for family labour in paddy production amounts to 611 thousand Rls per hectare or 646 Rls per hour for Amol-3, and those of Tarom are 700 thousand Rls or 850 Rls, respectively. In the both values of per hectare and per hour, the reward of Tarom is more favorable for the farmers than that of Amol-3 which the Government is recommending as a part of the programs for increasing the yield of paddy. Therefore, when the Government attempts to diffuse the improved variety, it should pay a full attention to coping with this severe situation.