

ISLAMIC REPUBLIC OF IRAN

FINAL REPORT

FOR

THE MASTER PLAN

ON


THE CASPIAN SEA COASTAL AREA

AGRICULTURAL DEVELOPMENT PROJECT

MAIN REPORT

FEBRUARY 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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国際協力事業団

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PREFACE

In response to the request of the Government of the Islamic Republic of Iran, the Japanese Government has decided to conduct a Master Plan study on the Caspian Sea Coastal Area Agriculture Development Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Iran a survey team headed by Mr. Mitsutoshi YAMADA of Sanyu Consultants Inc. three times during the period of September, 1984 to July, 1986.

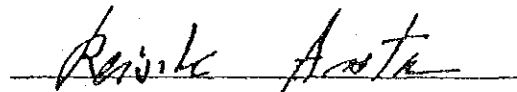
The team exchanged views with the officials concerned of the Government of Iran and conducted a field survey in the lower basin of the Haraz River in Mazandaran Province.

After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Islamic Republic of Iran for their close cooperation extended to the team.

February, 1987



KEISUKE ARITA

President

Japan International Cooperation Agency

LETTER OF TRANSMITTAL

February, 1987

Mr. Keisuke Arita
President
The Japan International Cooperation Agency
Tokyo, Japan

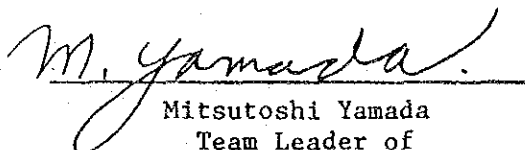
Dear Sir,

We are very pleased to submit herewith the final report on the Caspian Sea Coastal Area Agricultural Development Project in the Islamic Republic of Iran. The final report has resulted from various surveys/studies made since 1984 as three-staged field surveys for seven and a half months in total including consultative discussion with Iranian officials concerned and the home office works for six months. The objectives and scope of the Project are defined in the Scope of Works (S/W) concluded in July, 1984 between the authorities concerned of the two countries, and the Study team has tried to formulate a variety of projects related to firm establishment of the paddy culture with high productivity and encouragement of paddy-livestock combined agriculture which have been taken up in view of the basic concept of the development of the Project Area. The objective of the study is to carry out the Master Plan Study for the Project Area, and the detailed feasibility studies would be executed on each project involved in the Master Plan so as to be implemented one by one.

We wish to express our heartfelt thanks for positive and enthusiastic cooperation rendered to the Study Teams by H.E. Mr. J. Rasoulof, deputy minister of the Ministry of Agriculture who has been in charge of the Project and many other Iranian officials concerned, and furthermore, the closest guidance given by personnel concerned in the Japanese Embassy in Teheran, Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Fisheries and the Japan International Cooperation Agency. Also it is our great pleasure to add that the active participation of the Iranian counterparts has helped to proceed the study very smoothly.

Again, we, all members of the Study Team, wish to express our sincerest gratitude to the aforesaid personnel for their best and closest cooperation and assistance rendered to us in every stage of study and preparation of the report.

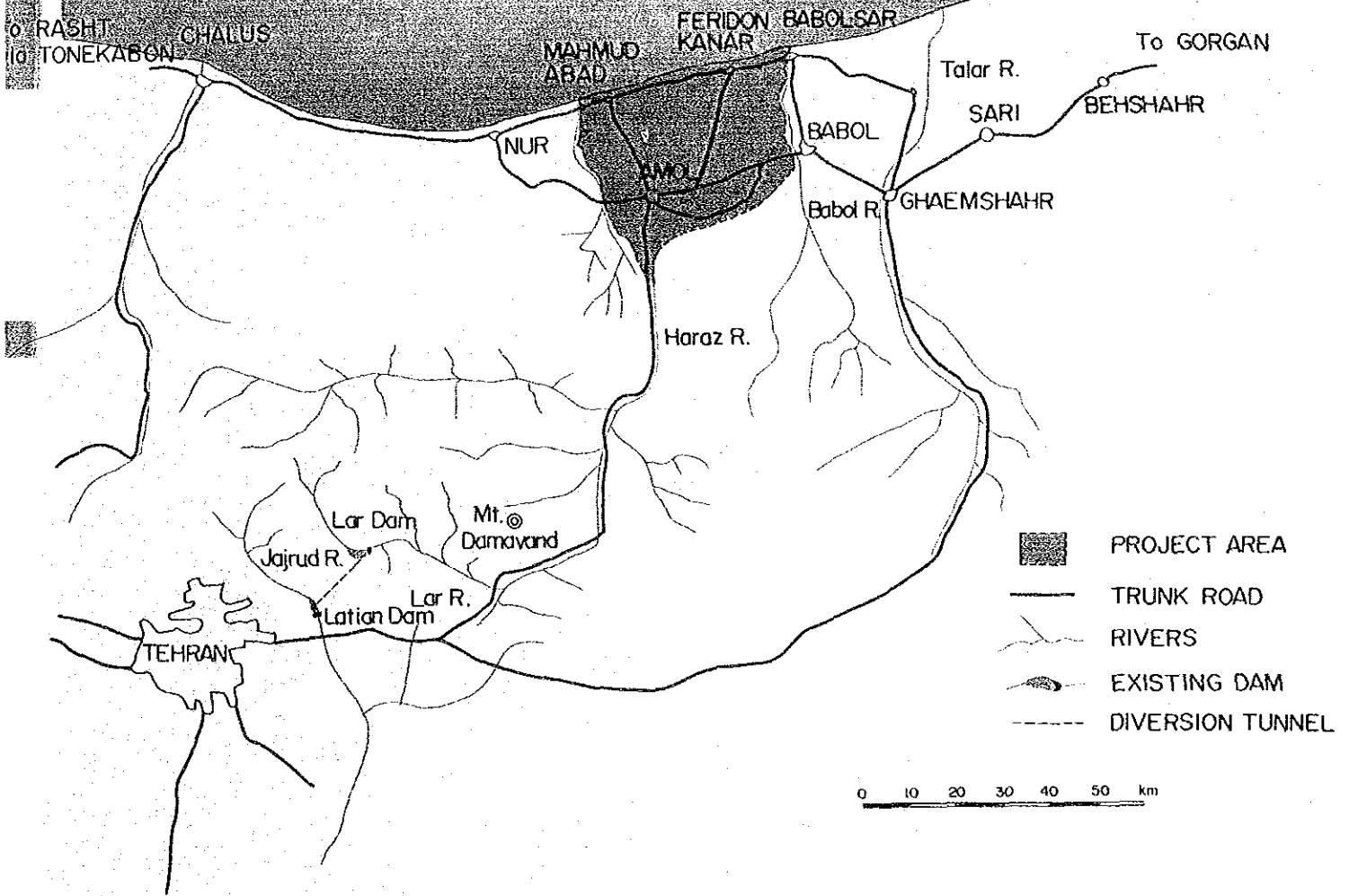
Very truly yours,



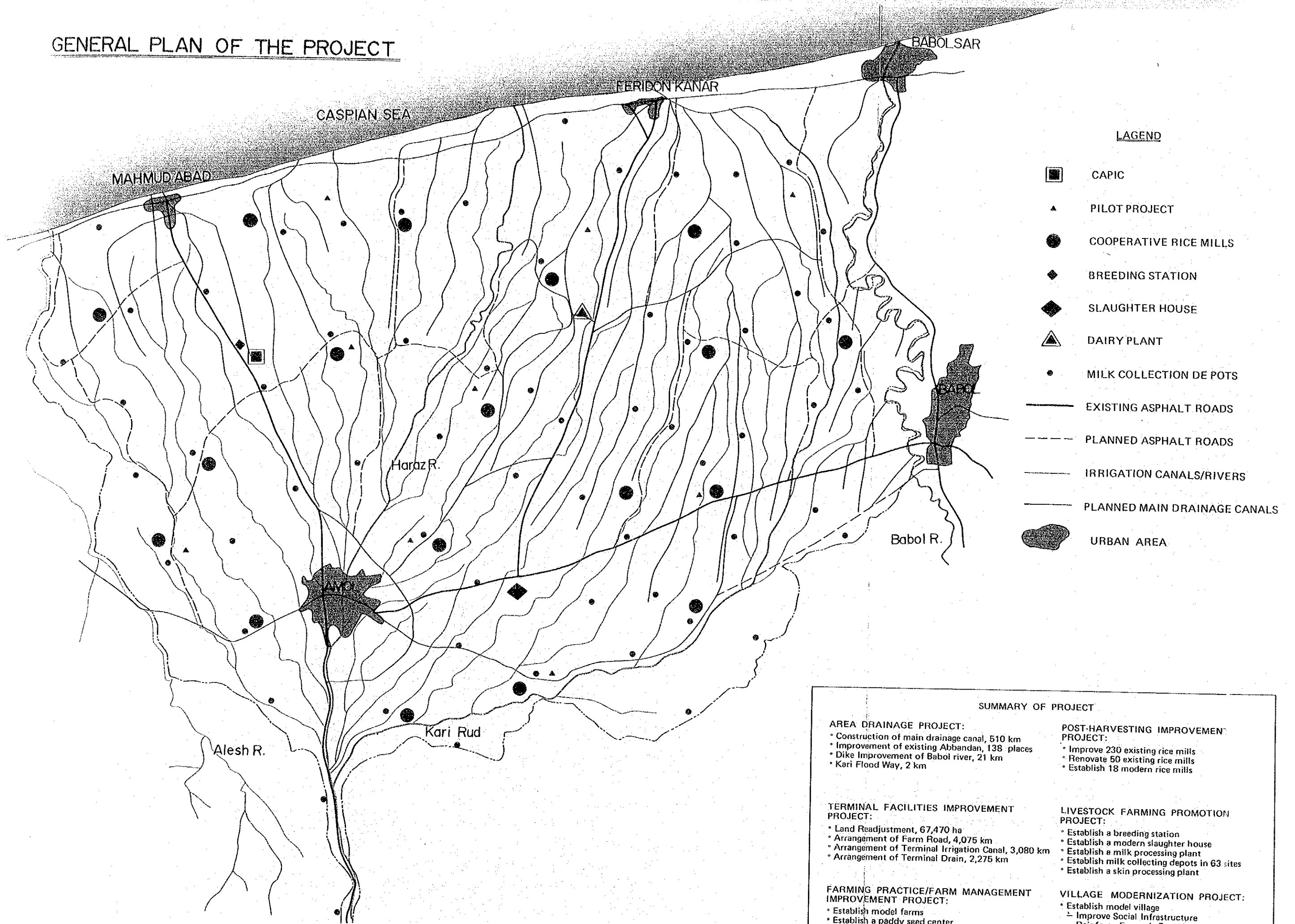
Mitsutoshi Yamada
Team Leader of
CSCAADP Study Team

LOCATION MAP

CASPIAN SEA COASTAL AREA
AGRICULTURE DEVELOPMENT PROJECT



GENERAL PLAN OF THE PROJECT



LEGEND

- CAPIC
- ▲ PILOT PROJECT
- COOPERATIVE RICE MILLS
- ◆ BREEDING STATION
- ◆ SLAUGHTER HOUSE
- ▲ DAIRY PLANT
- MILK COLLECTION DE POTS
- EXISTING ASPHALT ROADS
- - - PLANNED ASPHALT ROADS
- IRRIGATION CANALS/RIVERS
- PLANNED MAIN DRAINAGE CANALS
- URBAN AREA

SUMMARY OF PROJECT

- | | |
|--|---|
| <p>AREA DRAINAGE PROJECT:</p> <ul style="list-style-type: none"> • Construction of main drainage canal, 510 km • Improvement of existing Abbandan, 138 places • Dike Improvement of Babol river, 21 km • Kari Flood Way, 2 km | <p>POST-HARVESTING IMPROVEMENT PROJECT:</p> <ul style="list-style-type: none"> • Improve 230 existing rice mills • Renovate 50 existing rice mills • Establish 18 modern rice mills |
| <p>TERMINAL FACILITIES IMPROVEMENT PROJECT:</p> <ul style="list-style-type: none"> • Land Readjustment, 67,470 ha • Arrangement of Farm Road, 4,075 km • Arrangement of Terminal Irrigation Canal, 3,080 km • Arrangement of Terminal Drain, 2,275 km | <p>LIVESTOCK FARMING PROMOTION PROJECT:</p> <ul style="list-style-type: none"> • Establish a breeding station • Establish a modern slaughter house • Establish a milk processing plant • Establish milk collecting depots in 63 sites • Establish a skin processing plant |
| <p>FARMING PRACTICE/FARM MANAGEMENT IMPROVEMENT PROJECT:</p> <ul style="list-style-type: none"> • Establish model farms • Establish a paddy seed center • Establish cooperative nursery facilities • Introduce pest/vermin control system | <p>VILLAGE MODERNIZATION PROJECT:</p> <ul style="list-style-type: none"> • Establish model village • Improve Social Infrastructure • Reinforce Farmer's Organization • Introduce/Enlarge Rural Industries |

SUMMARY AND CONCLUSION

1. OUTLINE OF THE PROJECT

1.1. Importance of Development

The agricultural production has occupied more than 15 percent of the gross national product of the Islamic Republic of Iran since the revolution in year 1979, and is the second largest following to the production in petroleum sector. However, Iran is recently importing an increasing quantity of the major agricultural products like wheat, rice, meat and edible oils due to the rapid population growth and changing eating habit of Iranian people by upgrading of living standard, resulting in the outflow of hard currency gained by oil export.

To cope with the above-mentioned situations, the Government of Iran has attached great importance to the agricultural development in its domestic policy. However, the major portion of the country extends in the arid zone, and there are various restrictive factors in increasing and stabilizing the agricultural production in the country. The most severe is the shortage of water resources in quantity.

Under such conditions of agriculture in Iran, the Caspian Sea Coastal Area is exceptional. Blessed with abundant water resources, a paddy field zone of about 370,000 ha extends in the Area. Paddy production in the Area amounts to 600,000 tons per annum, which is equivalent to 86 percent of the national total production of 700,000 tons. On the other hand, the consumption of paddy rice in Iran is over 1,000,000 tons. The deficiency depends upon import. The increased production of paddy is an urgent requirement of the country.

The Project Area is located at the center of the Caspian Sea Coastal Area which is a paddy production zone in the delta plain formed

by the River Haraz. Farmers in the Project Area have considerably high -level farming techniques. The agricultural productivity in the Project Area will rise to a considerable extent, if an integrated agricultural development is executed to improve the present ill-drainage, insufficient farm roads, and irregularly-shaped small farm plots from which the Caspian Sea Coastal Area including the Project Area is suffering, and to improve paddy cultivation methods, increase the cropping intensity by introducing second crops, and strengthen livestock breeding.

The above-mentioned development will contribute much both to the regional economic development in the Caspian Sea Coastal Area and the national economic development attaining higher self-sufficiency of agricultural products and upgrading of farmers' living standards. The study this time has been carried out to formulate an agricultural development project plan centering around paddy cultivation for a selected area of about 100,000 ha in the Caspian Sea Coastal Area as explained below;

1.2. Development Plan

(1) Development Concept

In formulating an improvement and development plan of the existing agricultural area like the Caspian Sea Coastal Area, it is necessary to verify carefully the potential resources for agricultural development in the area inclusive of land resources, water resources, and human resources both in quality and quantity, and study the possibility and direction for more effective utilization of the potential resources for agricultural production. From this point of view, the Master Plan study was conducted from different angles as described below;

1) Cropping Intensity

The major part has already been developed for paddy production, and

there hardly exist reclaimable lands in the Project Area. However, the paddy fields in the middle and low lands, which amount to 65 percent of the total paddy fields in the Project Area, suffer from ill-drainage due to the flat topography and unfavorable soil conditions. In autumn and winter these paddy fields are submerged by rainy water, which hinders the cultivation of second crops after harvesting paddy. The drainage improvement in these fields is, therefore, indispensable in order to increase the present cropping intensity of 100 percent by the mono-cultivation of paddy to more than 150 percent with the introduction of second crops.

2) Improvement of Agricultural Infrastructure

The Haraz water is diverted through irrigation canals to the Project Area for paddy cultivation. The irrigation canals which have no permanent diversion works hinder the rationalized water management. The plot-to-plot irrigation is made at on-farm level, resulting in waste of fertilizers and agricultural chemicals and in difficulty in maintaining an appropriate water depth for the growth of paddy. Furthermore, irregularly-shaped small farmlands and a low farm road density prevent farmers from effective water management and farm practices.

To increase the agricultural productivity, the improvement of irrigation facilities and land readjustment will be necessary in addition to the drainage improvement mentioned in above 1).

3) Cultivation of Crops

The present yield of paddy is high at 5.5 tons/ha on an average (unhulled rice). However, the production cost is extremely high at 450,000 Rls/ha in which labor cost occupies 350,000 Rls/ha. It is important to reduce the production cost by adequate farm mechanization to increase the net income from paddy cultivation. As a matter of

course, the improvement of ill-drained paddy fields and farm roads and the land readjustment mentioned above 1) and 2) will be prerequisite for introducing farm machinery.

For a high yield of paddy per unit area, the land consolidation for rationalized water management and the establishment of a seed center for distributing qualified seeds and model farms for extension of new cultivation techniques will be necessary.

The second crops shall be cultivated to increase the cropping intensity, agricultural productivity and farm income. It will be necessary to introduce as the second crops berseem and clover for livestock breeding and vegetables like lettuce and spinach.

4) Livestock Breeding

Cattle-oriented livestock farming is popular in the Project Area. However, local species with a low productivity share 90 percent of the cattle being raised in the Project Area. The present low production of meat and milk is also attributable to the shortage of fodder crops which causes underfeeding. The improvement of livestock breeding through artificial insemination and the increased cultivation of fodder crops as second crops shall be encouraged.

5) Agro-Industries

Presently rice milling is the major agro-industry in the Project Area. However, the improvement of milling facilities will be necessary since the loss in milling process is very high at more than five percent. No other agro-industries have yet been developed sufficiently, resulting in limited non-agricultural employment opportunities. To absorb non-employed population in vacant seasons of paddy cultivation, agro-industries like

agricultural products processing, etc., shall be introduced in addition to the cultivation of second crops and encouragement of livestock breeding.

6) Farmers' Organization and Rural Social Infrastructure

The majority of farmers in the Project Area are subscribers of the existing agricultural cooperatives. However, these agricultural cooperatives are not very eager for paddy production. For the improvement of infrastructure for production and the introduction of modernized agricultural techniques mentioned above, strengthening of farmers' organization will be inevitable. Effective operation of the existing agricultural cooperatives shall be studied.

Although the rural infrastructure in the Project Area has been improved to a considerable extent, farm roads, education facilities, and medical facilities are insufficient. A comprehensive improvement of rural social infrastructure will be necessary.

(2) Method of Development

To materialize the above-mentioned development concepts, the project plans aiming to solve or improve the existing problems in each field shall be formulated. The Master Plan proposes the following six projects for this purpose;

- Area Drainage Project;
- Terminal Facilities Improvement Project;
- Farming Practices and Farm Management Improvement Project;
- Livestock Farming Improvement Project;
- Post-Harvesting Improvement Project; and,
- Village Modernization Project.

Each project is explained below;

1) Area Drainage Project

Objectives and Outline:

The project aims to enlarge the cultivable area of second crops through improvement of the main drainage facilities and flood protection facilities. In addition to the improvement of existing drainage canals, these canals will be extended to form rationalized drainage canal networks. Simultaneously, the existing ponds will be improved to function as regulation reservoirs aiming to minimize the cross section of drainage canals. The major facilities are as follows;

Extension of the Main Drainage Canals	510 km
Improvement of the Existing Ponds	138 km
Construction of the Babol River Dikes	21 km
Construction of a Floodway for the Kalil River	2 km

Project Cost (including miscellaneous construction items)

Main Drainage Canal Works	10,400 million Rls
Farm Pond Works (Spillway, etc.)	1,350
Dike and Floodway Works	250
<u>Total</u>	<u>12,000 million Rls</u>

Project Benefit:

Inundation Control for Paddy	13,075 ha
Expansion of Cultivable Area of Second Crops *	5,900
Service Area of Terminal Drainage Canals	34,240

* The effect of surface water drainage through main drainage canals.

2) Terminal Facilities Improvement Project

Objectives and Outline:

The project aims to make land readjustment in each terminal land consolidation block of about 110 ha, which is a typical size of the service area of one terminal irrigation canal, and improve irrigation and drainage canals as well as farm roads for farm mechanization and for a high efficiency of farm practices. The target scale of farm plots and the target densities of farm roads, and irrigation and drainage canals, which will be separated in the project, are shown below;

	<u>Present</u>	<u>Target Scale</u>			
		<u>High Land</u>	<u>Low Land</u>	<u>High Land</u>	<u>Low Land</u>
Average farm plot	0.21	to	0.22	0.61	to 0.59 ha
Farm road density	48.6	to	7.55	54.0	to 33.2 m/ha
Irrigation ditch density	46.0	to	31.9	43.6	to 40.2 m/ha
Drain density	0	to	12.9	9.6	to 44.0 m/ha

Project Cost (including miscellaneous construction cost items)

Intake facilities	900 million Rls
Settling Basin	450
Diversion Works	3,480
Improvement of Drainage Canals	130
<u>Sub-Total</u>	<u>4,960 million Rls</u>
Land Consolidation Works *	50,340 million Rls
Underground Drainage	2,800
<u>Sub-Total</u>	<u>53,140 million Rls</u>
<u>Total</u>	<u>58,100 million Rls</u>

* Average construction cost per ha: 370 to 470 thousand Rls

Project Benefit:

- Available Area for Farm Mechanization: 68,460 ha
- New Cultivable Area of Second Crops: 36,540 ha
- Effect of inudation control by terminal drains and effect of lowering groundwater level by tile drains

Labor saving by farm mechanization and increase in yield/ha through improvement of irrigation and drainage will be expected.

3) Farming Practices and Farm Management Improvement Project

Objectives and Outline:

The project aims to formulate an increasing plan of paddy yield per unit area by utilizing the existing farm facilities, taking into consideration the time-consuming land consolidation works which will be made block by block, simultaneously to develop and extend new farm practices for the land consolidation to be proceeded, to rationalize the farm management at farmers' level through cooperative management of nursery and cooperative operation of farm machinery, to establish model farms for enlightening beneficiary farmers, and to improve the seed center and the facilities for forecasting and controlling pest and insect damage.

Project Benefits:

	<u>Under</u> <u>Present Condition</u>	<u>After</u> <u>Project Implementation</u>
Labor saving		
Tarom (Local Variety)	1,119 man.hour/ha	612 man.hour/ha
Amol-3 (Improved V.)	1,274 man.hour/ha	746 man.hour/ha

Yield/ha

Tarom	3.5 tons/ha	4.2 tons/ha
Amol-3	6.7 tons/ha	8.4 tons/ha

4) Livestock Farming Promotion Project

Objectives and Outline:

The project aims to improve the environment for livestock breeding by securing fodder through the introducing second crops, improving species of livestock, controlling sanitary conditions of livestock, to establish feed preparation techniques including the use of by-products of paddy, and to promote the processing of livestock products.

The project also aims to establish such public facilities at farmers' level as the breeding station and animal clinic, etc. as well as drying facilities of berseem and hay-making and forage preparation facilities to utilize paddy straw. To open 60 milk collection depots with dairy plants, and renovate slaughterhouse for effective use of livestock products and for adding the value thereof.

Project Cost (Construction Cost of Public Facilities):

Public Facilities: 6,220 million Rls

Project Benefit:

	<u>Under</u> <u>Present Condition</u>	<u>After</u> <u>Project Implementation</u>
Increase production of milk	40,000 tons/annum	100,000 tons/annum
Increased production of meat	2,600 tons/annum	4,600 tons/annum

5) Post-Harvesting Improvement Project

Objectives and Outline:

To lower the present milling loss by improving the existing rice mills, to provide required facilities for introducing advanced farming practices such as paddy drying system required to apply mechanized harvesting with combine and to avail effective use of paddy by-products such as rice bran. To achieve the above-mentioned purposes, the following improvement and arrangement of facilities will be undertaken;

Improvement of Existing Rice Mills:

To improve paddy dring and storage facilities and to introduce newly non-dehusked paddy separators	230 places
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Renovation of Existing Rice Mills:

Integration of facilities or Renovation of facilities	50 places
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Installation of modern rice mills:

Modern rice mills for paddy yield to be increased	18 places
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In parallel with the above-mentioned facilities improvement, the prevailing rice milling system on contract basis will be shifted to selling system of paddy rice from farmers to millers to save the farmers' load and to awaken the rice millers' interest on the qualitative control.

Project Benefit:

	<u>Under</u> <u>Present Condition</u>	<u>After</u> <u>Project Implementation</u>
Increase of milling rates		
Complete grain	45 %	54 %
Large size broken rice	5 %	5 %
Small size broken rice	12 %	6 %

Note: The above percentages show the ratios in weight of paddy rice

6) Village Modernization Project

Objectives and Outline:

To avail skilled labor supply which is required in introducing high productivity agriculture, and to enlarge the employment opportunity in non-farming activities such as rural industries to absorb surplus labor derived from the rationalized farm management. The project will consist of i) improvement of rural social infrastructure, ii) promotion of agro-industries, and iii) strengthening of farmers' organizations. As for i), some model villages will be selected in implementing the infrastructural improvement for active participation of beneficiary farmers, then the results will be extended to surrounding villages.

(3) Project Implementation

The above-mentioned project works are not independent each other in their nature, but have rather close mutual linkage; a project will be inevitable to implement another or the other projects to supplement or to absorb the technical or socio-economic changes which occur as a result of implementation of the other projects. Therefore, those projects shall be implemented in a

long-term view as the regional development deciding the implementation program, method of capital investment, etc., carefully taking into consideration the mutual linkage. For this, a basic consensus on the development policy of the Project Area among the parties concerned such as public authorities, beneficiaries, etc., shall be made based on the Master Plan. Then, further study and planning for each project work shall be continued.

(4) Project Cost

The total Project cost is estimated at 80,200 million Rls as its breakdown is shown below;

° Area Drainage Project	12,000 million Rls
° Terminal Facilities Improvement Project	58,100
° Livestock Farming Promotion Project	6,200
° Village Road Improvement Works *	3,880
<u>Total</u>	<u>80,200 million Rls</u>

Note * To be carried out as part of the Village Modernization Project. Besides, the project costs of Farming Practices and Farm Management Improvement Project, Post Harvesting Improvement Project and Village Modernization Project except village road improvement works are not included in the Total Project Cost.

2. PROJECT EVALUATION

The Project aims to raise the self-sufficiency rate of the major agricultural products whose dependency upon import is high even at present, and to increase farm income through increasing the land and labor productivities. For the sound economic development of Iran, the increase in agricultural production and activation of rural population who share a half of the national population are a vital need. Therefore, the Project is responsible to such national demand.

Although the Project Area itself shares only 0.06 % of the territory of Iran, the concept of the Project is applicable to other paddy cultivation areas centering around the Caspian Sea Coastal Area. The Project is expected to contribute greatly to the development of national economy of Iran by means of extension of the results obtained in the Project to the other areas, taking into consideration the physical and socio-economic characteristics of each development area.

The implementation of the projects proposed in the Master Plan will be effective both for raising the income level and for improving the living environment of rural inhabitants by accelerating their active participation to the development projects. It is sure that the increase in productivity in the Project Area, which shares 34 percent of the total rice production of Iran, will give a considerable impact in achieving the self-sufficiency of rice in the country.

Taking into consideration the existing conditions of the Caspian Sea Coastal Area, which includes the Project Area, the idea which aims to promote the high productive agriculture through improvement of farm practices and rationalized multi-cultural farm management with improved agricultural infrastructure on the basis of beneficiary's self-supporting system as suggested in the Master Plan could be realized by proper arrangement and reinforcement of technical and administrative supporting organizations. From the viewpoint of the project economy, the financial internal rate of return is calculated at 12.6 percent in case of the investment period of 25 years. This FIRR means that the Project has sufficient profitability.

On the other hand, it seems to be an increasing tendency that Iran will depend upon imported agricultural products in future due to the qualitative change in eating habits caused by increase in population and upgrading of living standards, etc. From the viewpoint of the national economy, it is a very urgent requirement to brake the tendency by effective utilization of domestic natural resources. Under the

situations, the implementation of the Project will be urgently required.

3. RECOMMENDATIONS

The following recommendations are made to implement the development projects proposed by the Master Plan;

(1) Coordination of Related Organizations and Reinforcement of Administrative Supporting System:

Various governmental agencies such as the Ministries of Planning and Budget, Agriculture, Energy, Roads and Transportation, Construction Jihad, Health and Sanitary, etc. will be involved in implementing a development project. Therefore, it is recommended to establish a development committee for the Haraz river downstream area for coordination of the tasks by these Ministries concerned to strengthen the agricultural supporting system.

(2) Public Investment and Introduction of Beneficiary's Own Investment System

1) In selecting the projects and related works to which public investment should be made out of these projects proposed in the Master Plan and related works, the impact on public benefit or regional development brought about by the project implementation should be taken into account. However, the public investment should be made to the area drainage improvement project, improvement of the main irrigation canals, and the improvement of connecting roads of villages, which have a characteristic of public utility.

2) Farmers in the Project Area are enjoying a higher level of life as compared with those of other regions in Iran even at present. The capital reserve or potential capital in the Project Area is assumed to be considerably large. The

execution of development projects under full public investment could result in enlarging the difference of living standard between the Project Area and other region to further extent. Therefore, the development shall be executed under the beneficiary's own investment system as much as possible by minimizing the public investment.

(3) Implementation of Pilot Project

For those projects which shall be mainly implemented by the beneficiary's own investment such as the terminal facilities improvement, farm practice and farm management improvement, post-harvesting improvement and livestock farming promotion projects, the practicability and profitability of suggested projects shall be verified and demonstrated to awaken the will of beneficiary farmers for participation. From such point of view, the implementation of pilot project will be indispensable.

(4) Reinforcement of Technical Supporting System

To ensure the successful implementation of the pilot project, the verification of new practices such as terminal facilities improvement, and farm practices and farm management improvement, etc. and the training of specialists or the warming up of practices through the on-farm verification are necessary. The Caspian Sea Coastal Area Agricultural Development Project - Pilot Implementation Center (CAPIC) shall be, therefore, established by the Ministry of Agriculture as an organization to provide required technical support. The CAPIC aims to carry out the on-farm verification of new practices developed by the research experimental institutes, etc., having its own farmland, to enlighten the farmers by means of implementing the pilot project, and furthermore, to provide technical support to the ARTSC which is the executing agency of development works at the extension of results from the pilot projects to the surrounding farmers.

(5) Organization of Beneficiary Farmers

To proceed the implementation of the Terminal Facilities Improvement Project, it is necessary to organize the beneficiary farmers. As a farmers' organization, the Working District with an average area of 110 ha which is the command area of a tertiary irrigation canal is to be established as terminal unit, and the Working Districts form the Sub-District of Development for each command area of rural cooperative, in consideration of the mutual guarantee for receiving agricultural loan, then the Sub-District of Development provides a Development District which is a command area of each Rural Service Center or a terminal unit of the executing agency.

(6) Collection of Basic Data

The planning and implementation of development scheme shall be proceeded with accurate and sufficient data. There are also many subjects to be collected at the further stages of studies in case of the Project Area, therefore, those data pointed out in the Master Plan Report are to be collected.

(7) Execution of Feasibility Study for each Project

- 1) For the development of the Project Area, more detailed development plan shall be provided. The feasibility study for each project is necessary.
- 2) For the first stage of feasibility study, the Area Drainage Terminal Facilities Improvement and Farming Practices/Farm Management Improvement Projects shall be carried out as a combined study. The improvement of the main irrigation networks shall be taken into consideration at the same time. The problems of arising water level of the Caspian Sea and the flood control of the Babol, Garma, Alesh, and Kalan rivers

which cause flood in the Project Area are also to be studied. Following the above, the feasibility study on the Livestock Farming Promotion, Post-harvesting Improvement and Village Modernization Projects shall be carried out with priority.

(8) Securing Capital Fund

For the development of the Project Area, technical services, capital investment, loan, etc. are necessary for a long period, and consequently, a proper budgetary arrangement is required therefor. To meet such requirements, a long-term capital investment plan to avail the administrative and financial arrangement shall be properly established based on the above-mentioned feasibility study.

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ABBREVIATIONS AND GLOSSARY

International Agencies

ADB	Asian Development Bank
FAO	Food and Agriculture Organization of United Nations
IBRD	International Bank for Reconstruction and Development
IRRI	International Rice Research Institute
JICA	The Japan International Cooperation Agency
UNESCO	United Nations Educational, Scientific and Cultural Organization
USBR	United States Bureau of Reclamation

Iranian Government

MOA	Ministry of Agriculture
MOE	Ministry of Energy
MORT	Ministry of Roads and Transportation
MOCJ	Ministry of Construction Jihad
MOPB	Ministry of Plan and Budget
MOH	Ministry of Health
MPG	Mazandaran Provincial Government
GDA of Mazandaran	Mazandaran General Department of Agriculture
RWB of Mazandaran	Mazandaran Regional Water Board
AO of Amol	Amol Shahrestan Agriculture Office
ARTSC of Babol	Babol Shahrestan Agriculture, Rural and Tribal Service Center
ANDWO	Amol Nur District Water Office
BDWO	Babol District Water Office
IMO	Iranian Meteorological Organization
NCC	National Cartographic Center

Unit of Measurements

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	kilometer
ha	:	hectare
sq.cm, cm ²	:	square centimeter
sq.m, m ²	:	square meter
sq.km, km ²	:	square kilometer
MSM, 10 ⁶ m ²	:	million square meter
lit	:	liter
cu.m, m ³	:	cubic meter
MCM, 10 ⁶ m ³	:	million cubic meter
lit/sec	:	liter per second
cu.m/sec, cms	:	cubic meter per second
lit/sec/ha	:	liter per second per hectare
m/sec	:	meter per second
ppm	:	part per million
abdang	:	Iranian unit of discharge, 1 abdang = 0.25 cu.m/sec
g	:	gram
kg	:	kilogram
ton, t	:	metric ton
KW	:	kilowatt
MW	:	megawatt
Kwh	:	kilowatt hour
Gwh	:	gigawatt hour
°C	:	degree centigrade
°F	:	degree fahrenheit
EL	:	elevation above mean sea level
MSL	:	mean sea level
FWL	:	full water level
HWL	:	high water level
LWL	:	low water level
PGD	:	Persian Gulf Datum

sec.	:	second
minu.	:	minute
hr.	:	hour
min.	:	minimum
max.	:	maximum
%	:	percent
No.	:	number
HP	:	horse power
EC	:	electric conductivity
ET	:	evapotranspiration
Cl	:	chlorine
N	:	nitrogen
P	:	phosphorus
K	:	potassium
HYV	:	high yielding variety
O & M	:	operation and maintenance
FIRR	:	financial internal rate of return
B/C	:	benefit cost ratio
FY	:	fiscal year

Conversion Factors

Rial	:	Iranian Rial, 1 Rial = US\$0.0125
US\$:	Dollar, 1 US\$ = Rial 80

Iranian Calendar

Farvardin	March 21	-	April 20
Ordibehesht	April 21	-	May 21
Khordad	May 22	-	June 21
Tir	June 22	-	July 22
Mordad	July 23	-	August 22
Shahrivar	August 23	-	September 22
Mehr	September 23	-	October 22
Aban	October 23	-	November 21
Azar	November 22	-	December 21
Dey	December 22	-	January 20

Bahman	January 21	-	February 19
Esfand	February 20	-	March 20
1362	March 21, 1983	-	March 20, 1984
1363	March 21, 1984	-	March 20, 1985
1364	March 21, 1985	-	March 20, 1986

Administrative Division

Ostan	Province
Shahrestan	Township
Bakhsh	District
Dehstan	Village District

Glossary of Iranian Terms

rud	river
band	weir
abbandan	farm pond
chah	well
cheshmeh	spring
mirab	water master

BACKGROUND AND PROGRESS OF THE STUDY

BACKGROUND AND PROGRESS OF THE STUDY

1. Background of the Study

The Government of the Islamic Republic of Iran has been trying to develop the country with emphasis placed on agriculture and the Ministry of Agriculture as a main body has positively executed a variety of the agricultural development projects to meet the national requirements. The nation, however, inevitably has come to be dependent considerably upon import of foods due to rapid population growth, change in quality of dietary life resulting from uplevel of living standards, and difficulty in farm production increase with limited water resources, etc. And the Iranian authorities concerned have had thorough understanding on the role of agriculture in the sound economic development program, and agriculture has been taken up with top priority in the Five-Year Development Plan (1983-1987).

In August, 1983, when Mr. S. Abe, the Japanese Minister of Foreign Affairs at the time, visited the country, he had a consultative talk with Mr. Mir-Hossein Mousavi, the Premier of the Islamic Republic of Iran, and other high ranking government officials, to discuss the technical and economic cooperation between the two countries, and the both parties have reached the agreement to realize the agricultural development plan for the paddy cultivation zone along the Caspian Sea.

Since long time, the Iran-Japan economic relationship has been established only in the field of general commerce and heavy/chemical industries, but little cooperation has been seen in the field of agriculture. Under the circumstance, the recent agreement in the agricultural cooperation has been highly evaluated as transaction to open the new era in the friendly relationship of the two countries.

The Government of Japan, according to the aforesaid agreement, dispatched a contact mission in February, 1984, to select the proposed project area of about 100,000 ha almost in the middle of Mazandaran, the downstream area of the Haraz river, and in July, 1984, the preliminary survey team concluded the agreement with the Iranian authorities concerned on the Scope of Works for the Japanese Cooperation.

According to the agreement, the Japan International Cooperation Agency (JICA) dispatched the experts to the field in September, 1984, so as to conduct a master plan formulation for agricultural development in the downstream area of the Haraz river for 20 months in the original plan; however, the originally proposed study period has been extended up to November, 1986 due to the circumstances.

2. Gist of the Scope of Works

The Project Area or the area to be subject of the Master Plan Study and the objective of the study have been agreed in the Scope of Works which was signed on July 18th, 1984 as below:

(1) Project Area:

The area of the Lower Haraz river basin, approximately 100,000 ha, roughly bounded by the Babol River, Kari Canal and Aleshrud.

(2) Objective of the Study:

The objective of the study is to provide a master plan for the above

mentioned Project Area which consist of the following items:

- (i) To formulate an agricultural development plan centering on the rice crop.
- (ii) To recommend integrated methods for improved farm management and extension to farmers.
- (iii) To recommend necessary activities such as demonstration and research to endorse the above-mentioned integrated methods.

3. Progress of Master Plan Study

The Japan International Cooperation Agency has carried out the field survey 3 times dispatching the study team, and, on the other hand, the Ministry of Agriculture of Iran has assigned counterpart experts to the JICA team and advisory group of senior experts to cooperate in carrying out the study.

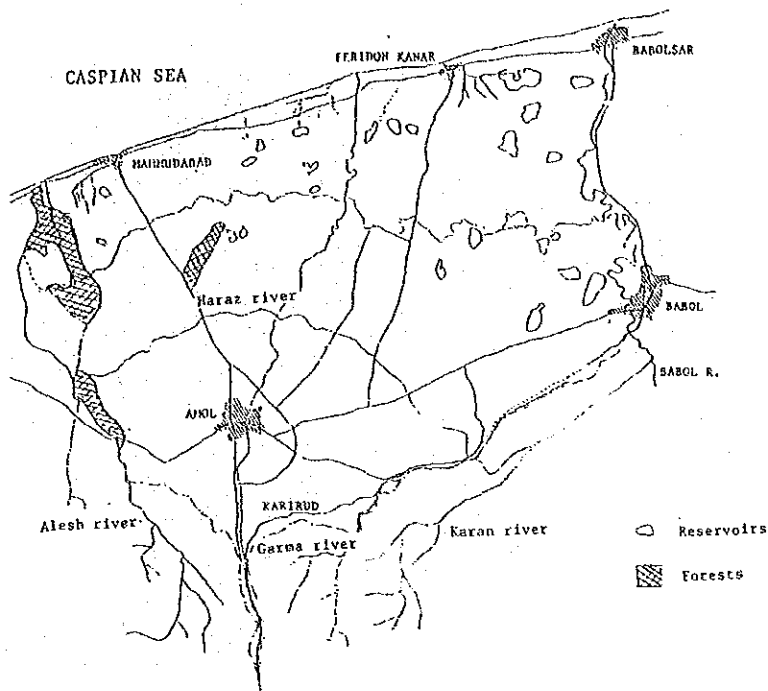
The schedule of the above-mentioned study and the list of persons engaged in the study are attached to the end of this report.

4. Comments of MOA

Some comments had been issued by the MOA to the draft final report (I) and (II), respectively, and this Final Report has been provided after proper revision/amendment to the draft reports based on the comments of MOA and discussion thereon between JICA Team and Iranian counterparts. The MOA requested to include studies on the River-basin Conservation, Forestry Development and Aquaculture at the Inland Water Surface in the Master Plan. But these subjects are not included in this report because these are not directly related to the Scope of Works of this Master Plan Study, and separate study therefor will be recommended. Thereby, some supplemental explanations are provided as below:

(1) Relation with the Project Area:

The relation of above-mentioned 3 subjects of River-basin Conservation, Forestry Development and Aquaculture at the Inland Water Surface with the Project Area are summarized hereunder.



The River basins related to the Project Area are, as shown in the left exhibit, the Haraz river (Catchment Area of Upper and Middle Reaches: 4,086 sq.km.), Alesh rud (144 sq.km), Garma rud (84 sq.km) and Karan river (220 sq.km.). All of 4 rivers have their major portion of catchment area at the outside of the Project Area. Furthermore, only the Haraz river is contributing to the Project Area as a water resource, and other 3 rivers are

causing ill-drainage of some parts of paddy fields with their autumn-winter flood being obstacle for introduction of second crops.

Approximately 3,370 ha of forest area is still remaining along the Aleshrud and another 320 ha is also remaining at the east of Amol-Mahmudabad road. The latter is unreclaimed part of the forest area of about 1,800 ha which had been leased to an agri-business at the beginning of 1350s, and the former is that part of forest area along the Aleshrud which locates in the Project Area.

The utilizable inland water surface in the Project Area is the abbandans, farm ponds, which are spread over the low and middle lands, and their total area is about 3,830 ha. Those abbandans are presently storing water flow of nearby irrigation canals in non-irrigation period to supplement irrigation water at the surrounding paddy fields, and they are also playing a role of regulating or controlling the return-flow and surplus flow from the upper in the irrigation period.

Based on the above-mentioned situations, the manner or direction of development of each subject are explained as below:

(2) River-basin Conservation Plan:

1) Haraz River Basin

The whole basin extends in the Alborz mountains, where are mostly covered with steep rocky slopes, thin woods or bush zone except for some forest area which covers a part of the middle and lower basins. The Alborz mountains were formed through the orogenic movements of the Alps, and heavily eroded during the uplifting movements. And erosion has still been advancing and landslide in

various scales from large to small have taken place frequently. The steep topography, heavy erosion and frequent landslides are the hindrance to the effective land use, and a great deal of sediment has been transported to the downstream areas through the Haraz river due to rainfall and snow-melting.

Under the conditions, the land productivity is quite low in the basin, and the present land use is limited as grazing of sheep and goats at the bush zone, etc. other than small scale cultivation of fruit tree, wheat/barley, pulse, etc. at the river terraces.

The drastic Haraz river basin conservation will be extremely difficult not only in economic but also in technical points of view. Therefore, the conservation and land use in this basin is deemed possible only by very limited measures at the key points of the conservation and major sites, and the following measures will be applicable.

- 1- The thin woods of juniper, etc. are to be protected as conservative forest aiming at their expansion.
- 2- To provide soil saving dams at the small streams flowing into the Haraz river to reduce the inflow of sediment therefrom.
- 3- To provide proper protection works at the portion of steep slope or eroded place along the road to prevent further erosion.
- 4- To endeavour the afforestation with terrace making at the comparatively gentle sloped area at the middle reach basin.
- 5- The forest areas at rather steep slope in the middle and lower reach basin are to be protected as conservative forest.
- 6- To provide appropriate guideline for land use of river sides area, and the part of such lands are to be secured as conservative forest of poplar, etc.

In this respect, therefore, it is proposed that the following survey/study shall be conducted for the aforesaid countermeasure to be promoted effectively and efficiently for quite local conservation of the river basin.

- 1- Survey on land use potential (including vegetation and ecology).
- 2- Clarification of danger magnitude by area through geological, topographical and seismic surveys.
- 3- Survey on potential sites for debris barriers, reforestration, and water resources development, etc.

Future land use and conservation of the basin shall be carefully considered with the above survey to be promoted. Among the above surveys, the water resources development potential survey has been presently undertaken by the Ministry of Energy.

A series of these surveys, considerably long time-consuming works, shall be executed as separate works from the development works in the downstream area which is given higher priority.

2) River Basins of the Alesh, Garma and Karan

Different from the Haraz river basin, the three river basins having comparatively gentle topography are covered with thick forest, therefore, there are few places where need special measurement for land conservation. However, the reclamation of forest has been in progress from the rimland and the rivers are overflowing to surrounding areas at many places due to rising up of river bed, etc., therefore, a long term conservative measurement is to be provided.

The successful conservation of these basins for the above land use will inevitably require the following surveys.

- 1- Cadastral survey
- 2- Vegetation survey (survey on productive tree density and clarification of hindrance factors from tree growth)
- 3- Study on possible land use (natural parks, timber productive tree forest, etc.)
- 4- Geological, topographical and seismic surveys for clarification of danger magnitude by area
- 5- Survey on potential sites for water resources development (especially for the Alesh river basin)
- 6- Survey on potential sites for debris barriers and flood control

The conservation of these basins will be technically less difficult than that of the Haraz river basin and economically, and the development benefit will be created earlier than that of the Haraz case. It might be a way of development to give a higher priority to the survey on these river basins than those of the Haraz river basin.

(3) Forestry Development Plan:

The present conditions of forest within the Project Area have mainly been surveyed from the viewpoint of land use in the Master Plan, and concluded that the reclamation of forest is principally avoided due to limitation of water resources (ref. to the paragraph 5.3.2 in main report). As for use of existing forest, the JICA Team exchanged view with the experts of Forestry Office of Mazandaran, who expressed that the use of forest as grazing area would not be favourable as general policy of forestry conservation. However, well-managed grazing in the forest is also an effective measure for conservation of forestry resources. Therefore, the remaining forest at the western ridge of the Project Area is recommended to be studied from such point of view together with neighbouring forest in Nur Shahrestan area. Especially, the Nur area has no sufficient stable water resources and further expansion of paddy field is very difficult. Therefore, the application of a similar land use plan as Amol area will be impossible. The effective use of the remaining forest is to be considered from such point of view as well.

(4) Aquaculture Plan at existing Inland Water Surface:

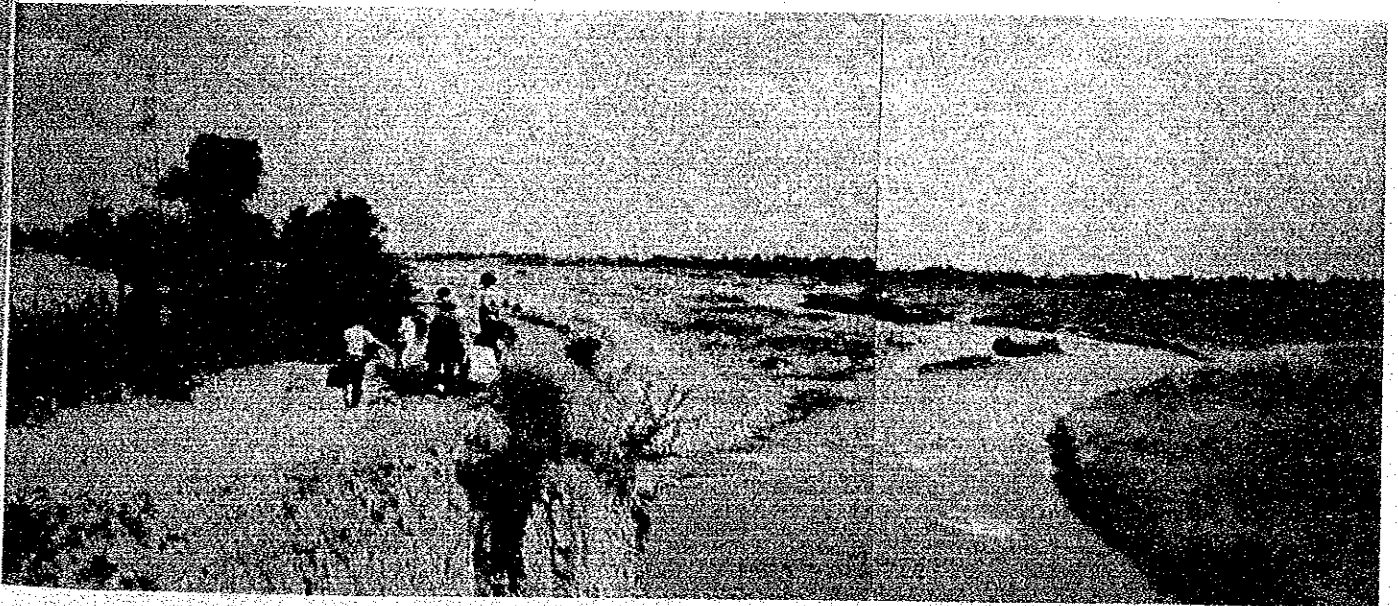
As for use of existing land water surface centering to fish culture, only the potentiality is suggested in the paragraph 5.4.5 of the main report because the existing abbandans are suggested to be used as regulating ponds of irrigation water and retarding basin of drainage water considering the objective of this Master Plan which aims at agricultural development centering to paddy cultivation.

For fish culture plan, further study is necessary to be carried out based on the results of survey on existing abbandans which is under preparation at present including the renovation plan of facilities of Semes Kande Fishery Center.

The use of existing abbandans for fish culture shall be carefully studied considering the problems of water pollution due to agri-chemicals, eco-system of predatory fishes and other aquatic animals, etc. in future. It is reported that some 14,000 ha of reservoir area is available in Mazandaran Province and marketability of cultured fish is also very high. Therefore, the aquaculture plan for such reservoir area is recommended to be proceeded without limiting the area in the Project Area of this Master Plan.

CHAPTER 1.

GEOGRAPHICAL STANDINGS OF THE PROJECT



CHAPTER 1. GEOGRAPHICAL STANDINGS OF THE PROJECT

1.1. Location and Area

The Project Area is located in the eastern part of the Caspian Sea Coastal Area. As shown in Exhibit-1, the area lies on the alluvial plain bounded by the Babol river on the east and by the Alesh Rud on the west. The Project Area extends from lat. 35°24'N to 36°43'N and from long. 52°12'E to 52°40'E.

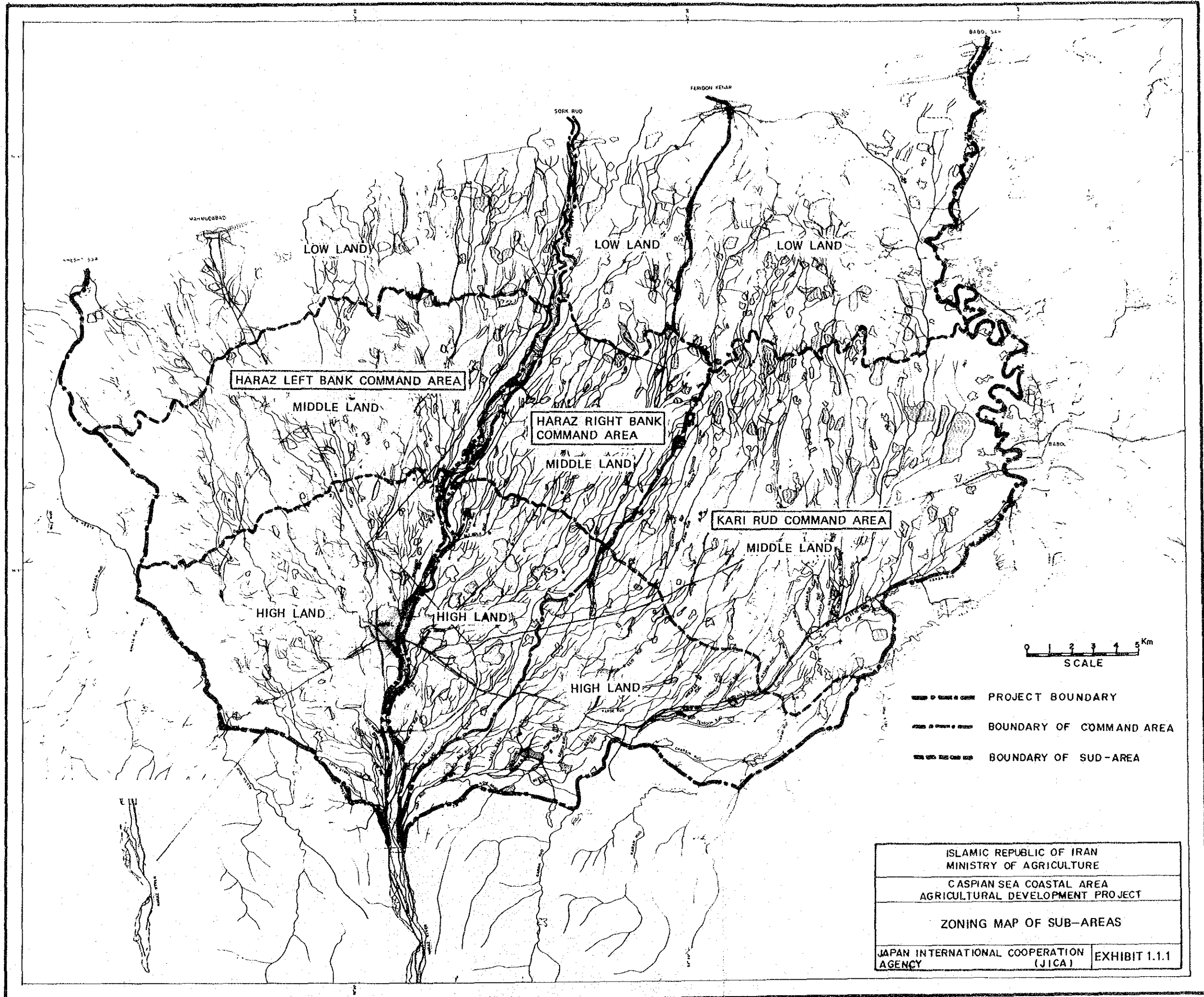
The Project Area is isolated from the central plateau by the Alborz Mountains on the south, and the distance is about 100 km physically and 200 km by road from Tehran, the capital of Iran, locating at the northern edge of the central plateau.

The Project Area has a gross area of 105,220 ha and extends 40 km east and west and 25 km north and south. Since it is irrigated by the Haraz river flowing through the Area and by the Kari Rud which is the stream branching from the Haraz river, the Project Area is divided into three irrigation command areas, namely the Haraz Left Bank, the Haraz Right Bank and the Kari Rud Command Areas. Furthermore, it is also divided into three lands, namely the high land, the middle land and the low land from the topographical viewpoint as illustrated in Exhibit 1.1.1.

In planning of the development of Project Area, nine (9) sub-areas will be applied dividing the Project Area by irrigation networks and topographical features as mentioned above. The features of sub-areas are described in Table 1.1.1. and the boundary is shown in Exhibit 1.1.1.

Table 1.1.1. Scale of the Project Area

Irrigation Command Area	Gross Area (ha)	Sub-areas (ha)		
		High Land (above EL20m)	Middle Land (EL20m - EL-10m)	Low Land (below EL-10m)
Haraz Left Bank	39,870	11,930	13,340	14,600
Haraz Right Bank	19,220	6,580	6,550	6,090
Kari Rud	45,270	10,310	19,960	15,000
<u>Sub-total</u>	<u>104,360</u>	<u>28,820</u>	<u>39,850</u>	<u>35,690</u>
Haraz River Bed	860			
<u>Total</u>	<u>105,220</u>			



HARAZ LEFT BANK COMMAND AREA

HARAZ RIGHT BANK COMMAND AREA

KARI RUD COMMAND AREA

LOW LAND

LOW LAND

LOW LAND

MIDDLE LAND

MIDDLE LAND

MIDDLE LAND

HIGH LAND

HIGH LAND

HIGH LAND

0 1 2 3 4 5 Km
SCALE

- PROJECT BOUNDARY
- BOUNDARY OF COMMAND AREA
- BOUNDARY OF SUB-AREA

ISLAMIC REPUBLIC OF IRAN MINISTRY OF AGRICULTURE	
CASPIAN SEA COASTAL AREA AGRICULTURAL DEVELOPMENT PROJECT	
ZONING MAP OF SUB-AREAS	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	EXHIBIT 1.1.1

1.2. Physical Aspects

1.2.1. Topography and Geology

(1) Topography

The southern limit of the Project Area is the piedmont of a hilly range formed by the Alborz Mountains and extends to the Caspian Sea on the north. The Area is composed of a piedmont fan and an alluvial plain formed with sediments of the Haraz river.

Topographically, the Project Area can be categorized into the following three areas.

1) Piedmont Fan

The southern part of the Project Area is formed with piedmont fan and extends from elevation 190 m PGD (Persian Gulf Datum) to elevation 20 m PGD. This fan forms a semicircle with a radius of about 15 km and one percent (1%) gradient slope. Relief and gullies are observed in the fan, and most of the gullies have been developed for rice cultivation. Irrigation canals run at right angle to the contours.

2) Alluvial Plain

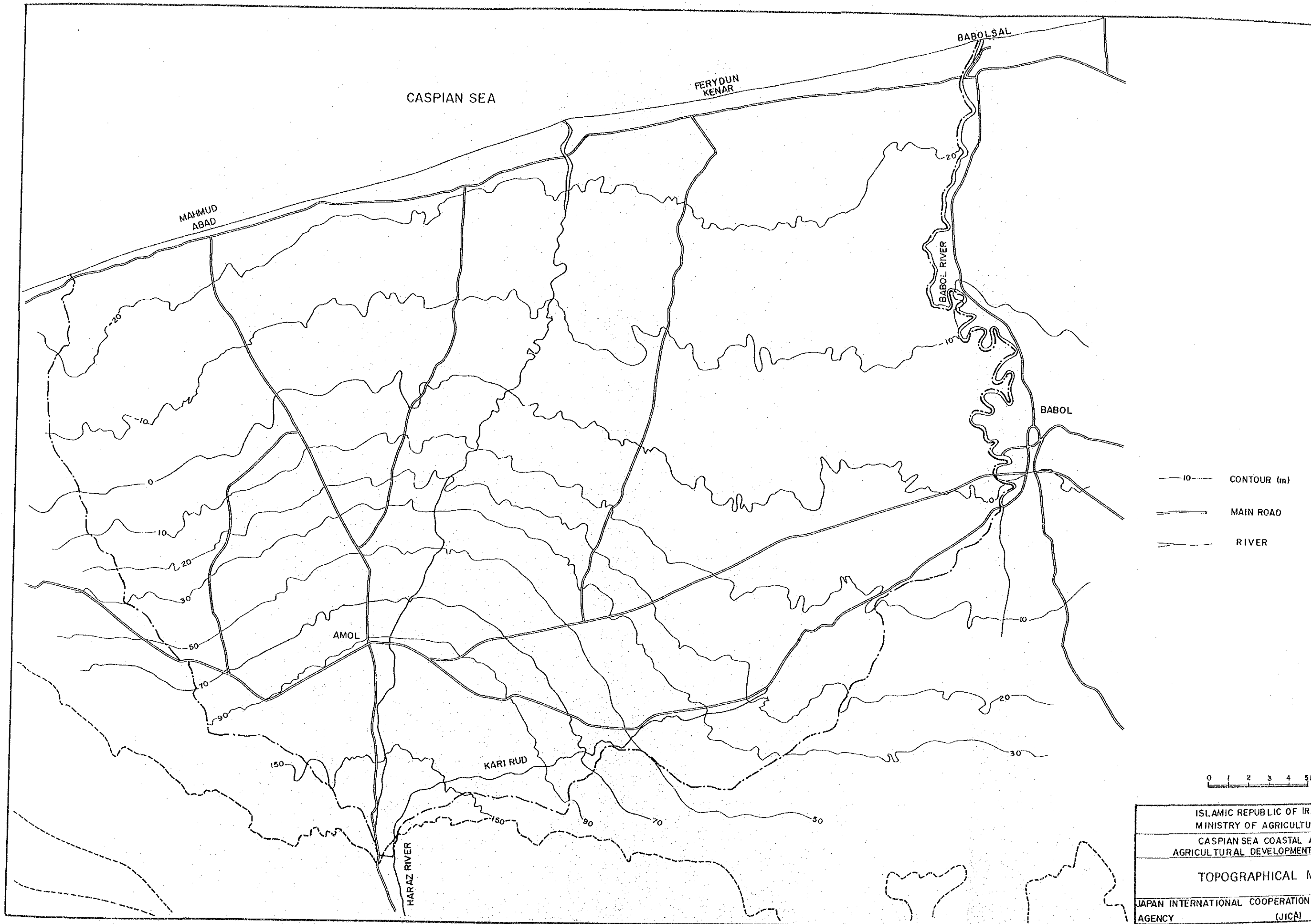
The alluvial plain extends from the tail of the piedmont fan to the Caspian Sea and slopes gently at 0.15 percent to 0.3 percent. The elevation of this area is between 20 m and - 23 m PGD. In this area the courses of irrigation canals from the piedmont fan are complicated and many irrigation ponds (abbandans) are provided below the elevation of 10 m PGD. The alluvial plain extends widely to the east near the Haraz river but not to the west.

3) Sand Dune

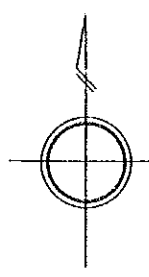
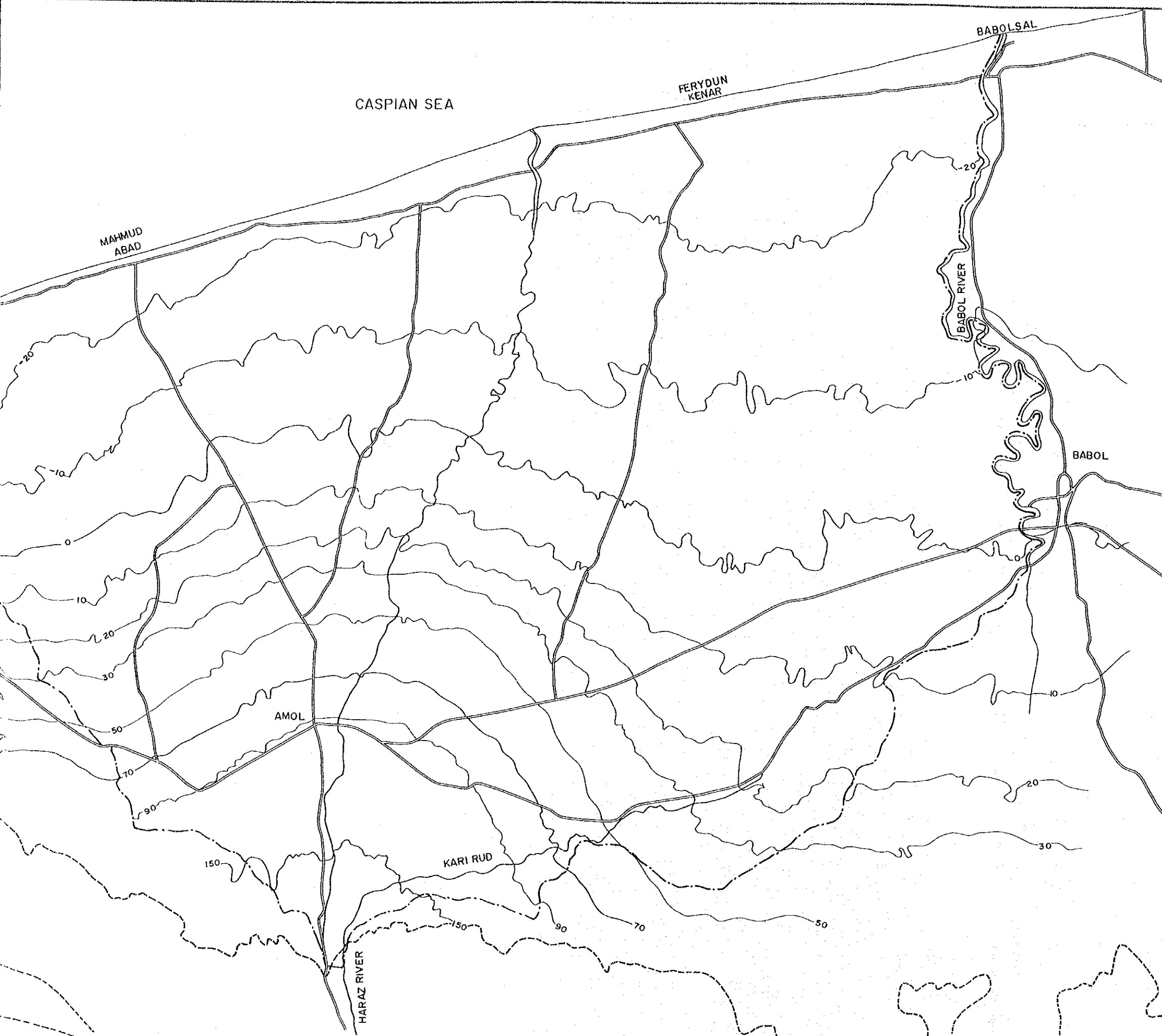
Along the coast of the Caspian Sea, sand dunes are formed with a width of 300 to 700 m in the north of the coastal highway. In the southern part of the alluvial plain, there are the back swamps behind the sand dune due to poor drainage.

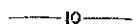
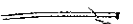
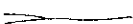
(2) Geology

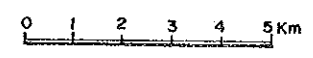
The geological formation in the Project Area is composed of quarternary unconsolidated deposits, without outcrops of bedrock. The geological features of the bedrock are described in the Reference-5 and Geological Map of Iran (1:2,500,000), and are outlined below. The Alborz Mountains stretch nearly east-west along the southern shore of the Caspian Sea, and their uplift took place



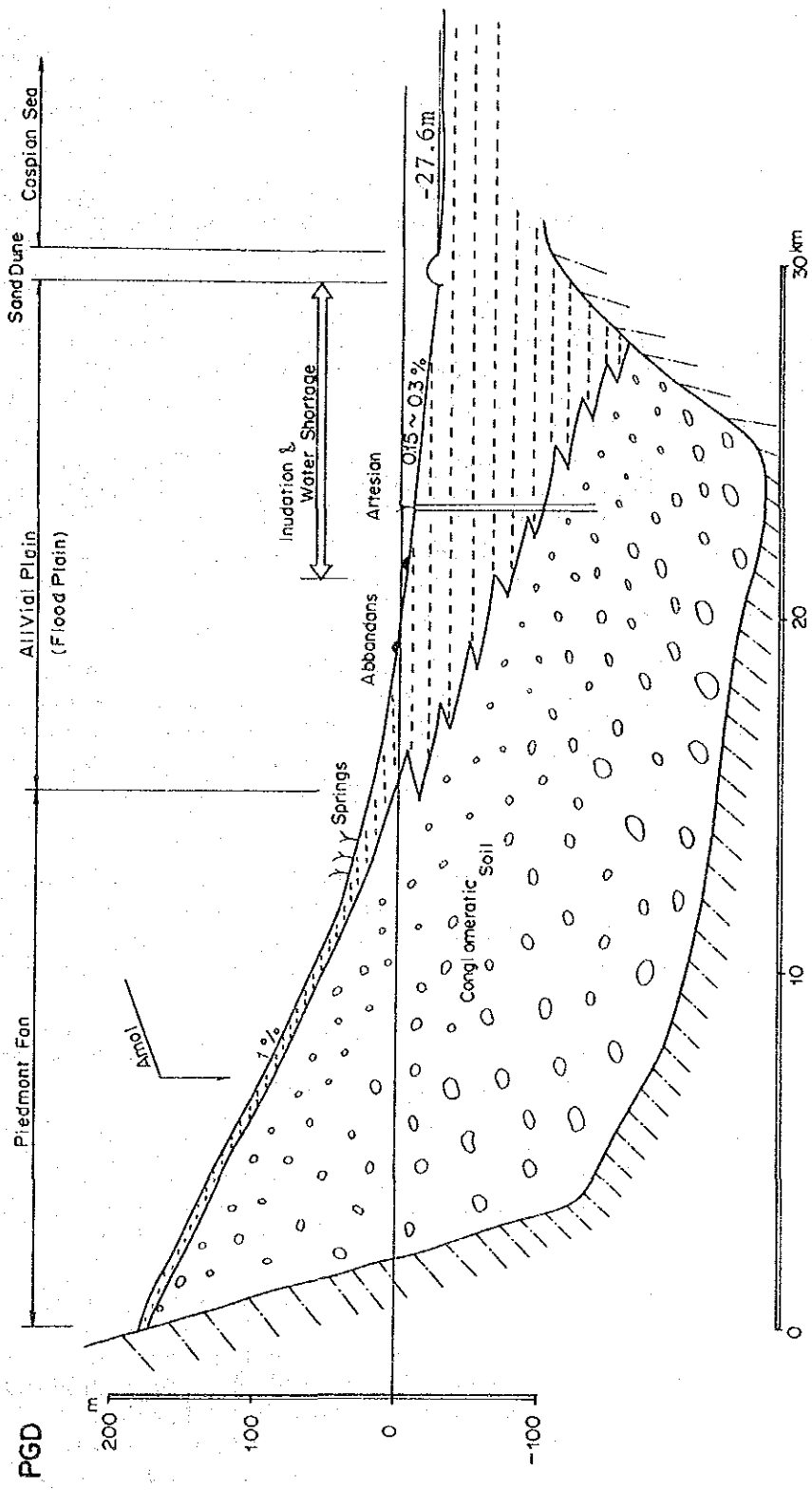
ISLAMIC REPUBLIC OF IRAN
 MINISTRY OF AGRICULTURE
 CASPIAN SEA COASTAL AGRICULTURAL DEVELOPMENT
 TOPOGRAPHICAL MAP
 JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



-  10 CONTOUR (m)
-  MAIN ROAD
-  RIVER



ISLAMIC REPUBLIC OF IRAN MINISTRY OF AGRICULTURE	
CASPIAN SEA COASTAL AREA AGRICULTURAL DEVELOPMENT PROJECT	
TOPOGRAPHICAL MAP	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	EXHIBIT-12.1



Note : Section along the Haraz River

Figure 1.2.1 TOPOGRAPHICAL AND GEOLOGICAL SECTION

in the Alpine orogeny from the Miocene to the Pliocene Neogene Tertiary era, when they went from the most active to the last stages of formation.

The deep erosion accompanied by the most active upheavals produces the clastic deposits (molasses, conglomerate facies) in the Mio-Pliocene.

The southern hills are formed by conglomerate facies from the Mio-Pliocene, and the bedrock of the Area is considered to be composed of this member. The bedrock descends at an inclination of about ten percent from the hills to a level of -100 to -300 m PGD with large undulation. The bedrock is overlaid with late Quarternary unconsolidated deposits, and at the bottom there are marine deposits from the Ancient Caspian Sea with fluvial deposits from the Haraz river on top, but without a clear boundary.

The surface geology relates closely to the topography. According to the observation of outcrops and the Reference-5, the piedmont fan is mainly formed by conglomeratic soils with a few impermeable layers and silt layers in the middle. There are 2 - 3 m thick surface soils and the depth to the basement gradually increases from upstream to downstream.

The alluvial plain is made on an alternation of sand or silt. However, the range of each stratum is still unknown. A continuation of the conglomeratic soil forming the piedmont fan presumably exists under the alluvial deposits. The wells reaching the conglomeratic layer occasionally form artesian wells and these wells are found even at -10 m PGD.

It is considered that there are two kinds of water sources for the artesian wells; one is seepage water from the piedmont fan and the other is fossil water due to transgression and regression of the Caspian Sea. The former is good in quality but the latter contains salinity.

Springs are sometimes found in gullies at around 25 m PGD and they are usually formed in groups on a gully.

Water from the artesian wells and springs flows into the water courses and is used to supplement the irrigation water. The geological profile along the Haraz river is summarized in Exhibit 1.2.1.

1.2.2. Meteorology

Climate of the Project Area belongs to the Semi-Mediterranean Temperate Climate having the humid summer with a high temperature and less rainfall and the moderate winter with abundant precipitation. The annual precipitation is about 800 mm.

As shown in Table 1.2.1, annual mean temperature of the Project Area is about 16°C. Monthly mean temperature reaches minimum in January and February, and maximum in August. It fluctuates from 7°C to 26°C in a year. Extreme minimum and maximum temperatures were recorded at -7°C in January 1964 and 43°C in May 1970 respectively at Babolsar. Monthly mean minimum temperature becomes more than 10°C from May so that rice can grow without hazard. Nursery, however, is sometimes affected by cold weather below 10°C in April. Mean relative humidity is high throughout the year due to the effects by the Caspian Sea, standing at more than 80% except in June.

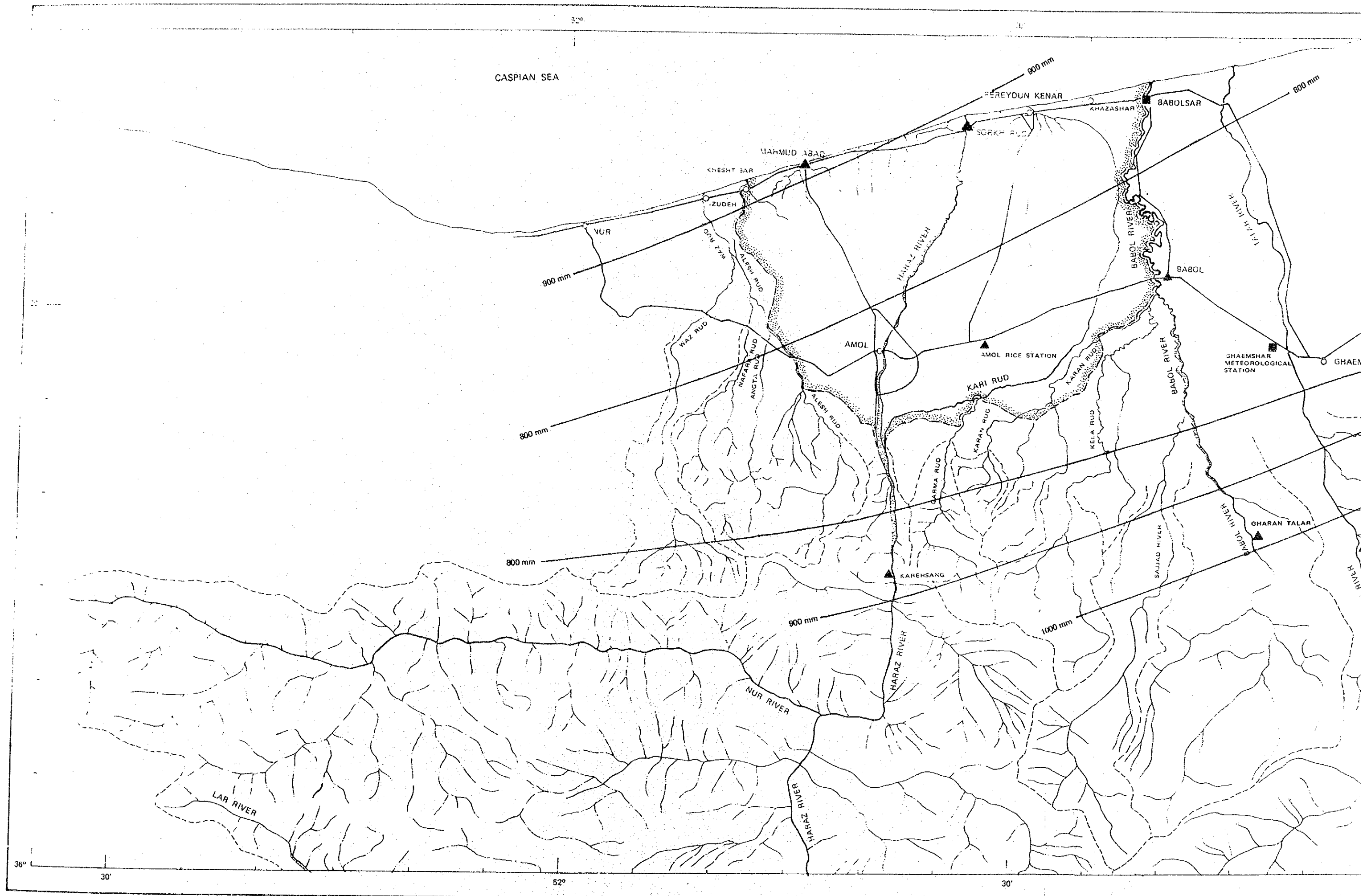
As shown in Exhibit 1.2.2, annual precipitation is a little at the inland and much along the coastal area in the Project Area. It is supposed that precipitation increases in the southern piedmont hilly range. Annual mean precipitation is about 750 mm at the inland, 850 mm along the coastal area and 793 mm on an average in the whole Project Area. Since precipitation is only 177 mm during the irrigation period from April to August, which is a considerably small amount in comparing with the irrigation requirement of 1,152 mm (Amol-3, see Table B.1.6, Appendix B.1). Contrarily, it rains abundantly during non-irrigation period especially from October to December. Such pattern of precipitation is not only unfavorable for paddy culture but also causes ill drainage.

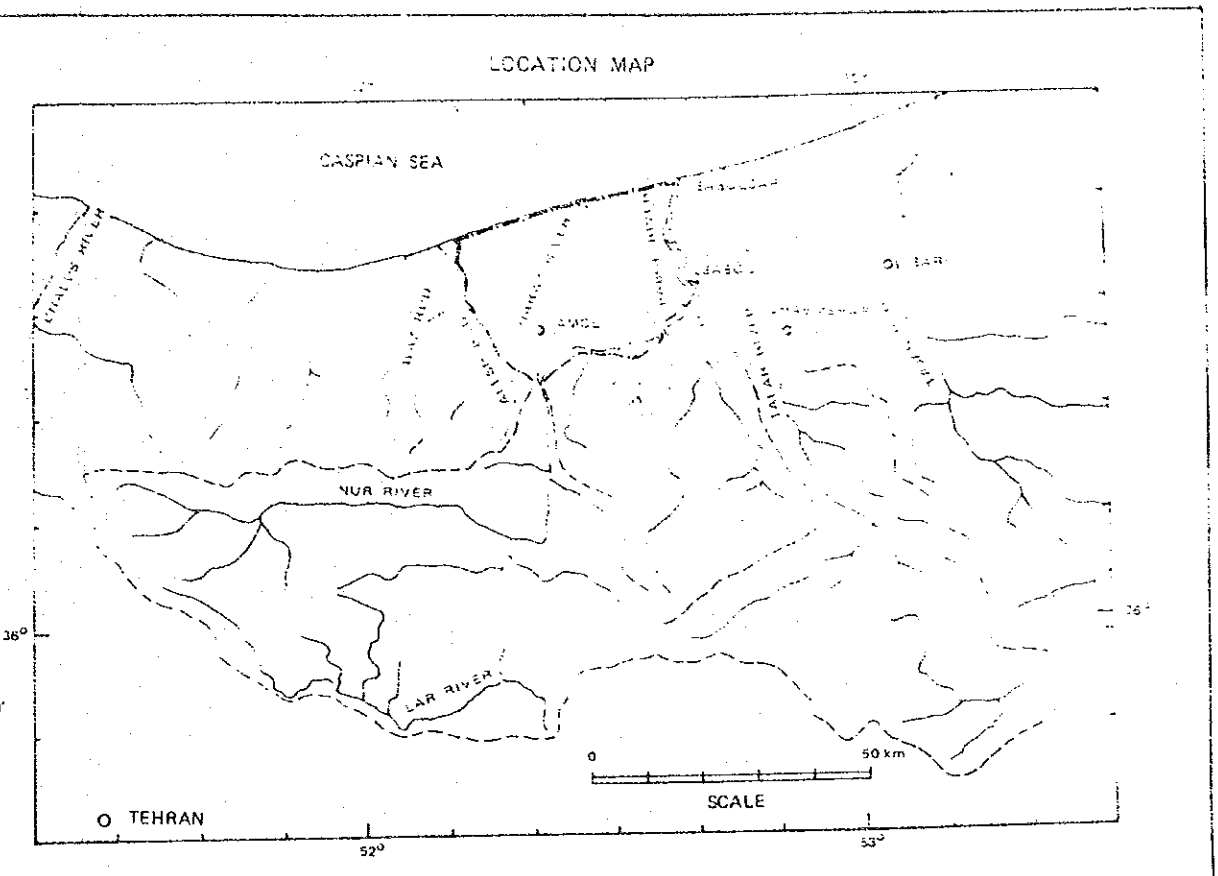
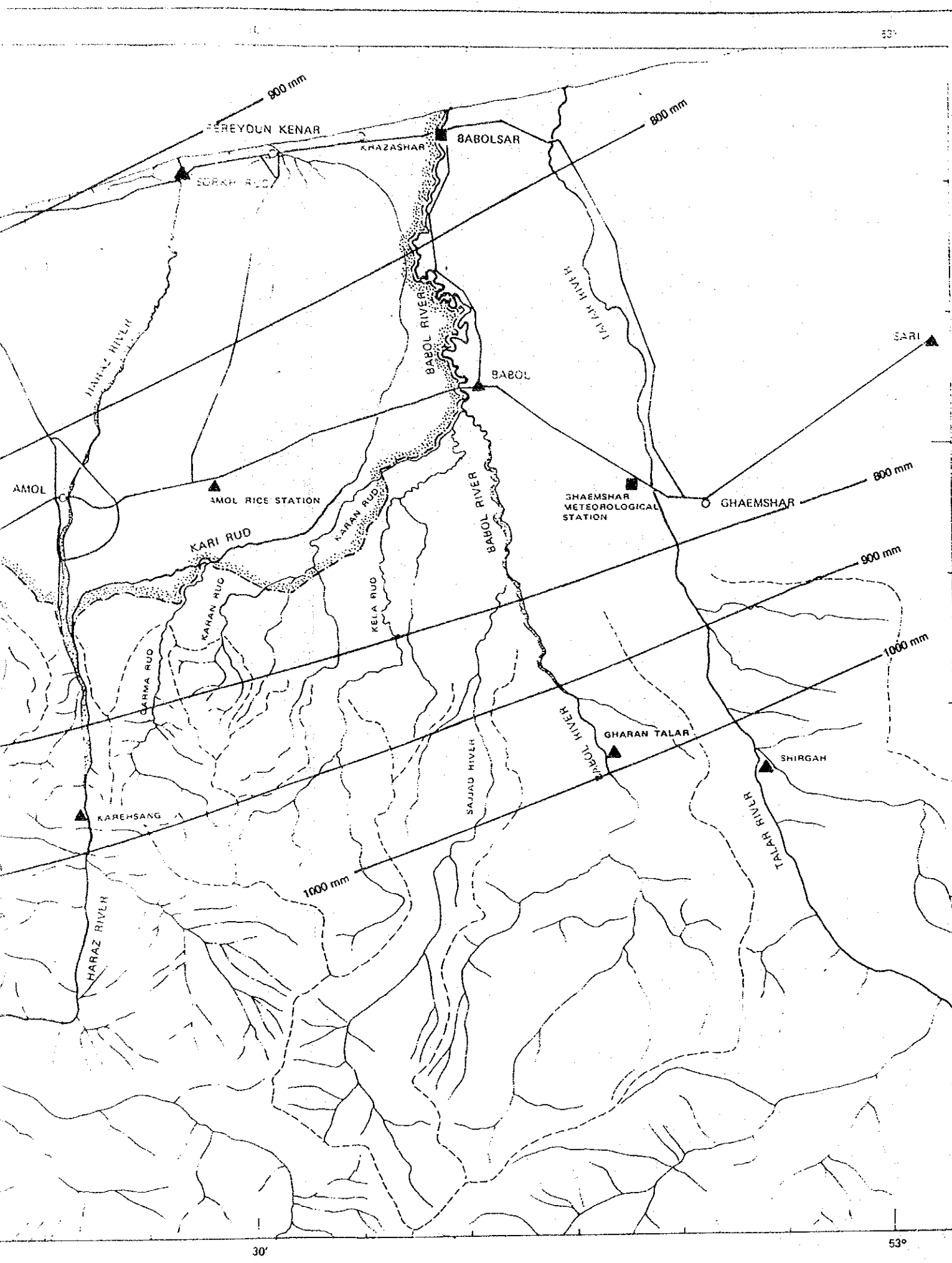
Annual mean rainy days are 106 days, 78 days of which have less precipitation than 10 mm per day. Monthly rainy days are less than 7 days from May to August which are less rainy days in comparing with the other months. From January to March, rainy days are found much more than those in the other months, but heavy rainfall rarely occurs.

Evapotranspiration is estimated at 1,086 mm per annum by the modified Penman method.

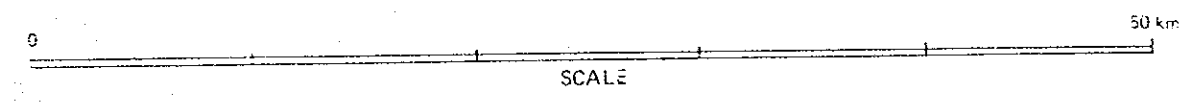
Table 1.2.1. General Climate in the Project Area

Climate	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Monthly Mean Temperature (°C)	7.4	7.2	9.6	14.0	19.2	23.4	25.1	25.7	22.9	18.3	13.2	9.3	16.3
Monthly Mean Relative Humidity (%)	84	84	85	82	81	78	80	82	83	83	84	85	83
Monthly Mean Precipitation (mm)	82	73	66	46	26	28	30	47	77	112	95	111	793
Monthly Mean Rainy Days (days)	10.8	9.3	12.5	9.6	6.4	5.4	5.6	7.0	9.6	9.3	9.8		10.2 105.5
Monthly Mean Evapotranspiration (mm)	31	40	62	93	136	165	164	146	105	74	42	28	1,086





- LEGEND**
- PROJECT BOUNDARY
 - ROAD
 - RIVER
 - WATERSHED
 - CLIMATOLOGICAL STATION
 - SYNOPTIC STATION



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CASPIAN SEA COASTAL AREA AGRICULTURAL DEVELOPMENT PROJECT	
METEOROLOGICAL OBSERVATION NETWORK AND ANNUAL ISOHYETAL MAP	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	EXHIBIT 1.2.2

