

## **EXECUTIVE SUMMARY**

### **1. INTRODUCTION**

The objectives of the Study are:

- 1) to formulate a master plan on integrated watershed management for the selected area in Karoon watershed to prevent further degradation of natural resources and promote sustainable development.
- 2) to carry out technology transfer to the counterpart personnel in the course of the Study.

The Study consists of following two phases.

Phase-I: Basic study for preparation of inventory on physical and non-physical features of watershed area, and selection of the area for Master Plan Study.

Phase II: Formulation of Master Plan for integrated watershed management for the selected areas

The whole study area covers the upper Karoon watershed of 26,800 km<sup>2</sup> area that is shown in the Location Map. The Phase-II Study is a master plan study on the five (5) areas selected in the Phase-I Inventory Study. The five selected areas are as follows.

- ① K4-1-9 Vastegan
- ② K5-19-A Chaman Goli-Bazoft
- ③ K7-0-19-1 Sarbaz
- ④ K7-48 Tang Sorkh
- ⑤ K8-28 Zeras

### **2. SOCIO-ECONOMIC BACKGROUND**

Watershed management is touched upon in Water and Agriculture Sector in the Third 5-year plan. Among 27 Executive Strategies, description of watershed management could be found in the 10th item, that is: "Watershed management for the conservation and exploitation of soil and water resources; especially, in the river basins having water supply project shall be the priority to be carried out." Out of total of 27 Executive Strategies, watershed management is 10th priority. This means that watershed management occupies a rather fair significance in Water and Agriculture Sector, as well as in the context of national development.

### **3. THE STUDY AREA**

#### **3.1 Physical Feature**

##### **(1) Location and Topography**

The Study area is located in the Southwest of Iran and whole the area is about 27,000km<sup>2</sup>. Most of the area is located in a high altitude from 1000 to 4000m in Zagros mountain range and the mountain area occupies about 76% of the entire area. 19% of the area consists of the

alluvial fan, river terrace, and alluvium deposits and these area are flat plane which used for the farm land, town and for another human life.

(2) Geology

Karoon basin is located in the two different zones, consisting of Paleozoic and Mesozoic lithology area and Cenozoic lithology area. The base rock area accounts for about 78% of all regions and 65% of these lithology is Paleozoic consisting of limestone and sandstone. 12% of the base rock is sandstone and shale in Precambrian. 20% of the base rock consists of Mesozoic rock, mainly distributing soft marl. The bedrock of Paleozoic is very hard and the collapsing rock is a source of the debris flow. The rock of the Mesozoic is extremely weak, and it causes the landslide and erosion easily

(3) Meteorology

The basin rainfall varies from 250 mm to 1700 mm, and 650 mm in average. Rainfall exceeds 1,500 mm in upper basins of K5 and K8. Rainfall decreases toward south east. Most of precipitation occurs from December to May, especially from January to March. The highlands above EL. 2,000 m are covered with snow in winter. Winter is moderate and short, while summer is long and hot. Temperature reaches the highest in July and the lowest in February. Annual average temperature is about 25 °C. Monthly maximum temperature is about 40°C and minimum temperature is -14°C.

(4) Hydrology and River Regime

Karoon river is one of the longest rivers in Iran. The length of Karoon is about 840 km and its catchment area is about 70,000 km<sup>2</sup>. Annual discharge is estimated at 453 m<sup>3</sup>/s. The lowest downstream of the Study area is at the upstream of Shahid Abass Pour Dam and its catchment area is 27,000 km<sup>2</sup>. Main tributaries of Karoon river are Ab.Vanak, Beheshtabad, Bazoft, Khersan and Monji river. Average monthly discharge at Karoon 1 dam ranges from 190 m<sup>3</sup>/s to 710 m<sup>3</sup>/s. The maximum discharge of Karoon river occurs during April due to snowmelt. Floods occur mainly from January to April.

(5) Soil

In the Study Area, major soils are Lithic Leptosols, Gypsic Regosols, Calcaric Regosols, Calcaric Cambisols and Haplic Calcisols. Lithic Leptosols are distributed mainly in higher lands with shallow depth at the foot and slope of mountains. Calcaric Regosols are commonly found and distributed widely from higher lands to flat lower lands. Gypsic Regosols are found at marly formation and weak to erosion. Calcaric Cambisols and Haplic Calcisols are important and forming fertile flat piedmont plains with a deep depth. Parent material of soils is limestone so that the soils are generally little alkaline (pH from 7.5 to 8).

### 3.2 Land Use and Vegetation

(1) Current Land Use

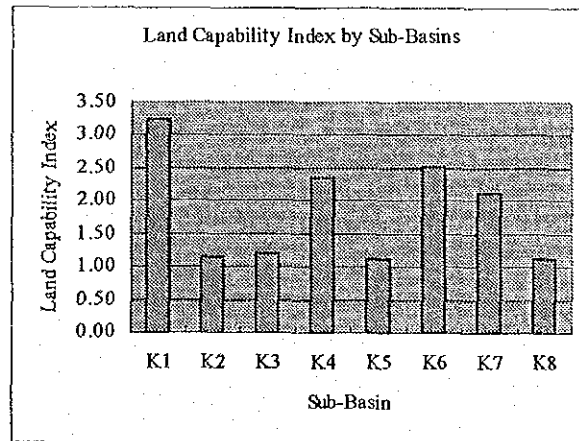
Several land use categories have been applied in the studies conducted by the Ministry of

Jihad-e-Sazandegi and the Ministry of Agriculture since the 1980s. Based on those studies, current land use of the Study area is summarized as below:

Sub-Basin	Proportion of Land Use (%)							
	Irrigated farmland	Dry farmland	Rangeland	Forest	Forest with inter-cropping	Rock	Water bodies, Permanent snow	No Data
K1	15%	6%	76%	2%	-	-	1%	-
K2	3	1	62	28	-	-	6	-
K3	1	1	38	60	-	-	-	-
K4	8	2	73	15	-	-	1	1%
K5	-	1	20	76	-	1%	2	-
K6	10	2	34	52	2%	-	-	-
K7	2	2	27	52	-	14	-	3
K8	1	3	31	54	6	2	3	-

(2) Land Capability

Land capability index has been estimated based on the land capability with the assumed weights as the figure in right hand. The land capability indexes varies by sub-basins from 1.12 in K8 to 3.24 in K1. It means that productivity or capability of unit land in K1 might be about three times of it in K8. Four sub-basins, namely K1, K4, K6 and K7, are considered as relatively high productive sub-basins, and other four sub-basins, K2, K3, K5 and K8, are relatively low from an aspect of land capability.



(3) Vegetation

In the Study area, where changes in topographical condition are very significant, varieties of natural vegetation grow. At altitude of more than 4,000 m, where there are weathered materials, some cold resistance grasses grow for a short time. At 3,500 m altitude, scattered trees such as Juniper, and shrub can be seen. The 2,500 m is the altitude where the vegetation is most concentrated. Based on dominance and pasturage benefit, eleven plant species are recognized. Bromus (brome grass) among the grasses, Astragalus (milkvetch) among the shrubs and Quercus (oak) among the tree are the wide spread plant species.

(4) Right of Common

The provincial forest and rangeland organization decides the rangeland use and migration route for nomadic people. At village level, territory of village is permitted as the common land for grazing, but grazing is prohibited in the large forest for preservation of natural environment.

(5) Nomadism

The nomadic migration system is characterized by the traditional method of grazing at the rangeland in mountain in summer, and raising at their home village in winter. Period of grazing

is about five months from May to September, totally 6 months including migrations in spring and autumn. The government promotes a settlement, with provision of living infrastructure as social and welfare support for pastoral nomadic people. However, the permanent settlement makes slow progress.

(6) Present Grazing Situation

It is suffered that the area is over grazed beyond its carrying capacity. Consequently, present grazing situation is studied roughly. Following issues are grasped as the results. In the study area, over-carrying ratio is estimated at 2 to 10 times, average about 4 times of the carrying capacity of the area, and the area is over grazed as a whole.

### 3.3 Socio-economic Condition

(1) Administrative Division

The study area extends over five provinces of Chaharmahal va Bakhtiyari, Kohgiluyeh va Boyerahmad, Fars, Esfahan and Khuzestan. Especially, most of the area are covered by the Chaharmahal va Bakhtiyari province. Administrative division is composed of township, town, district and rural district under province.

(2) Population

Population of the Study area is estimated at 1,089,000 including nomadic people based on the Census 1996. The ratio of male and female is 51.4% and 48.6% respectively. Age group of less than 9 years old accounts for 31.5%, that is high percentage among the population. Annual population growth rate of the country was 2.5% from 1986 to 1991 and 1.5% from 1991 to 1996 in a tendency to decrease, while the growth rate in the area was considerably high at 2.5% in the Census 1996.

(3) Land Tenure and Land Holding

According to the land reform, all farmers in the Study area are own farmers. Average land holding is 3.3 ha in the Study area, while 4.7 ha in K4 and K8 sub-basins and only 1.1 ha in KI sub-basin.

(4) Income Level

Main income of farmers including nomadic people in the Study area derives from agriculture and animal husbandry. Income proportion of agriculture and livestock is 5:95, mainly derived from animal husbandry. It means that traditional livestock is a property and a mean of livelihood for farmers and nomadic people. Income from agriculture shows that agriculture is for self-sustenance. Farmers earn 3,000,000 to 6,000,000 Rials on an average.

### 3.4 Rural Infrastructure

(1) Road Network

Chaharmahal va Bakhteyari Province, the center region of the Study area, is connected with

adjacent provinces through 17 principal roads, 12 with Esfahan Province, 4 with Khuzestan Province and 1 with Kohkilouyeh va Boyer Province.

(2) Water Resources

In the Study area, surface water is estimated at 6,000 MCM, while present utilization for domestic and irrigation water is 950 MCM. It means that the potential of surface water development is high for irrigation and groundwater recharge projects. Major sources of groundwater are springs and qanaats. Since karstic structure is dominant in the Study area, spring water is abundant and good in quality. Qanaats have not been developed as in the central region of Iran. Qanaats have been developed only around the residential areas. Wells have been developed in recent 30 years and mainly utilized for irrigation and industrial purposes.

(3) Water Supply

In rural area, domestic water demand varies from 90 liter/day/person to 120 liter/day/person. It is considered to be low demand in K8 and southern part of K7 basin compared to other basins. Most water source is groundwater, while 50% by surface water in K8 sub-basin. In the cities, groundwater is utilized in 100 %.

(4) Irrigation

Gravity irrigation systems are conspicuous in the Study area and furrow and border/basin irrigation methods are dominant. Ratio of surface water and groundwater utilization is reported as 65 % and 35 % respectively. Irrigation efficiency is low from 30 % to 35 %. MOA has a program to reduce water loss and to increase irrigation efficiency.

3.5 Agriculture and Other Rural Industry

(1) Agriculture

Main crops in the Study area are wheat, barley and forages. In some areas with abundant water, paddy rice, beans and vegetables are cultivated. On the other hand, on hillsides, grapes, apples and nuts are cultivated. The distribution of farmland is tabulated as follows:

Cropping Rate of Main Crops

Unit: %

Sub-basin	Wheat	Barley	Rice	Forages	Pulses	Sugar beet	Other crop
K1	40.1	14.7	0.5	37.9	2.6	1.0	3.2
K2	45.1	13.1	0.2	40.9	0.2	0.0	0.5
K3	27.4	9.0	28.2	34.4	0.2	0.0	0.8
K4	39.7	11.1	0.0	36.8	7.3	0.6	4.5
K5	45.0	9.5	6.3	39.1	0.0	0.0	0.1
K6	13.2	9.9	9.8	23.0	35.9	1.8	6.4
K7	35.1	12.6	7.2	18.0	15.9	7.7	3.5
K8	27.4	19.4	30.3	9.7	2.0	0.0	11.2

Source: Data of Ministry of Agriculture

Yields of main crops in the Study area and the country are shown in Table below

Unit: kg/ha

Area	Irrigation	Wheat	Wheat	Rice	Alfalfa	Clover	Sugar beat	Beans	Grapes	Apples
Study Area	Irrigated	3,180	2,990	4,710	9,780	7,010	20,990	2,470	9,520	18,245
	Non-irrigated	1,280	1,120							
Country	Irrigated	3,149	2,816	4,173	9,980	8,006	24,860	1,240	10,029	13,674
	Non-irrigated	821	834							

Source: Data of Ministry of Agriculture

#### (2) Livestock

The numbers of main livestock are 3,820,000 of sheep, 3,210,000 of goats, 280,000 of cows, 170,000 of equines and 6,220,000 of poultry. Since goats are not economical due to destruction of rangeland, recently there is a tendency that the ratio of sheep to goats has become 4 to 1. The production of milk in rural areas has increased year by year. Families in villages have begun to consume milk and sell milk products to market.

#### (3) Inland Fishery

The Provincial Jihad Organizations manages inland fishery in the area and is promoting fishery. Species of freshwater fish are rainbow trout and red trout. Fish farms are located in all sub-basins except K8. The number of fish farms registered in the Office is 60 farms and the quantity of production is 1,465 tons in a year.

#### (4) Rural Industry

Traditional rural industries in Iran are represented by carpets, which are pieces of woollen handicraft closely related to animal husbandry in villages. Besides carpet weaving, there are gelim weaving as well as traditional hats, shoes and daily necessities among nomads. These farm village industries are household industries, and production depends on the labor of women of the families.

#### (5) Marketing system

The policy to maintain the prices of basic foodstuff such as wheat and barley is adopted by the government, and these products are sold through village cooperative. Livestock is mainly sold to markets through middleman. There are no fixed distribution systems for livestock of nomads.

### 3.6 Natural Disasters related to Watershed Management

#### (1) Flood and Debris Flow

Since the Study area is mountainous, debris flows are dominant in the tributaries. On the other hand, flood occurs along the Karoon River, major tributaries and flat plains such as the vicinity of Shahre Kord. In Khuzestan Province, the lower reaches of the Karoon river basin, a huge flood occurred in 1923, and caused death of around 3,000 people. In addition, floods hit in 1928, 1939 and 1949, and significant damage on human lives and economy had been given to the Province. In the provinces of Kohgiluyeh and Khuzestan, the southwest part of the Study area, flood occurs frequently in November and December, while in Chaharmahal and Esfahan, the

snow-melting period of March to May is predominant. Causes of flood are heavy rainfall and snow melting as meteorological condition, and steep rivers and sedimentation and river bed rise caused by soil erosion as natural condition. The steep rivers are the Sarkhun, the upper reaches of Bazoft and Kurang, and Sulegan. Sedimentation and soil erosion are remarkable in the Boshar river basin.

**(2) Landslide**

Most of the landslides of bedrock have been generated in an old age and many landslides have relapsed in recent years. In geological features of the landslide, there are a lot of area of Marl, talus and the river terrace deposits. A direct cause of generation is erosion of the slope foot by rivers and artificial cutouts by the road construction, etc.

**(3) Surface Soil Erosion**

The area of severe erodibility of Level 9<sup>th</sup> (over 1,390 m<sup>3</sup>/km<sup>2</sup>) is estimated at 1,113 km<sup>2</sup>, equivalent to 4.2 % of the total area. Out of 1,113 km<sup>2</sup>, the area of 606 km<sup>2</sup> locates in K7 basin, and 262 km<sup>2</sup> and 189 km<sup>2</sup> in K2 and K3 respectively. In K2 Basin, 21.4 % of area is classified into severe erodibility largely extended along the Ab Kurang river. Total amount of erosion is estimated at about 10 MCM per year in the Study area. Out of 10 MCM of erosion, 37 % is produced in K7 sub-basin and 13 % both in K5 and K8.

**3.7 Social Status in Rural Area**

**(1) Rural Community**

Islamic Rural Councils are three to five men councils, elected by the villagers in the ordinary election process. The Councils are now administered by the Ministry of the Interior, and carry on the responsibilities in the lowest administrative chain: one of the councilor is regarded as a village chief.

**(2) Public Organization**

Public Organizations close to the villagers comprise (i) Agriculture Services Center (ASC), (ii) Jihad Center, and field organizations operating in the province; such as (iii) Department of Environment; (iv) Ministries of Health and Medical Education; (v) Education; (vi) Roads and Transportation; (vii) Post, Telegraph and Telephone; (viii) Energy and Cooperatives; (ix) Agricultural Bank; and so on.

**(3) Farmers Organization**

Central Organization of Rural Cooperative, under the Ministry of Agriculture is promoting the formation of rural cooperatives. Of which, most active are the Rural Services Cooperatives. Other organizations are found in Agricultural Cooperative Societies, Production Cooperatives and Moshaa Production Cooperatives.

**(4) Public Services**

Education: In the Study area, related provincial education organizations take the responsibility

on primary and secondary educational services. Primary school (compulsory education: 5 years schooling) is established at village level and secondary school (3 years schooling) at major villages of the rural district. High school (3 years schooling) is established at towns and center of the district.

Health service: Public health service in the area is carried out by related provincial health organizations under the control of the Ministry of Health. On the basis of the national health care system, the health network is established throughout the country. In rural area, health house is established at village level. Establishment criteria of health care facilities are a health house for 3 to 5 villages and a health center for more than 2,500 inhabitants.

Agricultural service: Provincial agricultural organizations take the responsibility on agricultural service for farmers who live in plain area. Agricultural services are conducted through the Agricultural Service Center and the Village Cooperative, which is established at the rural district level.

Livestock service: Public service for animal husbandry is carried out by the Livestock Office of the Provincial Jihad Organization. Direct service to nomads and farmers is conducted through the Livestock Service Station, which is posting at the district level.

Handicraft service: Provincial jihad organization supports to handicraft making such as carpet, gilim and other woven goods production in rural area.

#### (5) Education

The government promotes the encouragement of education and to improve the literacy rate of the people, as one of the important policies. As a result, adult literacy at the country level improved from 41.8% in 1979 to 74.5% in 1997 as well as improvement combined enrolment from 46% in 1980 to 75% in 1997. The enrolment ratio of primary education in the area is lower than that of the country, except for Kohgiluyeh va Boyerahmad province.

#### (6) Human Development Index (HDI)

Here, the difference in HDI among provinces related to the study area based on data in 1996 is examined. The rank of Chaharmahal va Bakhtiyari Province, accounting for the most part of the area, is medium (18th), and Khuzestan Province containing is similar (10th). Esfahan Province covering is ranked high (3rd). Fars Province with is also ranked high (4th). Kohgiluyeh va Boyerahmad Province is ranked low (24th).

#### (7) Gender Issue

The male head of a family is farm work in the whole stage, and boys help the father's farm work and graze livestock. Women perform small animal raising, milking and making dairy products, and help men to do farm work such as weeding and harvesting. In addition, they are engaged in handicraft work.

#### (8) Religion

In the last regime, religious world has nothing to do with the development. After the Islamic revolution, the Islamic government has been accelerated the policies which carry two big slogans for reconstruction of the nation i.e. "independent economy" to economical self-reliance



and “liberation of the oppressed” to social fairness.

### 3.8 Environment

The principal organization for environmental protection in Iran is the Department of the Environment (DOE). DOE is charged with defining and presenting the national rules, regulations and standards for preservation and enhancement of environmental quality. The article 50 of the constitution is the foundation for all environmental related laws and regulations. Also the Islamic penal code addresses the environmental issues and clarifies penalties for persons causing destruction to the environment. Several environmental laws prevail in the country, of which the Law of Environmental Protection and Enhancement (1974), and the Law of Conservation and Utilization of Forest and Range (1975) are related to fields of this Development Study.

There are three protected areas, one national nature monument and four wetlands of environmentally important as the national environmental reserve. One national park was declared in 1995. The cultural assets exist at three locations as the Atabakan Mosque, built in 13<sup>th</sup> century, and the Azadeh House, built in 17<sup>th</sup> century.

## 4 PCM WORKSHOP

The 1<sup>st</sup> Project Cycle Management (PCM) workshop for the Study was held on April 16-26, 2000 in order to make clear the objectives of the study.

## 5. SUB-BASIN INVENTORY

### (1) Division into Sub-basins and Components of Inventory

The division of the Study area was made taking into consideration of topographical conditions such as watershed boundary and river courses based on topographic maps of 1: 50,000. The 455 sub-basins are identified and the results of division are summarized as follows;

Basin code	River name	Area (km <sup>2</sup> )	No. of sub-basin	Average sub-basin area (km <sup>2</sup> )
K 1	Behesht abad	3,920.2	63	62.2
K 2	Ab. Kurang	1,223.7	21	58.3
K 3	Middle Karoon	2,509.1	47	53.4
K 4	Vanak	3,214.8	40	80.4
K 5	Bazoft	2,174.7	41	53.0
K 6	R. Lordegan	1,474.0	20	73.7
K 7	Khersan	9,021.6	164	55.0
K 8	Karoon	3,273.6	59	55.5
Total		26,811.8	455	58.9

The inventory describing natural, social and economic features such as land use, vegetation, land capability, protected area has been prepared

(2) Data Arrangement for GIS and SPOT Satellite Imageries

The GIS data preparation was carried out by organizing all in ARC/INFO data format by integrating them in a common coordinate system. Data were acquired by field survey, SPOT satellite imageries, interpretation of aerial photos, existing data such as topographic and others.

(3) Preparation of Skeleton (Background) Data for Maps and Thematic Maps

Skeleton data, capable of using as background for thematic maps such as vegetation, and others, were delineated. These included main and sub-basin boundaries, roads, major rivers, administration boundaries, lake/reservoir, and location of cities. By combining the interpretation as well as the existing map information, thematic data such as vegetation, land use, erosion sensibility, land capability, land slide, meteorological and gauging station location, protected areas, dam, and flood location were prepared.

## 6. SELECTION OF MASTER PLAN STUDY AREAS

### 6.1 Selection Criteria

Flood and debris flow : Master plan areas are to be selected from the sub-basins where the certain scale of flood and debris flow hit and sizable damage occurred in recent years, and the damage is evaluated in accordance with the criteria.

Landslide Damage : The landslide damage is also evaluated based on the extent of landslide areas accumulated in respective sub-basin, and at least one sub-basin where severe landslide occurred should be selected.

Number of Candidate Sites for Each Province : Each of the four provinces in the Study area, except Fars Province, should have one sub-basin, and one of the four provinces (possibly Chahar Mahal va Bakhteyari Province) have two sub-basins and select five sub-basins altogether.

Evaluation for Soil Erosion : Soil erosion is to be evaluated next to flood and landslide damage.

Necessity of Structural or Non-structural Measures : The following conditions are considered for the selection and evaluation.

- 1) Remedial works from previous disaster are not completed,
- 2) Immediate countermeasures are necessary judging from the present situation,
- 3) Structural or non-structural countermeasures for disaster prevention can be considered, and the residents can control and manage these countermeasures.

Possibility of Development : Water resources are one of the universal developments potential and the evaluation is made on this potential.

Land Capability : Evaluation is made based on the ratio of land capability index over sub-basin area.

Accessibility and Propagation : Accessibility by road and the effects of propagation are also evaluated.

### 6.2 Selection of Master Plan Areas

Master plan areas (sub-basins) are selected from respective provinces, 2 from Chahar Mahal va Bakhteyari, 3 from Esfahan, Kohkilouyeh va Boyer, and Khuzestan. The sub-basin for landslide is selected from Esfahan Province, and altogether, five sub-basins are selected and tabulated as follows;

Province	Sub-basin	Disaster		Ero-sion	Need for Counter-measures	Develop. Possibil-ity	Land Capa-bility	Access / Propagation					Total
		F/D	L/S					1	2	3	4	5	
Chaharmahal	K 3-1-16	4	-	1	5	5	5	1	1	1	1	1	25
	K4-1-9	4	-	4	5	5	5	1	1	1	1	1	28
Esfahan	K7-0-19-1	2	5	2	5	4	5	1	0	1	1	1	27
Kohkilouyeh	K7-48	3	-	3	5	5	4	1	1	1	1	1	25
Khuzestan	K8-28	2	1	4	5	3	5	0	0	1	1	1	23

Note: K 3-1-16 = Aziz abad, K4-1-9 = Vastegan, K7-0-19-1 = Kolbeluk, K7-48 = Tang Sorkh, K8-28 = Zeras

### 6.3 Selected Master Plan Areas

The Study Team proposed to the selected 5 sub-basin as the master plan study area, however, WMD insisted the following changes;

- \* Take up Chaman Goli-Bazoft instead of Aziz abad, because the Government has already designated Chaman Goli-Bazoft as strategic growth point.
- \* Include adjacent southern basin, where is the center for apple production, collection and shipment, and forms one community, to Kolbeluk and change the name of Kolbeluk into Sarbaz.

Chaman Goli-Bazoft area is very remote from Shahr-e-kord and in view of accessibility, propagation and the size of the area (almost 2 times larger than Aziz abad), it is not so practical. In addition, Kolbeluk area is also extended almost 2.5 times. In due consideration of the situation, development potentiality and willingness of the inhabitants, the Study Team accepted these changes.

Province	Selected Area by Study Team			Final Master Plan Area		
	Name	No.	Area(km <sup>2</sup> )	Name	No.	Area(km <sup>2</sup> )
Chaharmahal	Vastegan	K4-1-9	67.0	Vastegan	K4-1-9	67.0
	Aziz abad	K3-1-16	52.5	Chaman Goli-Bazoft	K5-19-a	113.1
Esfahan	Kolbeluk	K7-0-19-1	63.1	Sarbaz	K7-0-19-1	154.5
Kohkilouyeh	Tang Sorkh	K7-48	65.4	Tang Sorkh	K7-48	65.4
Khuzestan	Zeras	K8-28	63.7	Zeras	K8-28	63.7

## 7. SOCIO ECONOMIC FRAME

Figures for present and projected population and income level of Master Plan Areas are tabulated below.

Present and Projected Population by Master Plan Area

Master Plan Areas	Present	Target Years	
	1991	2010	2020
K4-1-9 Vastegan	4,460	4,460	5,280
K5-19a Chaman-Goli Bazoft	8,416	8,416	12,790
K7-0-19-1 Sarbaz	10,875	10,875	17,610
K7-48 Tang Sorkh	1,871	1,871	2,200
K8-28 Zeras	2,344	2,344	2,350
Total	27,966	27,966	40,230
Growth Rate (%)*	-	2.24	1.65

\* Average annual

Present and Projected Income Level by Master Plan Area are as follows;

(Unit: 1,000 Rials/household/year)

Master Plan Areas	Present	Growth Rate (%)*		In year 2020	
	1991	Projected	Performed	Ideal Growth	Actual
K4-1-9 Vastegan	10,851	6.0	4.8	33,280	26,800
K5-19a Chaman-Goli Bazoft	1,488*	6.0	4.8	24,200	19,500
K7-0-19-1 Sarbaz	26,972	6.0	4.8	81,690	65,800
K7-48 Tang Sorkh	5,668	6.0	4.8	18,150	14,600
K8-28 Zeras	12,957	6.0	4.8	39,330	31,680

## 8. THE PROJECT AREA

### 8.1 Natural Condition

#### (1) Location

Locations of 5 Mater plan areas are as shown in Table below:

Name of Area	Vastegan	Chaman Goli-Bazoft	Sarbaz	Tang Sorkh	Zeras
Basin Code	K4-1-9	K5-19a	K7-0-19-1	K7-48	K8-28
Area (km <sup>2</sup> )	89.9	113.2	154.5	65.4	63.7
Main Tributary	Vanak	Bazoft	Marbor	Boshar	Karoon
Province	Chahar Mahal & Bakhtiari	Chahar Mahal & Bakhtiari	Esfahan	Kohgiluyeh va Boyerahmad	Khuzestan

#### (2) Topography

##### a) Vastegan

The Vastegan area has an altitude range of 2210-3500 m. It is subdivided into four types: terraces, fans, hills and mountains. The alluvial plain is mainly made up of paleo-lake and marsh deposits. Swamps occupy a part of the plain. The earth/sediment debris, which is carried downstream by rivers from the highlands, is deposited into the flood plain causing damage to the agricultural land.

##### b) Chaman Goli-Bazoft

About 85% of the Bazoft area is represented by mountain belt, whose altitude ranges between 1500 and 3000 m. Its western side exhibits the presence of a row of highlands at altitudes of 2000-3000 m. In general, the mountain-tops are steep and bedrock exposures are common. The eastern side has ridges with lower altitudes 1500-2000 m. Each

tributary system constituting the drainage basin within the mountain region has a fan-like catchment area, which causes floods frequently.

c) Sarbasz

The eastern end of the mountain zone forming the Sarbasz area is affected by a major fault. Therefore, it exhibits the presence of steep scarps with exposed bedrock. Towards the east of the mountain zone, within an altitude range of 2200 – 2500 m, there is a hilly terrain with matured ridges. These hills occur in a row and they are densely dissected by minor gullies.

d) Tang Sorkh

The main river flows from SSE to NNW. A major tributary originating in the East flows into this river at Tang Sorkh. It has also created a wide 150-500 m plain that has been used for cultivation as well as fruit orchards. The above-mentioned tributary has a significant discharge, throughout the whole year.

e) Zeras

The main river (Karoon) within the Zeras area flows from SE to NE forming remarkable loops of repetitive meanders. The area spreads out, over a 3-6 km wide and 14 km long rectangular zone, nearly parallel to the river course. About 90% of the Zeras area is mountainous within 800-1700 m altitude. Although steep slopes with dips of 30-40° occur forming rows, the area as a whole exhibits a matured landform.

(3) Geology

There are two geological divisions: unconsolidated sediments formed during or after the Quaternary Diluvial age and the bedrock of Tertiary or older age. They are briefly described below.

- a) River deposits: These are loose unconsolidated formations comprising gravel, sand and clay. The relative proportion of these sediments, in geological terms, reflects the distribution of strata along the river courses.
- b) Detrital deposits: The detritus, which is mainly represented by angular clasts, have a low degree of compaction. Their lower parts may be cut off by river erosion or man-made forces, and leading to slope instabilities or subsequent damages to the structures alike.
- c) Terrace deposits: These sediments are made up of gravel, sand and clay and they are well compacted. In certain parts, they are in semi-consolidated state. Loss of the toe and therefore also the support from the base, resulting from erosion, has led to roadside failures and landslides.
- d) Debris flow deposits: These deposits are mainly composed of breccia of hard limestone. Although natural disasters in the past occurred in Tang Sorkh and Sarbasz, the latter requires attention in future. In general, debris flows originate in areas characterized by hard limestone
- e) Landslide deposits: Relatively small landslides are seen in various places. Though large landslides in the past occurred within the Zeras area, it seems almost stable at present. Some medium scale landslides are in active in Sarbasz, where marl is dominant.

(4) Soil

a) Vastegan

Vastegan sub-basin can be divided into two clear different basins, namely the upper mountain area and the lower alluvial fan and plain area. In the mountain area, soils are very scarce and remained at very limited places. In the plain area, five soil units are observed, namely 1)Haplic Calcisols in plateaus, 2)Calcaric Regosols in gravelly alluvial fans, 3)Calcaric Fluvisols and 4)Calcaric Cambisols in piedmont alluvial plains and 5)Eutric Gleysols in lowlands.

b) Chaman Gholi-Bazoft

Three soil units are observed in Chaman Gholi-Bazoft, namely 1)Vertic Cambisols in hills, 2)Haplic Kastanosems in old alluvial fans and 3)Calcaric Cambisols in plateaus.

c) Sarbaz

In Sarbaz, gravelly soils are largely extent at the foot slope of the mountains. Four soils are observed in the area, namely 1)Eutric Leptosols in hills, 2)Calcaric Cambisols in hills and plateaus, 3)Haplic Calcisols in plateaus, and 4)Calcaric Regosols in gravelly alluvial fans.

d) Tang Sorkh

In Tang Sorkh, four soils are observed, namely 1)Eutric Leptosols in hills, 2)Calcaric Cambisols in old alluvial fan and plateaus, 3)Calcaric Regosols in gravelly alluvial fans, and 4)Calcaric Fluvisols in river beds.

e) Zeras

In Zeras, red color soils cover extensively and deeply very steep slopes. Since soil texture is heavy and clayey, surface runoff easily occurs and soils are easily eroded. Severe gully and rill erosions are accelerated in such areas where land is not properly managed.

(5) Meteorology

a) Vastegan

Annual rainfall is about 780 mm, concentrating from October to May. Minimum temperature becomes below 0°C from October to April and whole area is covered with snow in this period. Temperature reaches maximum at about 30°C in July.

b) Chaman Goli-Bazoft

Annual rainfall is about 1,400 mm, concentrating from October to May. Minimum temperature becomes below 0°C from December to March and snow falls for 4 months of this period. Minimum temperature is -6 °C. Temperature reaches maximum at about 30°C in July.

c) Sarbaz

Annual rainfall is about 700 mm, concentrating from December to April. Minimum temperature becomes below 0°C from October to April and snow may fall for these 7 months. Minimum temperature is -7 °C in January. Temperature reaches maximum at about 30°C in July.

d) Tang Sorkh

Annual rainfall is about 1,150 mm, concentrating from November to May. Minimum

temperature becomes below 0°C from November to March. Minimum temperature is -2 °C. Temperature reaches maximum at about 30°C in July.

c) Zeras

Annual rainfall is about 770 mm, concentrating from November to April. Minimum temperature exceeds 0°C through the year and maximum temperature reaches about 40°C in August.

(6) Hydrology

a) Vastegan

Specific discharge and annual discharge depth are 0.006 m<sup>3</sup>/s/km<sup>2</sup> and 200 mm/year. Suspended load ranges from 16 to 30 m<sup>3</sup>/km<sup>2</sup>/year.

b) Chaman Goli-Bazoft

Specific discharge and annual discharge depth are 0.046 m<sup>3</sup>/s/km<sup>2</sup> and 1,440 mm/year. Suspended load is estimated at 23 m<sup>3</sup>/km<sup>2</sup>/year.

c) Sarbaz

Specific discharge and annual discharge depth are 0.027 m<sup>3</sup>/s/km<sup>2</sup> and 840 mm/year. Suspended load is estimated at 30 m<sup>3</sup>/km<sup>2</sup>/year.

d) Tang Sorkh

Specific discharge and annual discharge depth are 0.018 m<sup>3</sup>/s/km<sup>2</sup> and 580 mm/year. Suspended load is estimated at 60 m<sup>3</sup>/km<sup>2</sup>/year.

e) Zeras

Specific discharge and annual discharge depth are 0.013 m<sup>3</sup>/s/km<sup>2</sup> and 400 mm/year. Suspended load is estimated at 15 m<sup>3</sup>/km<sup>2</sup>/year.

8.2 Land Use and Vegetation

(1) Land Use

Present land use in the Master plan area is as follows

(unit : k m<sup>2</sup>)

Area	Item	Rocky	Forest	Range land	Forest Range Land	Farm land	Orchard	Tree Plant	Village	Waste	River Bed	Forest with Dry farming	Total
K4-1-9	Vastegan	40.39	0.00	11.42	11.42	35.24	0.46	0.69	1.59	0.11	0.00	0.00	89.90
K5-19a	Bazoft	74.91	1.27	18.75	20.02	11.17	0.23	0.00	0.32	0.00	0.31	6.24	113.20
K7-0-19-1	Sarbaz	74.13	0.00	53.92	53.92	2.08	20.41	0.18	1.57	0.00	2.21	0.00	154.50
K7-48	Tang Sorkh	22.26	0.00	31.18	31.18	4.58	2.66	0.04	0.26	3.15	1.27	0.00	65.40
K8-28	Zeras	7.21	0.00	33.61	33.61	21.41	0.00	0.00	0.21	0.50	0.76	0.00	63.70
Total		218.90	1.27	148.88	150.15	74.48	23.76	98.24	3.95	3.76	4.55	6.24	584.03

Source: JICA Study Team

(2) Land Capability

Class I lands, no limitations for irrigation, are located only at piedmont alluvial plain in

Vastegan. Class II lands, slight limitations for irrigation, are located widely also in Vastegan, but limited in other areas. In other areas, class III, moderate limitations for irrigation, and IV lands, severe limitations for irrigation, are prevailing.

(3) Vegetation

Due to overexploitation and poor management of natural resources most of valuable grasses have disappeared, leaving a large denuded area. Present vegetation is mostly comprised of shrubs and forbs of less pasturage value.

(4) Productivity

Amount of natural herbage produced in a rangeland reflects its productivity. Factors such as amount/distribution of rainfall and soil fertility influence productivity of an area. Production of rangeland is far less than present demand.

(5) Present Grazing Situation

Overgrazing is a common practice in rangeland of master plan areas, since they are forced to accommodate livestock even 10 times more than their capacity. Overgrazing not only suppress the regeneration of natural vegetation, but leads to decline in soil fertility and disappearance of valuable plant species.

8.3 Socio-economic Condition

(1) Population

The population of the Study areas about 28,000, of which nomad population is 35%. Population density is low as 38 persons/km<sup>2</sup>.

Sub-basin	Village			Nomad				Total		
	Male	Female	Total	Male	Female	Total	Ratio(%)	Male	Female	Total
K4-1-9	1,700	2,000	3,700	400	360	760	17.0	2,100	2,360	4,460
K5-19a	2,951	2,955	5,906	1,344	1,166	2,510	29.8	4,295	4,121	8,416
K7-0-19-1	2,553	2,477	5,030	2,902	2,943	5,845	53.7	5,455	5,420	10,875
K7-48	556	602	1,158	352	361	713	38.1	908	963	1,871
K8-28	1,195	1,149	2,344	0	0	0	0.0	1,195	1,149	2,344
Total	7,760	8,034	15,794	4,998	4,830	9,828	35.1	12,758	12,864	27,966

Source: Study Team 2001 August

(2) Income Level

Main income of farmers including nomadic people in the study area derives from agriculture and animal husbandry.



Average Income Level (Unit: million Rials /year /household)

Sub-basin	Village			Nomad		
	Crops	Live stock	Total	Crops	Live stock	Total
K4-1-9 Vastegan	6.750	3.500	10.250	0.250	14.000	14.250
K5-19a Chaman Goli-Bazoft	0.775	0.835	1.610	0.330	1.120	1.450
K7-0-19-1 Sarbaz	33.636	4.109	37.745	7.864	8.818	16.682
K7-48 Tang sorkh	2.671	2.943	5.614	1.571	4.214	5.786
K8-28 Zeras	6.843	6.113	12.957			
Total / Average	10.135	3.500	13.635	2.003	5.630	7.634

Source: Study Team 2001 August

### (3) Employment Opportunity

Economically active population (age 10 and over) in the study area is 75.8 % of the total population and the average unemployment rate shows 11.4%. High unemployment ratio of more than 20 % are found in the K5-19a Chaman Goli-Bazoft and K8-28 Zeras, the unemployment ratio of which is 27.5 % and 23.5 % respectively. Those two areas are remote to the nearest industrial towns and/or cities. It is almost impossible to commute to the factories of neighbouring towns as employees. They also have disadvantage to get the information of employment.

### (4) Land Tenure and Land Holding

Average land holding and land use conditions per household in the Study areas, according to village survey, are estimated as follows.

Land Holding (unit: ha/household)

Sub-basin	Farmland	Orchard	Total
K4-1-9 Vastegan	1.87	0.10	1.97
K5-19a Chaman Goli-Bazoft	2.03	0.13	2.17
K7-0-19-1 Sarbaz	0.41	4.26	4.67
K7-48 Tang sorkh	2.30	1.70	3.99
K8-28 Zeras	3.43	0.01	3.44
Total / Average	1.73	1.50	3.24

Source: Study Team 2001 August

### (5) Structure of Rural Community and Process of Its Decision Making

Ministry of Jihad and Agriculture (Nomadic Affairs Organization, Forest and Rangeland Organization, Livestock Organization, Handicraft Organization, Public Company for Fishery), Ministry of Education, Ministry of Health and medical Education, Plan and Budget Organization, Statistical Center of Iran Provincial Jihad-e-Sazandegi Organization (Nomadic Affairs Office, Forest and Rangeland Office, Livestock Office, Handicraft Office, Provincial Public Company for Fishery), Provincial Education Organization, Provincial Health Organization, Provincial Plan and Budget Organization Each Village (Community) is having the Islamic Council (Shora) as the lowest reach of administration.

### (6) Fuel Source of Households

In the village households, ratio of consumption of gas/petrol and fuel wood is 53% and 47%

respectively as a whole, while 20% by gas/petrol and 80% by fuel wood in Nomad households. Consumption of fuel wood is very high in Nomad households. Nomad households have more problems from a viewpoint of river basin preservation.

#### 8.4 Rural Infrastructure

##### (1) Rural Road

Accessibility from major cities are generally good to all Study areas due to wide and paved national roads or main rural roads. However, some villages are forced in poor accessibility within the area due to poor conditions of rural roads as non-pavement or gully erosion. Such villages with poor accessibility are Tabarak Olya, Tabarak Sofla, Ghale Tabarak in Chaman Goli-Bazoft due to non-pavement of rural roads and floods, and most villages in Zeras due to danger and severe gully erosion of rural roads.

##### (2) Water Supply and Sewage

All villages have own or cooperated water source and system for water supply except one village, namely Shagaz in Zeras. Most water sources are depending on spring water, while 4 villages (Bardkal, Behoz, Cham and Gard Lidan in Zeras) depend on river water of Karoon river and one village (Konark Sofla in Vastegan) depends on groundwater of well. Many villages, which depend on spring water, are facing water shortage.

##### (3) Electrification

All the villages within the selected five (5) Master Plan Study Areas is electrified. According to the Behavioral Survey, 181 households out of 204 (88.7 %) within the Master Plan Study Areas is using electricity. Utilization ratio of electricity is 100% of households for "Lighting", 72% for "radio", 71% for "refrigerator", 65% for "TV", 42% for "electric fan", 22% for "ironing", 14% for "vacuum cleaner".

##### (4) Irrigation

Present situation of irrigation in the Study areas is summarized as shown in Table below. Irrigated area is 5,070 ha in total, of which farmland is 2,253 ha and orchard is 2,817 ha.

Area	Irrigated Area (ha)			Number of Irrigation Schemes		Problems on Irrigation
	Farmland	Orchard	Total	Total	by MOA	
Vastegan	924	25	949	4 Schemes	3 Schemes	- Over Pumping of Groundwater
Chaman Goli-Bazoft	672	77	749	6 Schemes	1 Scheme under Construction	
Sarbaz	541	2,472	3,013	6 Schemes		- Unsteady on Water Supply
Tang Sorkh	116	243	359	3 Schemes	1 Scheme under Construction	
Zeras	0	0	0	none	none	- Poor on Water Source
Total	2,253	2,817	5,070	19 Schemes	5 schemes	

## 8.5 Agriculture, Livestock and Inland Fishery

### (1) Agriculture

#### a) Cropped Area and Crop Production

Generally, the major crops cultivated in the Study Area are wheat and barley, while the other minor crops in terms of planted area are legume, alfalfa, vegetables and fruit trees.

Unit: ha

Sub-basin	Barley Wheat	Alfalfa	Sugar beat	Legume	Vegetable	Potato	Others	Total	Orchard	Grand Total
K4-1-9 Vastegan	540	271	82	15	0	47	10	965	50	1,015
K5-19a Bazoft	1,275	132	0	2	7	0	1	1,417	94	1,511
K7-0-19-1 Sarbaz	120	221	0	2	0	0	0	343	3,548	3,891
K7-48 Tang Sorkh	215	107	0	0	0	0	41	363	268	631
K8-28 Zeras	1,378	0	0	0	0	0	108	1,485	3	1,488
Total	3,528	731	82	19	7	47	160	4,573	3,962	8,535

Source: Village Survey of the Study Team

Average land size owned by the villagers is 3.4 ha per family with variation from 1.7 ha in Charman Goli-Bazoft to 5.7 ha in Zeras. On the other hand, average land size owned by the nomads is 1.0 ha per family varying from 0.4 ha in Vastegan to 1.1 ha in Sarbaz.

### (2) Livestock

Shortage of feed is the main problem in whole areas, which is caused by shortage of water and lack of grazing land. Provincial Five Year Plan of Charharlmahal-va-Bakhtiyari includes diversification to industrial cow for meat and milk, improvement of insemination, decreasing local cow and increasing semi-local cow, changing from sheep and goats to cow, etc.

### (3) Inland Fishery

Inland fishery is found at the place where can obtain fresh good quality water from springs and rivers in the Study Area. The species of fishes cultivated in cold water are rainbow trout and red trout. The ownership of fish culture firms takes two forms: one is by village cooperative and others by entrepreneurs living in cities. In the Study area, only one of fish culture firms belongs to villagers, others belong to entrepreneurs.

## 8.6 Marketing System, Agro-processing and Rural Industry

### (1) Agriculture Product Marketing system

Selling prices of most main agriculture products are guaranteed by the government. However, products, of which prices are kept stable by the guaranteed price, are only livestock and fish like as sheep, goat and rainbow trout.

### (2) Agro-processing

Present Agro-processing: Crop processing, livestock processing

Crop processing: Wheat (all areas), rice (Zeras)

Livestock processing: Milk, butter, cheese and Kashk as cake

Cooperation of processing: Within the family, not by the cooperatives or by the company.

Willing of villagers: Willing to promote agro-processing activities

Future Development: First processing of apples and vegetables etc. under Farmers' Group or Cooperatives (collection and sell of products, sorting, packing and transporting of products)

(3) Rural Industry

Restrictions are high price of raw materials, far distance of market places and lack of budget for buying raw materials and weaving machines. Rural industry is one of the essential sectors for rural development, increment of employee rate and stability and sustainability of socio-economic. 115 types for food industry, 59 types for mineral industry, 78 types for textile, 118 types for chemical and cellulose and 57 types for metal are promoted in the region.

### 8.7 Natural Disaster

(1) Flood and Debris Flow

a) Vastegan (K4-1-9)

There are two major rivers in the area. Gela River collects the water from the mountain area and flows into the lowland causing a lot of flood and debris flow damage, while R.Aghabolugh River, that flows through the marsh located north, borders eastern part of the area. Upstream of R.Aghabolugh River is the marshland and it functions as a retarding pond, therefore, there is no severe flood damage along this river.

b) Chaman Goli-Bazoft (K5-19a)

There are three sub-basins in the master plan area. Fariak River, located in the northeastern basin has a small catchment area. Gusale Bar River collects the water from the north and northwest basin, while Tabarak River drains from the south and southwest basin. In addition, several small tributaries drain into Bazoft River. Gusale Bar River and Tabarak River generally have fan shaped catchment areas, which cause the concentration of floodwater.

c) Sarbaz (K7-0-19-1)

In the north sub-basin, there are two villages, Noorabad and Sarbaz. Both these villages are located either on the hill or hill slope, and free from flood and debris flow damage. However, the lower part of the basin is covered with Marl and eroded severely, especially the farmland along the tributaries of Marbor River. In the south sub-basin, Lee Sorkh River flows from south to north. On the upper most reach of this river is filled with debris consisted of big boulders, which were derived from the huge rockslide on the slope of the Dena Mountains.

d) Tang Sorkh (K7-48)

The area is divided into three sub-basins, namely Tang Sorkh River sub-basin, and other two sub-basins which are the rest of the catchment consisting of several small tributaries on the right bank and on the left bank of Boshar River. In Tang Sorkh River sub-basin, flood and debris flow are causing damages on the bridge to village and farmland. In the left bank tributary sub-basin, a severe flood occurred in the area, however, it didn't cause a lot of damage to the villages but to the farmland.

e) Zeras (K8-28)

In the northwest area, there is not much damage of flood and debris flow in the villages of

Dawodiha, Shahghaz and Sebalutak, which are located on the top of mountain or on the gentle slope. However, flood and debris flow occurs frequently at the villages of Bardkal, Lir Siya Shapouri, Lir Siya Mozrom and Satuf which are located beside the tributaries drained into the Karoon River.

(2) Landslide

a) Vastegan (K4-1-9)

There are some landslides in southern part of western upland. Small-scale rock falls occur on the Steep Cliff Area.

b) Bazoft (K5-19a)

Landslides in this area occur in and around Kachooz, Baghchenar, Dorak, Chemghaleh, Tabarak Sofla and Ghale Tabarak. Kachooz has rock falls from the slope along the main road and hit to the houses located below the road, especially in spring and after the heavy rain.

c) Sarbaz (K7-0-19-1)

Many landslides occur in the North Sub-basin, especially in and around the Noorabad and Sarbaz. In the South Sub-basin, landslides occur in three locations.

d) Tang Sorkh (K7-48)

Most of the landslides in this area occur rather apart from villages and farmland. The one behind the village of Cheshmeh Chenar is small-scale rock fall.

e) Zeras (K8-28)

Landslides in this area are scattered along the right bank of Karoon River, in and around the main road from Dawodiha to Lir Siya Shapouri, and on the Southwest Area.

(3) Surface Soil Erosion

Basin-wise soil loss is highest in Zeras as 48 t/ha/yr or 3.4 mm/yr. Tang Sorkh follows Zeras with 29 t/ha/yr or 2.1 mm/yr. Since Zeras is covered with thick soil layer in whole basin and utilized heavily by grazing and dry farming, soil loss is so high comparing to other areas. In Tang Sorkh, rainfall erodibility is so high that heavy erosion is caused. On the other hand, in Vastegan, heavy soil loss is caused by the weathering of marl formation. It is difficult to protect such geological weathering by present technology level. From a viewpoint of land use, rangeland is highest in soil loss. Dry farmland follows rangeland. There are no or less problems in irrigated farmland, orchard and three plantation.

## 8.8 Environment

Most of natural vegetation has been removed to create spaces for farming and other purposes. The vegetation is overexploited and shows no sign of regeneration. However presence of *Daphne* (mezereon) in vegetation composition indicates decline in soil fertility, in some localities, the remaining scattered *Juniperus* (juniper) trees contribute to natural beauty of the areas. The wildlife is mainly comprised of hunter animals such as wolf and eagle, which attack the livestock and poultry of people.

## **9 PCM WORKSHOP**

The Study Team facilitated five Project Cycle Management (PCM) workshops applying the PCM method including its participatory approach for planning. The workshops were held for the purpose of preparing a framework of the master plan of each pilot sub-basin. Furthermore, the technology transfer on the participatory planning from the JICA Study Team to the Iranian counterpart personnel was also intended.

## **10. PLAN FORMULATION**

### **10.1 Overall Goal and Project Purpose**

The area has been degraded by decrease of the vegetation and the forest area due to overgrazing and cutting trees for fuels and reclamation for increase of the new cultivation area. In case of heavy rainfall or rapid snow melting, many types of disasters such as debris flow and flood are anticipated. The area is suffering from a vicious cycle of natural-social environment: "Decrease of farm income (Poverty) - Further exploitation of land - Degradation of natural environment - Natural disasters and damage to farmland - decrease of productivity of land -Decrease of farm income (Poverty)". The vicious cycle is schematically shown below, and the regional society is facing the danger of collapse.

The overall goal of the master plan is to break through the above vicious cycle at two nodes of the "Degradation of natural environment" and "Decrease of farm income. In order to realize the overall goal, following five project purposes are proposed.

- (1) Mitigation of flood, debris flow and landslide damages
- (2) Control of soil erosion and conservation of water
- (3) Restoration and improvement of rangeland vegetation
- (4) Improvement of living standard
- (5) Improvement of agriculture product/input marketing, agriculture extension and strengthening of community activities

Several approaches to each project purpose are considered, and each approach forms an individual project. Execution of each approach (project) will produce an effect (effects) on the project purposes.

### **10.2 Basic Policy of Master Plan**

#### Disaster Prevention Works

In order to reinforce and/or supplement the resistance to natural disaster, civil structures in various types and vegetation measures are planned appropriately. With these measures, restoration and/or improvement on the devastated terrain will be accomplished and maintained properly, and eventually flood/debris flow and soil erosion is to be lessened and/or mitigated.

As direct objectives, protection of villages, farmland and infrastructure such as roads and

irrigation facilities is planned as disaster prevention measures. In the plan formulation, the required number of facilities is examined based on the characteristic of each master plan area, and the urgency, which is dependent on the correlation between direct objectives for protection and degree of devastation.

Check dams, one of the major disaster prevention facilities, have functions of not only storing capacity for debris but also are expected to mitigate the riverbed gradient, prevent vertical/horizontal erosion of the river course, stabilize the foot of slope, prevent the movement of unstable sediment left on the riverbed, prevent devastation of riverbed and river banks and reduce the sediment to be carried downstream. The erosion caused by the degradation of the watershed area becomes serious problem, which produces materials for debris flow. The countermeasure to control sedimentation is fundamentally equal to the countermeasure to control surface erosion in the watershed area. Vegetation recovery by means of controlled number of livestock and period of grazing, spreading seed of natural vegetation, control of cutting forest trees by substituting other fuel, afforestation, control of the new reclamation land and improvement of cultivation method will be examined.

Non-structural measures, such as warning and evacuation system during disaster, and training for operation and maintenance on the disaster prevention facilities are to be examined.

Community Development : Most of the inhabitants are poor and have no awareness of disaster, which is caused by the degradation of basin environment through overgrazing and cutting trees. The rural inhabitants should have economic stability to spare their resources by themselves for the facilities to prevent disasters. Some amount of capital accumulation will be necessary as only the people with economic sufficiency can afford time and mind for paying attention to environment and disaster. In this connection, many types of agriculture including rehabilitation of irrigation facilities and crop diversification, fish culture, and rural industry promotion should be taken place so as to make the rural people economic independent.

These development plans include "Structure Measure Plans" and "Non-structure Measure Plans". These two plans cannot be divided each other. They should make up for each other for accomplishment of themselves. Structure Measure Plans include procurement of equipment and materials, establishment of facilities, etc. On the other hand, Non-structure Measure Plans include establishment of groups and cooperatives, training and education by government to said groups and cooperatives.

Public Work and People's Participation : These civil works such as construction of check dams, rehabilitation of rural road and rural water supply will be implemented by public works in principle. In this case it is very important that people's participation is not for saving investment by using free labor force from people's groups, but for strengthening the people for sustainable development.

To achieve community development under people's initiative, an intensive approach to the

village with technical information for plan formulation will be needed, and organizing and strengthening user's committees will trigger community development activities and reduction of vulnerability, then finally achieve a successful disaster prevention and community development project.

It is vitally important to select the farmers group and/or organization, who have strong willingness for development and are positive to pay for their share of project cost. Emphasis should be placed on the "Participatory" planning and implementation for the success of sustainable and positive development. The promotion of the better farmer's participatory organization is also important to get the official subsidies to the project and to receive the governmental training and education.

### **10.3 Outline of Master Plan**

Based on the basic policies above mentioned, master plans for five areas have been formulated and their outline is tabulated in the following tables.



## K4-1-9 Vastegan - Outline of Master Plan

I. Disaster Prevention Work				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
	Check dam (Upstream of Gela Riv.) : 16 Nos.	Debris Capacity (17 yrs.), Prevention of river devastation, etc.	Training for operation & maintenance of disaster prevention facilities, Training for check dam construction procedure	Prolonging the life of disaster prevention facilities
	Check dam (Steep cliff) : 6 Nos.	Protection of Nasir abad, irrigation water source, fishpond and farmland (160 ha)		
	Riv. Improvement : channel work (3.5km-long, w=20~30m) & River treatment (3.6 km-long, w=30~50m)	Protection of Gela Riv. L.bank - farmland : 450 ha		
			Supply of grass seed, Soil & water conservation enlightenment activity, Legislative measures	Acceleration of vegetation improvement
			Extension and training for apple cultivation	Acceleration of Production
People's participation works	Check dam (Upstream of Gela Riv.) : 10 Nos.	Supplement main check dams (Debris Capacity 30,000m <sup>3</sup> )	Participate training for check dam construction procedure	Acceleration of check dam construction
	Vegetation improvement (seedling), Vegetation production plot 4 ha, 3 watering points	Carrying capacity of rangeland 730 ha	Participate soil & water conservation enlightenment activity, 41 ha annual rotation plot, Watchman posting	Acceleration of vegetation
	Orchard terracing: 42 ha Irrigation facility for orchard	Reduction of soil loss : 81.5 t/ha/yr to zero, Apple production 40 t/ha/yr	Participate extension and training for cultivation of apples	Amount of production Job opportunity
II. Community Development				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
	Upgrading of Bijeh Gerd irrigation canals : L=4.0 km	Production from 10~12 ha farmland with 20 liter/s additional water	Agricultural extension promotion & training	Amount of production
	Community road improvement : L = 9 km	Transportation cost & time	Training for road maintenance	
	Rural water supply improvement: each village	Additional capacity at 2020, 176 m <sup>3</sup> /day	Training for proper water use and water tariff	Reduction of water use, safety supply of water
	Ground water monitoring : 4 wells	Conservation of groundwater	Water conservation activity	
			Support for milk cow diversification	Carrying capacity
			Extension service of promotion & training for livestock & handicraft, Low interest loan	Amount of production
People's participation works	Extension of irrigated farmland	10~12 ha	Participate agricultural extension training	Amount of production
	Farm road improvement: 476 km	Transportation cost & time	Participate training for maintenance	
	Building for collection, processing & sale of milk and its products: each village & Konark Olya	Each village: 1.0t/day/village, Konark Olya : 5t/day	Group & cooperatives for milk production & sale, Food production for milk cows, Diversification for milk cows : 750	Additional production per cow 2,665lit
	Multipurpose center : each village	Promotion of group, cooperatives & community activities, Execution of governmental extension services	Group & cooperatives for handicraft & agricultural production & sale, Participate extension training	Amount of production sale & income, Community activity
			Mechanical farming	Amount of production

K5-19a Chaman-Goli Bazoft- Outline of Master Plan

I. Disaster Prevention Work				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
		• Check dam - Feriak & other Riv. : 5 Nos. -Gusale Bar & Tabarak Riv. ; 19 Nos.	Debris Capacity (3 yrs.), Intake weir protection, Prevention of river devastation, etc.	Training for operation & maintenance of disaster prevention facilities, Training for check dam construction procedure
	Riv. treatment : Gusale Bar Riv. L=800m. 2-ground sill with spur dykes	Protection of village Rd.100 m, farmland 1 ha and cemetery, etc.		
	Landslide Protection: 6 locations	Protection of Rd. L=6Km		
	Rock fall prtction: L=100 m at Kachooz	5 houses with 40 people & Rd.		
	Gully protection : 20 gullies at Dorak	Protection of farmland		
			Soil & water conservation enlightenment activity	Acceleration of farmland and rangeland protection
			Supply of grass seed, Soil & water conservation enlightenment activity, Legislative measures	Acceleration of vegetation improvement
People's participation works	Check dam : 14 Nos.	Supplement main check dams (Debris Capacity 28,000m <sup>3</sup> )	Participate training for check dam construction procedure	Acceleration of check dam construction
	Riv. treatment : R.bank of Bazoft Riv. L=500m	Protection of farmland 2.5 ha & Feriak village	Participate operation and maintenance training for disaster prevention facilities	Prolonging the life of disaster prevention facilities
	Gully protection: Looserock check dam 75 Nos.	Farmland protection of 30 ha	Participate training for check dam construction procedure	Acceleration of farmland protection
	Soil erosion protection: Contour bund 798 ha	Soil loss reduction : 2.31 mm/yr to 0.95 mm/yr	Participate soil & water conservation enlightenment activity, 36 ha annual rotation plot, Watchman posting, Reduction of use of fire wood	Acceleration of vegetation
	Vegetation improvement (seedling), Vegetation production plot 4 ha, 3 watering points	Carrying capacity of rangeland 1,019 ha		
	Forestland recovery: 4 ha/year	Planting 400 almond tree/ ha		
II. Community Development				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
	Upgrading of Gusale Bar 3-irrigation canals : L=8.4 km	Production from 45 ha farmland with 73 liter/s additional water	Agricultural extension promotion & training	Amount of production
	Community road improvement : L= 6 km	Transportation cost & time	Training for road maintenance	
	Rural water supply improvement: each village	Additional capacity at 2020, 1,682 m <sup>3</sup> /day	Training for proper water use and water tariff	Reduction of water use, safety supply of water
			Support for milk cow diversification	Carrying capacity
			Extension service of promotion & training for livestock, handicraft & fish culture	Amount of production
			Low interest loan for mechanization	Amount of production
People's participation works	Extension of irrigated farmland	45 ha	Participate agricultural extension training	Amount of production
	Farm road improvement : 152 km	Transportation cost & time	Participate training for maintenance	
	Building for fish distribution: Ghale Tabarak	Production: 200t/year	Marketing Planning	Amount of sale
	Building for collection, processing & sale of milk and its products: 6 locations	5 location : 1.0t/day/location 1 location : 5t/day	Group & cooperatives for milk production & sale, Food production for milk cows, Diversification for milk cows : 1,380	Additional production per cow 2,665lit
	Multipurpose center : 7 villages	Promotion of group, cooperatives & community activities, Execution of governmental extension services	Group & cooperatives for handicraft & agricultural production & sale, Participate extension training	Amount of production sale & income, Community activity
			Mechanical farming	Amount of production

K7-0-19-1 Sarbaz- Outline of Master Plan

I. Disaster Prevention Work				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
	• Check dam (North basin) : 20 Nos. • Check dam (South basin) : 14 Nos.	Debris Capacity (4 yrs.), Farmland Protection, River devastation prevention	Training for operation & maintenance of disaster prevention facilities, Training for check dam construction procedure	Prolonging the life of disaster prevention facilities
	Landslide Protection : 9 locations	Farmland 58 ha & Rd. L = 1.1 km		
			Soil & water conservation enlightenment activity	Acceleration of farmland and rangeland protection
			Supply of grass seed, Soil & water conservation enlightenment activity, Legislative measures	Acceleration of vegetation improvement
People's participation works	Check dam : 12 Nos.	Supplement main check dams (Debris Capacity 36,000m <sup>3</sup> )	Participate training for check dam construction procedure	Acceleration of check dam construction
	River treatment : L= 5.5 km	Protection of farmland : 42 ha	Participate training for maintenance	
	Soil erosion protection: Contour bund 162 ha	Soil loss reduction: 2.94 mm/yr to 1.06 mm/yr	Participate soil & water conservation enlightenment activity, 173 ha annual rotation plot, Watchman posting,	Acceleration of farmland protection
	Vegetation improvement (seedling), Vegetation production plot 4 ha, 3 watering points	Carrying capacity of rangeland 2,524 ha		Acceleration of vegetation
II. Community Development				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
	Upgrading of 4-irrigation canals : L=8.4 km	Farm production with 244 liter/s additional water	Agricultural extension promotion & training	Amount of production
	Community road improvement : L= 20 km	Transportation cost & time	Training for road maintenance	
	Rural water supply improvement: 11 villages	Additional capacity at 2020, 2,637 m <sup>3</sup> /day	Training for proper water use and water tariff	Reduction of water use, safety supply of water
			Support for milk cow diversification	Carrying capacity
			Extension service of promotion & training for apple, livestock & handicraft	Amount of production
			Low interest loan for mechanization	Amount of production
People's participation works	Extension of irrigated farmland	135 ha	Participate agricultural extension training	Amount of production
	Farm road improvement : 300 km	Transportation cost & time	Participate training for maintenance	
	Building for collection, processing & shipping of apple: 3 locations	Production: 2,400t/year	Group & cooperatives for apple production, collection, grading, shipping & sale	Amount of sale
	Building for collection, processing & sale of milk and its products: 5 locations	4 location : 1.0t/day/location 1 location : 5t/day	Group & cooperatives for milk production & sale, Food production for milk cows, Diversification for milk cows : 1,219	Additional production per cow 2,665lit
	Multipurpose center : 7 villages	Promotion of group, cooperatives & community activities, Execution of governmental extension services	Group & cooperatives for handicraft & agricultural production & sale, Participate extension training	Amount of production sale & income, Community activity
			Mechanical farming	Amount of production

## K7-48 Tang Sorkh- Outline of Master Plan

I. Disaster Prevention Work				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
	• Check dam - Tang Sorkh Riv. : 9 Nos. - Boshar Riv. R.bank : 8 Nos. - Boshar Riv. L. bank : 3 Nos.	Debris Capacity (12 yrs.), Farmland Protection, River devastation prevention	Training for operation & maintenance of disaster prevention facilities, Training for check dam construction procedure	Prolonging the life of disaster prevention facilities
			Soil & water conservation enlightenment activity	Acceleration of farmland and rangeland protection
			Supply of grass seed, Soil & water conservation enlightenment activity, Legislative measures	Acceleration of vegetation improvement
People's participation works	Check dam : 6 Nos.	Supplement main check dams (Debris Capacity 18,000m <sup>3</sup> )	Participate training for check dam construction procedure	Acceleration of check dam construction
	Soil erosion protection: Contour bund 44 ha	Soil loss reduction: 2.96 mm/yr to 1.11 mm/yr	Participate soil & water conservation enlightenment activity, 252 ha annual rotation plot, Watchman posting	Acceleration of farmland protection
	Vegetation improvement (seedling), Vegetation production plot 4 ha, 3 watering points	Carrying capacity of rangeland 756 ha		Acceleration of vegetation
	Forestland recovery: 2.5 ha/year	Planting 400 almond tree/ ha		
II. Community Development				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
	Installation of irrigation intake facility on check dam at Tange sorkh River	Farm production with 119 liter/s additional water	Agricultural extension promotion & training	Amount of production
	Community road improvement : L= 5 km	Transportation cost & time	Training for road maintenance	
	Rural water supply improvement: 7 villages	Additional capacity at 2020, 274 m <sup>3</sup> /day	Training for proper water use and water tariff	Reduction of water use, safety supply of water
			Extension service of promotion & training for vegetables, apple & handicraft	Amount of production
			Low interest loan for <i>mechanization</i>	Amount of production
People's participation works	Extension of irrigated farmland	Farm production with 119 liter/s additional water	Participate agricultural extension training	Amount of production
	Farm road improvement : 97 km	Transportation cost & time	Participate training for maintenance	
	Building for collection & shipping of vegetables : Tange sorkh	Capacity : 3 t/day	Group & cooperatives for vegetables & apple production, collection, grading, shipping & sale	Amount of sale
	Building for collection, grading & shipping of apple: Tange sorkh	Capacity : 800 t/year		
	Multipurpose center : Tange sorkh	Promotion of group, cooperatives & community activities, Execution of governmental extension services	Group & cooperatives for handicraft & agricultural production & sale, Participate extension training	Amount of production sale & income, Community activity
		Mechanical farming	Amount of production	

## K8-28 Zeras- Outline of Master Plan

I. Disaster Prevention Work				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
	Check dam : 16 Nos.	Debris Capacity (3 yrs.), Farmland Protection, River devastation prevention		Training for operation & maintenance of disaster prevention facilities, Training for check dam construction procedure
Landslide Protection : 4 locations	Rd. L= 1.3 km			
House relocation : 2 villages	71houses, 360people, 3,700 sheep & goat and 160 cows			
			Soil & water conservation enlightenment activity	Acceleration of farmland and rangeland protection
			Supply of grass seed, Soil & water conservation enlightenment activity, Legislative measures	Acceleration of vegetation improvement
People's participation works	Check dam : 9 Nos.	Supplement main check dams (Debris Capacity 9,000m <sup>3</sup> )	Participate training for check dam construction procedure	Acceleration of check dam construction
	Gully protection : Check dam 486 Nos.	Farmland protection of 293 ha		Acceleration of farmland protection
	Soil erosion protection: Contour bund 1,724 ha	Soil loss reduction: 3.19 mm/yr to 1.08 mm/yr	Participate soil & water conservation enlightenment activity	
	3 watering points	Acceleration of vegetation improvement	336 ha annual rotation plot, Watchman posting	Acceleration of natural vegetation, Nutrition improvement for livestock
II. Community Development				
Public works	(1) Structure measures	Index	(2) Non-structure measures	Index
	Community road improvement : L= 27 km	Transportation cost & time	Training for road maintenance	
	Rural water supply improvement: 15 villages	Additional capacity at 2020, 313 m <sup>3</sup> /day	Training for proper water use and water tariff	Reduction of water use, safety supply of water
			Extension service of promotion & training for livestock & handicraft	Amount of production
People's participation works	Farm road improvement : 285 km	Transportation cost & time	Participate training for maintenance	
	Building for collection, processing & sale of milk and its products: 2 locations	2 location : 2.0t/day/location	Group & cooperatives for milk production & sale	Amount of production
	Multipurpose center : 3 locations (Behoz, Dareh Zangi, Lir Siya Shapouri)	Promotion of group, cooperatives & community activities, Execution of governmental extension services	Group & cooperatives for handicraft & agricultural production, shipping & sale (4 locations), Participate extension training	Amount of production sale & income, Community activity

## 11. IMPLEMENTATION AND O/M PLAN

Implementation of the proposed projects will be commenced in 2002, after completion of the Master Plan Study, and will be completed in 2020.

Under the leadership of Watershed Management Deputy, Ministry of Jihad Agriculture, Project Coordination Committee for the implementation of the projects should be established. Relevant government organizations both in the local and central level should be organized into the committee. The tasks of the committee are a) to coordinate rules and tasks among relevant government organizations, b) to adjust and allocate budget for the project implementation, c) to manage project implementation organization, d) to provide necessary information and administrative assistance to project implementation organization.

For smooth implementation of the projects, Project Implementation Committee should be established. The main implementation body is to be Provincial Jihad Organization, Ministry of Jihad Agriculture. The Organization is to entrust the consultant with the detailed design of main facilities, to give the contractor an order of construction works by means of tendering, and to supervise and support village organization for the operation and maintenance of the project facilities. The duties of the Project Implementation Committee are a) to facilitate the village organization to promote villager's participation into the project implementation, b) to establish rules and regulations for the management, operation and maintenance, c) to provide training course to representatives of the village organization, d) to implement the projects in cooperation with village peoples,

The structural measures taken in the projects are comprised of various works and facilities such as flood and debris flow control facilities, irrigation facilities, roads and terracing, etc. These are classified into two types of works from managerial aspect; operation management type and function management type. The subjects of operation and maintenance for the former type of projects are a) establishment of organizational structure for operation, b) establishment of means of operation, c) collection of information needed for operation such as irrigation area, market price, etc, d) training of operational engineering technologies, e) collection of operation fee such as fuel expenses and electricity charges. And the subjects for latter type of projects are a) establishment of organizational structure for maintenance, b) establishment of means of inspection and maintenance, c) training of maintenance engineering technologies, d) collection of maintenance fee.

The village organization should carry out the maintenance works in principle. The project implementation committee is to prepare the rules and regulation for management and maintenance of the project facilities so that village organization maintains the expected operational function and development effects.

**12. COST ESTIMATION**

Project cost at each Master Plan area is shown as follows.

Vastegan	Chaman Goli-Bazoft	Sarbaz	Tang Sorkh	Zeras
21,637,800,000 Rials	17,618,700,000 Rials	25,271,840,000 Rials	5,444,390,000 Rials	18,716,300,000 Rials

US\$1.00=8,000Rials

US\$1.00=122 Japanese Yen

**13. PROJECT EVALUATION**

Purpose of the financial analysis is to assess such profitable projects as increase of irrigated agriculture, promotion of fish culture, and collecting and grading center of apples and vegetable. Construction of check dam, river treatment, and landslide protection don't generate profits, and are excluded in the analysis. As a result, the proposed projects are financially feasible as a total.

Economic analysis is carried out to evaluate all proposed projects except for groundwater monitoring, and community enhancement, because the benefits from these projects are difficult to express in monetary term. Results of economic analysis in view of EIRR are Vastegan: 23.5%, Chaman Goli-Bazoft: 24.1%, Sarbaz: 49.7%, Tang Sorkh: 31.0%, and Zeras: 18.4%. These results shows that the proposed projects in the 5 Master Plan areas are economically feasible as a total. Major benefits are generated by increase of irrigated agriculture, diversification to milk cow, and collecting and grading center of apple and vegetable.

**14. RECOMMENDATION**

*(1) Government Function*

Project planning in each province is the responsibility of the corresponding Provincial Jihad Organization and the Study and Evaluation Department (SED) of WMD only check and evaluate the plan. Major work of the SED is to collect and analyze those data of floods and landslides and etc. and it seems that the staffing and capability of SED for project planning are insufficient. SED should have the initiative and responsibility of project planning of the large scale projects and the projects extending to large area of more than one province. Staffing and capacity of SED inclined to engineering aspect and ordinary economic and financial evaluation of the project have not conducted until now. SED should master these tools and apply them for project planning and evaluation.

The participatory workshop generally helped the local residents actively participate in the planning process. However, number of the governmental officers was sometimes more than that of the residents people's and active participation was interfered by the governmental officers' attitude. Even though the officers of all levels of administration (local, provincial and central) are essential components of the workshop participants, some officers were too active (aggressive) to insist their ideas. They acted as if they knew all the problems of the residents and they could make most appropriate decisions on the master plan even without listening to the local residents. Such attitude completely opposes to the participatory approach. The attitude

of government officials should be moderate not so as to interfere the participation of the resident people.

(2) Pilot Project

The Study Team recommends prompt implementation of the projects. Disaster prevention work including mitigation of flood, debris flow and landslide and natural environmental recovery including soil erosion control and vegetation restoration are very urgent. However, projects proposed in the master plan are integrated and have many components and some project such as soil erosion control and vegetation recovery have less implementation experience. Experimental pilot project would be recommended in a selected area among the five (5) master plan study areas. The Study Team would like to recommend Vastegan as a pilot project area because of many components of project and accessibility and expected propagation effect, which will enable easy project monitoring, extension and propagation.

a) Purpose of the Project

The project aims at reduction of poverty and improvement of natural environment. With reference to the PCM Workshop held at Vastegan, the two major issues; low buying motivation (living standard) and youth's migration to cities are raised. Therefore, reduction of poverty implies to stimulate people's buying motivation and to improve living standard. In addition, youth's migration to cities will be reduced and then the local community will be revived. On the other hand, improvement of natural environment implies to reduce the damage on farmland and to secure income by decreasing natural disaster, and finally to provide people safe and peace life.

b) Effects of the Project

- To reduce soil loss of about 8t/ha/year (5 mm/year) to almost negligible and to stabilize and maintain the productivity in the hilly rangeland, where the land suffers from severe soil erosion due to deterioration of vegetation by over grazing

- To create annual income of about 6,000,000 Rial for each family, which is equivalent to 60% of present income, by converting lower productive rangeland to apple orchard with productivity of 40t/ha.

c) Components of the Project

Area: 15ha

Facilities:

Diversion Weir: 1 masonry weir

Irrigation Canal: L = 2,800m (Conveyance Canal = 1,300m, Main Canal = 1,500m)

Concrete Canal (B 0.20m x H 0.20m)

Orchard Terrace: 15ha

Project Cost: 488,486,000 Rial



*Executive Summary*

Facility	Breakdown of the Project Cost (rial)			
	Total Cost	Adm. Cost	Labor Cost	Material Cost
Water Source (Diversion Weir, Canal)	264,507,000	35,496,000	31,352,000	197,659,000
Orchard Terrace (including apple nursery)	223,979,000	10,666,000	171,628,000	41,685,000
<b>Total</b>	<b>488,486,000</b>	<b>46,162,000</b>	<b>202,980,000</b>	<b>239,344,000</b>
<b>Composition</b>	<b>100%</b>	<b>9%</b>	<b>42%</b>	<b>49%</b>

O/M Cost: 27,202,000 Rial/year

Facility and Farming	Breakdown of O/M Cost (rial/year)			
	O/M Cost	Adm. Cost	Labor Cost	Material Cost
Water Source (Diversion Weir, Canal)	2,849,000	191,000	1,011,000	1,647,000
Orchard Terrace	1,778,000	0	1,430,000	348,000
Farming Cost	22,575,000	0	9,375,000	13,200,000
<b>Total</b>	<b>27,202,000</b>	<b>191,000</b>	<b>11,816,000</b>	<b>15,195,000</b>
<b>Composition</b>	<b>100%</b>	<b>1%</b>	<b>43%</b>	<b>56%</b>

Participants: 75 families (0.2ha/family) participating among 600 families in 4 villages.

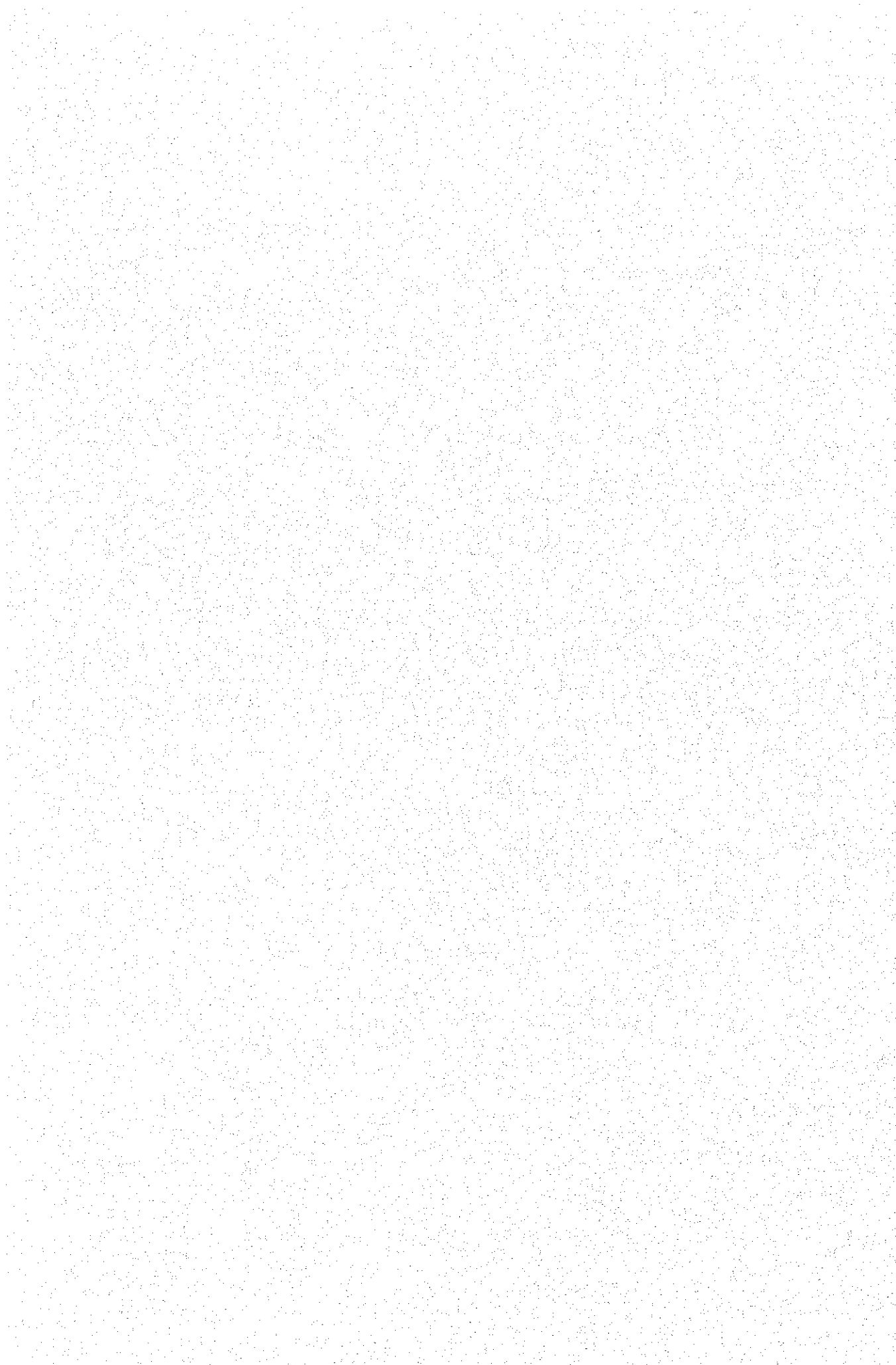
Trees per family: 80 trees (1tree/25m<sup>2</sup> x 2,000m<sup>2</sup>=80 trees)

Benefit of the Project: 32,800,000 Rial/ha x 15ha = 492,000,000 Rial

492,000,000 Rial/75 families = 6,560,000 Rial/family/year

=60% of Present Income

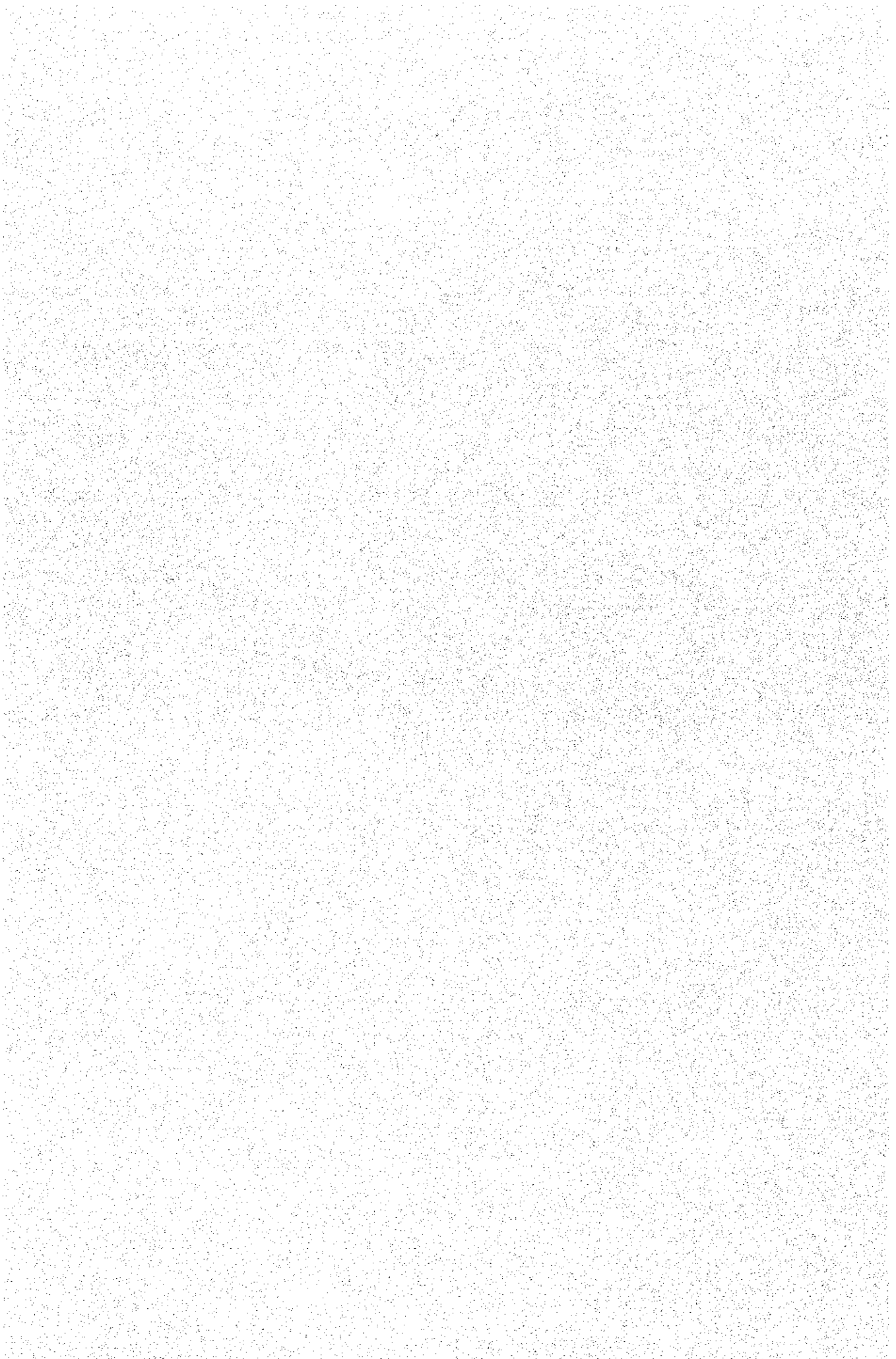
(Present Income: 10,300,000 Rila/family/year)



***PHASE I INVENTORY STUDY***

***CHAPTER I***

***INTRODUCTION***



## CHAPTER 1 INTRODUCTION

### 1.1 Authority

The Scope of Work (S/W) for the Study on Watershed Management Plan for Karoon River in the Islamic Republic of Iran (hereinafter referred to as 'the Study') and the Minutes of Meeting for the said S/W were agreed upon and signed between the Japan International Cooperation Agency (hereinafter referred to as 'JICA') and Watershed Management Deputy, Ministry of Jihad-e-Sazandegi, Islamic Republic of Iran (hereinafter referred to as 'WMD') on October 24, 1999.

The Inception Report was submitted to WMD by the Study Team on February 29, 2000, and Minutes of Meeting was agreed upon and signed on March 6, 2000.

This report is the Final Report prepared in accordance with the Scope of Work and the Inception Report.

### 1.2 Background

The Karoon River is a tributary of the Tigris-Euphrates River and has the largest drainage area (about 70,000 km<sup>2</sup>) in the Islamic Republic of Iran (hereinafter referred to as Iran). The upstream basin occupies the highly elevated Zagros mountain range where natural disasters such as debris flows, landslides and floods are prevailing because of the land degradation and subsequent soil erosion.

In order to avoid and/or reduce the damage of the above mentioned natural disasters, the Government of Iran has made continuous efforts of promoting afforestation in the mountain area and constructing small scale check dams to prevent soil erosion and to keep upstream river channel stable. In spite of the efforts of the government, the efficient and effective countermeasures for prevention of natural disaster damage have not been accomplished.

Under these circumstances, in August 1998, the Government of Iran requested the Government of Japan for technical assistance for the master plan study on watershed management for Karoon River. In response to the request, the Japanese Government decided to undertake the Study and sent a Preparatory Study Team, and the Scope of Work was agreed upon and signed in October 1999. In February 2000, JICA dispatched a Study Team of fifteen (15) members headed by Mr. Hironori Takahashi to conduct the Study.

### **1.3 Objective and Scope of Study**

#### **1.3.1 Objective of the Study**

The objectives of the Study are:

1. to formulate a master plan on integrated watershed management for the selected area in Karoon watershed to prevent further degradation of natural resources and promote sustainable development.
2. to carry out technology transfer to the counterpart personnel in the course of the Study.

#### **1.3.2 Study Area**

The whole study area covers the upper Karoon watershed of 26,800 km<sup>2</sup> area that is shown in the Location Map. The Phase-II Study is a master plan study on the five (5) areas selected in the Phase-I Inventory Study. The five selected areas are as follows and are also shown in the Location Map

- (1) K4-1-9 Vastegan
- (2) K5-19-A Chaman Goli-Bazoft
- (3) K7-0-19-1 Sarbaz
- (4) K7-48 Tang Sorkh
- (5) K8-28 Zeras

#### **1.3.3 Scope of the Study**

Base on the Scope of Works agreed upon between the Iranian Government and Japanese Government, the Study consists of following two phases.

Phase-I: Basic study for preparation of inventory on physical and non-physical features of watershed area, and selection of the area for Master Plan Study.

Phase II: Formulation of Master Plan for integrated watershed management for the selected areas