5 SUB-BASIN INVENTORY

5.1 Division into Sub-basins

The Study area, upstream of Shahid Abbaspor Dam, consists of eight main river sub-basins from K 1 to K 8 and is divided into small sub-basins in order to formulate the inventory.

The division of the Study area is generally made taking into consideration of topographical conditions such as watershed boundary and river courses, inhabitant areas and the size of the areas, based on topographic maps of 1: 50,000.

Sub-basins are originally set at 10 to 50 km^2, however, the size of sub-basins becomes rather large because inhabitant areas are scattered in the Study area and uniformity of sub-basins such as living and social conditions is taken into account.

The 455 sub-basins are finally identified and the results of division are summarized as follows;

Table 5-1-1 The Results of Division into Sub-basins

Basin code	River name	Area (km^2)	No. of sub-basin	Average sub-basin area (km^2)
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

Note; Revision is made on sub-basins and the total area revised becomes; 26,811.7 km^2

5.2 Components of Inventory

Study Area has been divided into 455 sub-basins with an average area size of 59 km^2, for which the inventory describing natural, social and economic features has been prepared. The items such as land use, vegetation, land capability, protected area, for which data and information were given in the form of maps (polygon data) were converted to numeric quantity in full use of GIS. Such inventory items as landslides, flood damage and geological features, which require the past records and data, and also photo-interpretation were manually prepared.

Table 5-2-1 (1) Inventory Items

Inventory Category	Inventory Items	Classification
1. General Information	1) Name of Province	
	2) Name of Township	
	3) Name of Villages	
	4) Name of Drained Tributary	
	5) Locating Coordination	
	6) Related 1:50,000 map	
	7) Catchment Area	
2. Meteorology and Hydrology	1) Mean Annual Rainfall (mm)	
	2) Mean Maximum Daily Rainfall	
	3) Mean Temperature	Max., Min.,Average
	4) Annual Evaporation	
3. Water Use	1) Annual Rainfall (MCM)	
	2) Annual Runoff (MCM)	
	3) Annual Runoff Depth (mm)	
	4) Mean Maximum Runoff	
	5) Annual Runoff Ratio	
	6) Water Use for Irrigation	
	7) Water Use for Domestic Water	
4. Flood Damage	1) Date, Cause, Location	
	2) Previous Big Floods	
	3) Total Damage	
	4) Damage of Human Beings	
	5) Damage of Livestock	
	6) Damage of Agriculture	
	7) Damage of Houses	
	8) Damage of Infrastructure	road, canat, well, bridge, spring, etc.
5. Landslide	1) Town, District, Village	
	2) Location Coordination	
	3) Date of Movement	
	4) Kind of Movement	
	5) Area	
	6) Main Cause	
	7) Lithology of Mass Movement	
	8) Damage	
	9) Classification of Risk	
6. Geological Feature and Geology	1) Elevation	Max. Min.
	2) Mountain area	
	3) Hilly area	
	4) River side terrace	
	5) Alluvial flat plain	
	6) Large scale fan	
	7) Special geological features	
7. Land Use	1) Irrigated farmland	Area by Land Use Category
	2) Non irrigated (dry) farmland	
	3) Forest	
	4) Forest with inter-cropping	
	5) Rock	
	6) Others	

Table 5-2-1 (2) Inventory Items

(continued)

Inventory Category	Inventory Items	Classification
8. Land Capability	1) Mountainous lands	Weighted Land Capability by Geographical Categories and Land Capability Index
	2) Hilly lands	
	3) Plateau and upper terraces	
	4) Piedmont plains	
	5) Elluvial fans	
	6) Lowlands	
	7) Gravelly colluvial fans	
	8) Gravelly river fans	
	9) Complexes	
	10) Land capability index	
9. Soil and Water Conservation Facility	1) Debris Barrages	
	2) Slope Stabilization	
	3) Contour Bands	
	4) Water Ways	
	5) Sediment Traps	
	6) Revegetation	
	7) Afforestation	
	8) Contour Tillage	
10. Erosion Class	1) Trace	9 classes by Erosion Amount
	2) Trace-Low	
	3) Low	
	4) Low-Fair	
	5) Fair	
	6) Fair-High	
	7) High	
	8) High-Severe	
	9) Severe	
11. Socio Economic Condition	1) Population	Population by rural and urban
	2) Households	Households by rural and urban
	3) EAP	Age 10 and over
	4) Unemployment Rate	Jobless
	5) Income Level	Agriculture & livestock income
12. Agriculture and Livestock	1) Agricultural Land	Irrigated land, Non-irrigated land
	2) Orchard	Irrigated land, Non-irrigated land
	3) Livestock	Sheep, Goats, Cows, Horses, etc.
13. Natural Vegetation and Environmental Reserve	1) Vegetation	Code, Area, Condition, Trend
	2) Carrying Capacity	Capacity for grazing
	3) Protected Area	Area
	4) National Park	Area
	5) Wetland	Area
	6) Genetic Reserve	Area
	7) National Nature Monument	Location

5.3 Data Arrangement for GIS

The GIS data preparation for this Study was carried out by acquiring the various kinds of required data then organizing all in ARC/INFO data format by integrating them in a common coordinate system. Data were acquired by field survey, SPOT (Panchromatic) satellite imageries, interpretation of aerial photos, existing data such as topographic and others. Following activities were employed for this:

5.3.1 Interpretation of Aerial Photos

The aerial photographs of ranging from 1991 to 1999 (scale 1:40,000) were interpreted for landslide and other features.

5.3.2 Analysis of SPOT Satellite Imageries

SPOT satellite imageries covering the whole Karoon watershed area were used in this Study for GCPs collection and interpretation purpose. Considering the steep slopes in the study area, to achieve more spatial accuracy, Digital Elevation Model (DEM) generated from contour data was employed to ortho-rectify the SPOT images. The ortho-rectified image data was used to transfer the thematic information so delineated on the aerial photographs.

5.3.3 Collection of Existing Data

Basically the collected existing data were those required for background and thematic maps. These include relatively wide verities of exiting data, both in form of digital and paper maps. Main collected data were topographic, administration, meteorological, land use, vegetation, land capability, erosion sensibility, dam location, flood location, protected area, and so on.

5.3.4 Preparation of Skeleton (Background) Data for 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 (altogether 8 main and 455 sub-basins), roads, major rivers, administration boundaries, lake/reservoir, and location of cities.

5.3.5 Preparation of Thematic Data for Maps

By combining the Interpretation as well as the existing map information, thematic data such as vegetation, land use, erosion sensibility (erodibility), land capability, land slide, meteorological and gauging station location, protected areas, dam, and flood location were prepared.

5.3.6 GIS Data Analysis

In order to facilitate an accurate overlay of two or more GIS data together, all the GIS data so received from different source with different coordinate (projection) systems were converted to the common system. Then, sub-basin data was overlaid with different thematic GIS data such as administration, vegetation, land use, land slide, land capability and others to know the area of various classes within a particular sub-basin.

5.3.7 Output of Maps

Based on above common coordinate system, the index map was prepared for 1:100,000 scaled maps. Using this index map, all the background data were overlaid first so that on its top, one or more thematic layers could be overlaid titling the map of that thematic (subject) data. Included thematic maps are land slide, vegetation, land use, land capability, erosion sensibility and so on.

6 SELECTION OF MASTER PLAN STUDY AREAS

6.1 Selection Criteria

There are many aspects to be considered for the selection criteria for candidate sub-basins, however, the following items are taken into consideration;

(1) Selection of Natural-disaster Area

Master plan areas are to be selected from the sub-basins where the certain scale of natural disaster hit and sizable damage occurred in recent years.

* Here, the disaster is confined to flood including debris flow, and landslides only.
* Flood including debris flow occurred in the latest 10 years and landslides occurred within 50 years are to be evaluated.

(2) Evaluation of Disaster Damage

Sub-basins where the certain scale of disaster hit and sizable damage occurred are to be selected, however, the following rule has been made for the evaluation of disaster damage.

a) Flood (including debris flow) Damage

It is rather difficult to evaluate the flood/debris flow damage in sub-basins, as the type of information obtained is not homogeneous and insufficient. However, in order to evaluate flood/debris flow damage with quantitative manner, the following rule is made as shown in Table 6-1-1.

Table 6-1-1 Rules of Evaluation (Flood and debris flow damage)

Order of Evaluation	Extent of disaster	Type of damage for evaluation
5	Severe	*Flood/debris flow in recent years + following 3 items Agriculture damage is more than 10 ha., Infra/ damage- more than 3 types including houses, Flood area / more than 2 village (location)
4	Very high	*Flood/debris flow in recent years, *Agriculture damage is more than 10 ha., *+ one out of the following 3 items* Infra/ damage- more than 2 types including houses, Flood area / more than 2 village (locations) Damage for human
3	High	*Flood/debris flow in recent years + one out of the following 4 items Agriculture damage is less than 10 ha (10~0), Infra/ damage- more than 2 types including houses, Flood area / more than 2 village (locations), Livestock Damage
2	Fair	*Flood/debris flow in recent years
1	Low	Flood/debris flow

b) Landslide Damage

The landslide damage is also evaluated based on the extent of landslide areas accumulated in respective sub-basin, as shown in the table below. In the Master Plan Areas, at least one sub-basin where severe landslide occurred should be selected.

Table 6-1-2 Rules of Evaluation (Landslide Area)

Order of Evaluation	Total landslide area per sub-basin (ha)
5	100.1~200.0
4	50.1~100.0
3	30.1~50.0
2	5.1~30.0
1	0~5.0

(3) 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.

(4) Evaluation for Soil Erosion

Soil erosion is important item and is to be evaluated after flood and landslide. In the soil erosion inventory, the extent of erosion is classified 9 stages and only the upper three stages (7 to 9) are to be evaluated. The extent of erosion is shown in the ratio (percentage) of eroded area to the sub-basin area, and the following rule is made for evaluation.

Table 6-1-3 Rules of Evaluation (Soil Erosion)

Order	Extent of erosion (7~9 stage)
5	More than 61 %
4	41 ~ 60 %
3	21 ~ 40 %
2	1 ~ 20 %
1	Less than 1%

(5) Necessity of Structural or Non-structural Countermeasures

Sub-basin where people are still living is the minimum requirement and, in addition to this, the following conditions are required;

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

There is no inventory on this item, therefore, based on the field reconnaissance and interview from provincial officials and the residents, the following rule for evaluation is made.

Table 6-1-4 Rules of Evaluation (Necessity of Countermeasures)

Order	Extent of Necessity
5	Very High
4	Relatively High
3	High
2	Identified
1	Low

(6) Possibility of Development

Sub-basins, which have sufficient water resources for development, are to be selected.

There is no inventory on this item, therefore, based on the field reconnaissance and interview from provincial officials and the residents, the following rule for evaluation is made.

Table 6-1-5 Rules of Evaluation (Possibility of Development)

Order	Availability for Water Resource
5	Abundant water resource is available easily
4	Water resource is available easily
3	Water resource is available
2	Water resource is insufficient & new source is required
1	New water source is required

(7) Land Capability

Land capability is also examined from the viewpoint of topography and soil conditions in connection with the land use.

Referring to the land capability inventory, the total land capability index is generally in proportion to the size of the sub-basin. In order to evaluate the land capability, the ratio of land capability index over sub-basin area is worked out and classified as follows.

Table 6-1-6 Rules of Evaluation (Land Capability)

Order	Ratio of land capability index over sub-basin area
5	More than 1.3
4	1.2
3	1.1
2	1.0
1	Less than 1.0

(8) Accessibility and Propagation

The minimum requirement for sub-basins should be accessible by road, and the following conditions are reviewed in order to evaluate the effects of propagation.

* Sub-basins located at the appropriate distance from provincial capital or district center (for example, Semirom to Esfahan Province and Izeh to Khuzestan Province)
* Sub-basins located near the main road
* Sub-basins where the road condition is good
* Sub-basins where similar disaster areas are located at surrounding area
*Sub-basins where the residents strongly request to the provincial office for remedial work

There is no inventory on this item, therefore, based on the conditions abovementioned, the following rule is made.

Table 6-1-7 Rules of Evaluation (Accessibility and Propagation)

Condition	Point	Condition	Point
Relatively close to either provincial capital or regional center	1	Rather far from either provincial capital or regional center	0
Close to the main road	1	Far from the main road	0
Access to the site is good	1	Access to the site is poor	0
Similar disaster areas are located nearby	1	Similar disaster areas are not located	0
Request for remedial work from the residents	1	Either no request or uncertain	0

6.2 Selection of Master Plan Areas

(1) Selection of Natural-disaster Areas

Natural-disaster areas were selected from the flood (including Debris flow) damage and landslide inventories.

(2) Evaluation on Flood (including debris flow) Damage and Landslides

Landslide damage is also shown in the inventory, however, the remarks do not cover all the records

and some records are not clarified. Thus, this inventory item is not sufficient enough to evaluate all the basins and to be used reference only. On the other hand, the items of landslide area and classification of risk cover all the records and these two items are used for evaluation of landslides. The indices for evaluation of landslides are as follows;

- Total landslide area in each sub-basin
- Rate of total landslide area per sub- basin
- Total figures multiplied landslide area by classification of risk (risk index)

Based on the selection criteria, evaluation on flood (including debris flow) damage and landslides has been made as shown in Tables 6.2.1 and 6.2.2 in the Main Report.

(3) Sorting of Sub-basins and Selection from Each Province

Sub-basins with flood (including debris flow) damage or landslides listed in Tables 6.2.1 and 6.2.2 are sorted out into respective provinces and the results are shown in Tables 6.2.3 and 6.2.4 in the Main Report. Then, the selection of Master Plan Areas is conducted for each province as follows.

a) Chaharmahal va Bakhtiyari Province

The natural disaster areas in Chaharmahal va Bakhtiyari Province are shown in Table 6.2.3 in the Main Report. There are 73 disaster areas in the Province, which consists of 52-flood damage area, 32-landslide areas and 11-duplicated areas. The detail is as follows;

Table 6-2-5 Results of Evaluation (1) : Chaharmahal va Bakhtiyari Province

Order	Number of disaster sub-basin	
	Flood/debris flow	Landslide
5	2	1
4	3	1
3	15	2
2	8	8
1	19	20

Sub-basins with the order of more than "4"on flood/debris flow damage and landslides are selected for further evaluation with other criteria, and the result is shown in the following table;

Table 6-2-6 Results of Evaluation (2) : Chaharmahal va Bakhtiyari Province

Sub-basin	Disaster		Ero-Sion	Necessity of Counter-measures	Develop-ment Possibili-ty	Land Capa-bility	Access/Propagation					Total	Order
	Flood/ debris flow	Land-slide					1	2	3	4	5		
K2-1	5	1	5	2	2	3	1	1	1	1	1	23	4
K3-1-14a	-	5	2	1	1	2	0	0	1	1	1	14	7
K3-1-16	4	-	1	5	5	5	1	1	1	1	1	25	2
K3-3-2e	-	4	5	3	2	5	1	1	1	1	1	24	3
K4-1-9	4	-	4	5	5	5	1	1	1	1	1	28	1
K7-0-3	4	-	2	3	3	5	0	0	0	1	0	18	5
K7-0-5	5	1	1	4	3	2	0	0	0	1	0	17	6

As for the sub-basin of K3-1-14a, the village "Chelo", where huge landslides occurred and the village itself had already abandoned, belongs to this basin, so that the Necessity of countermeasures and the Development possibility are evaluated low marks.

b) Esfahan Province

The natural disaster areas in Esfahan Province are shown in Table 6.2.4. There are 17 disaster areas in the Province, which consists of 14-flood damage area, 8-landslide areas and 5-duplicated areas. The detail is as follows.

Table 6-2-7 Results of Evaluation (1) : Esfahan Province

Order	Number of disaster sub-basin	
	Flood/debris flow	Landslide
5	0	2
4	2	0
3	1	0
2	10	2
1	1	4

Sub-basins with the order of more than "4"on flood/debris flow damage and landslides are selected for further evaluation with other criteria, and the result is shown in the following table;

Table 6-2-8 Results of Evaluation (2) : Esfahan Province

Sub-basin	Disaster		Ero-Sion	Necessity of Counter-measures	Develop-ment Possibili-ty	Land Capa-bility	Access/Propagation					Total	Order
	Flood/ debris flow	Land-slide					*1*	*2*	*3*	*4*	*5*		
K7-0-10-1	4	-	1	3	2	5	0	0	0	1	0	16	4
K7-0-18	4	2	1	3	2	5	1	0	1	1	1	21	3
K7-0-19-1	2	5	2	5	4	5	1	0	1	1	1	27	1
K7-0-24	2	5	3	5	4	5	0	0	1	0	1	26	2

There are two sub-basins having the evaluation on landslide of "5". The sub-basin of K7-0-19-1 is located close to the district center, Bideh, whereas, that of K7-0-24, located on the border of the basin boundary of the Study area, is rather far from the center.

c) Kohgiluyeh va Boyerahmad Province

The natural disaster areas in Kohgiluyeh va Boyerahmad Province are shown in Table 6.2.4. There are 8 disaster areas in the Province, which consists of 3-flood damage area, 5-landslide areas. The detail is as follows.

Table 6-2-9 Results of Evaluation (1) : Kohgiluyeh va Boyerahmad Province

Order	Number of disaster sub-basin	
	Flood/debris flow	Landslide
5	0	0
4	0	2
3	1	0
2	0	3
1	2	0

Sub-basins with the order of more than "3"on flood/debris flow damage and landslides are selected for further evaluation with other criteria, and the result is shown in the following table;

Table 6-2-10 Results of Evaluation (2) : Kohgiluyeh va Boyerahmad Province

Sub-basin	Disaster		Ero-sion	Necessity of Counter-measures	Develop-ment Possibili-ty	Land Capa-bility	Access/Propagation					Total	Order
	Flood/ debris flow	Land-slide					1	2	3	4	5		
K7-48	3	-	3	5	5	4	1	1	1	1	1	25	1
K7-30	-	4	2	5	2	1	0	0	1	0	1	16	2
K7-37-5a	-	4	2	3	2	2	0	0	1	1	0	15	3

There are two sub-basins having the evaluation on landslide of "4". The both sub-basins are located rather far from the Provincial capital, Yasuj.

d) Khuzestan Province

The natural disaster areas in Khuzestan Province are shown in Table 6.2.4. There are 13 disaster areas in the Province, which consists of 3-flood damage area, 12-landslide areas and 2-duplicated areas. The detail is as follows.

Table 6-2-11 Results of Evaluation (1) : Khuzestan Province

Order	Number of disaster sub-basin	
	Flood/debris flow	Landslide
5	0	0
4	0	0
3	1	1
2	3	4
1	0	7

Sub-basins with the order of more than "2"on flood/debris flow damage and landslides are selected for further evaluation with other criteria, and the result is shown in the following table;

Table 6-2-12 Results of Evaluation (2) : Khuzestan Province

Sub-basin	Disaster		Erosion	Necessity of Counter-measures	Development Possibility	Land Capability	Access/Propagation					Total	Order
	Flood/debris flow	Land-slide					*1*	*2*	*3*	*4*	*5*		
K8-13b	3	-	1	1	5	1	0	0	1	1	1	13	5
K8-25-1b	2	2	4	3	2	3	1	1	1	1	1	21	2
K8-28	2	1	4	5	3	5	0	0	1	1	1	23	1
K3-0b	-	2	2	3	3	5	1	1	1	1	0	19	3
K8-22	-	2	1	3	3	1	1	1	1	1	0	14	4
K8-27	-	2	2	3	3	1	0	0	0	0	0	11	7
K8-29	-	3	2	3	3	1	*0*	*0*	*0*	*0*	*0*	*12*	*6*

As for the flood/debris flow damage, there is only one sub-basin (K8-13b) having higher order of evaluation "3" among the selected sub-basins, however, the villages in this sub-basin are generally developed on the flood plain of the Karoon River. On the upstream of this sub-basin, Karoon No.3 Dam is now under construction and the flood damage will be reduced to a great extent after the completion of dam. Thus, the Necessity of countermeasures is evaluated low marks.

On the other hand, as for the landslide, there is only one sub-basin (K8-29) having higher order of evaluation "3" among the selected sub-basins, however, this sub-basin is not accessible by road. Thus, the access/propagation effects are evaluated with zero.

e) Selected Master Plan Areas from Respective Provinces

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, K7-0-19-1, and altogether, five sub-basins are selected and tabulated as follows;

Table 6-2-13 Results of Evaluation: Total

Province	Sub-basin	Disaster		Erosion	Necessity of Counter-measures	Development Possibility	Land Capability	Access/Propagation					Total
		Flood/debris flow	Land-slide					*1*	*2*	*3*	*4*	*5*	
Chaharma-hal	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

6.3 Selected Master Plan Areas

According to the criteria and the procedure described in the previous sections, five sub-basins shown

in the following table were selected.

Table 6-3-1 Selected Master Plan Study Areas (Results of Evaluation)

Name	No.	Area(km^2)	Province
1. Aziz abad	K3-1-16	52.5	Chaharmahal
2. Vastegan	K4-1-9	67.0	Chaharmahal
3. Kolbeluk	K7-0-19-1	63.1	Esfahan
4. Tang Sorkh	K7-48	65.4	Kohkilouyeh
5. Zeras	K8-28	63.7	Khuzestan

The Study Team proposed to take up the above 5 sub-basin as the master plan study area in the Interim Report. However, WMD insisted to take up Chaman Goli-Bazoft instead of Aziz abad in the discussion on Interim Report, because Chaman Goli-Bazoft has already been designated as strategic growth point. This area is remote, and it takes more than 4 hours by car from Shahr-e-kord. It is considered that implementation of the project in this area would have less propagation effects. In due consideration of the situation, development potentiality and willingness of the inhabitants, the Study Team accepted the proposal of WMD to take up Chaman Goli-Bazoft as master plan study area.

WMD requested the Study Team to extend the area of Kolbeluk and to include the adjacent area of south. They also requested to change the name from Kolbeluk to Sarbaz. The Study Team accepted these request.

Finally WMD and the Study Team agreed to undertake the master plan study on 5 areas listed in the following table.

Table 6-3-2 Selected Master Plan Study Areas (Final)

Name	No.	Area(km^2)	Province
1. Vastegan	K4-1-9	67.0	Chaharmahal
2. Chaman Goli-Bazoft	K5-19-a	113.1	Chaharmahal
3. Sarbaz	K7-0-19-1	154.5	Esfahan
4. Tang Sorkh	K7-48	65.4	Kohkilouyeh
5. Zeras	K8-28	63.7	Khuzestan

7 SOCIO-ECONOMIC FRAME

7-1 National Frame

7.1.1 Population

After the Islamic Revolution in 1979, Iran faced a significant population growth nevertheless the war against Iraq was fought. Average annual growth rate between 1976 and 1986 was as high as 3.91 percent/annum. This tendency, however, is slightly improved after 1986, and the average annual growth rate is improved 2.46 percent/annum between 1986 and 1991 and 1.45 percent/annum between 1991 and 1996, resulting 1.96 percent/annum between 1986 and 1996.

In one hand, further population growth is anticipated as there is not much family planning measures taken and public services improved. On the other hand, some negative factors especially the recent stagnation of the national economy and diffusion of education might check the tendency.
There is another factor in discussing population growth of Iran that the recent population growth is mainly occuring in urban area and rural area is, until now, left behind the tendency.

Therefore, it is roughly estimated the population of Iran in 2010 and 2020 as follows, considering the average anuual population growth rates to be 2.4 percent/annum until 2010 and 2.0 percent/annum between 2010 and 2020.

Population in 1996	60.1 million (Census figure)
Population in 2000	66.0 million
Population in 2010	83.7 million
Population in 2020	102.0 million

7.1.2 Economy

As has been already discussed in the Interim Report, Iran's economy has been characterized by its huge dependence on the oil exportation and the fluctuation of oil price in the international market seriously affects its economic performance. As is shown in Table 7-1-1 the real GDP has enjoyed significant growth of 19.9 % and 17.4 % in 1994 and 1995 mainly due to the rapid growth of Oil sector. In 1996, this tendency was somewhat checked notwithstanding the favorable condition of international oil price to 5.8 % but it recovered to 10.2 % in 1997. Not only the oil price but also other international market suffered general stagnant condition and Iran's exchange rate to US$ sharply

decreased from 3,000 Rials/$ to 5,500 Rials/$ in 1998 (it further decreased to 7,900 Rials/$ in 1999) the real GDP experienced negative growth of 4.4 % compared to the previous year. Due to the steady growth of non-oil sectors such as Manufacturing, Construction and Real Estate, 1999 growth rate managed to recover positive growth rate of 3.2 % in 1999. According to the Central Bank of Iran (Bank Markazi),the real GDP growth in the fiscal year 1999/2000 registered 2.4% (in factor cost) with the major part contributed by non-oil sectors.

Table 7-1-1 GDP at 1988 Constant Prices (Real GDP)

(unit : Billion Rials)

	1993	1994	1995	1996	1997	1998	1999
Agriculture	2,650.5	3,120.2	3,688.4	3,822.9	3,957.6	4,333.6	4,320.6
Mining	62.3	68.4	84.2	88.2	91.0	94.6	98.4
Manufacturing	1,148.0	1,940.3	2,180.6	2,320.1	2,510.3	2,560.5	2,624.5
Oil	1,403.0	2,516.7	2,517.8	2,566.0	2,430.0	2,410.4	2,386.3
Water, Electricity and Gas	173.5	285.0	397.3	424.9	443.9	466.8	490.1
Construction	648.9	508.3	623.8	707.8	686.0	613.4	687.0
Trade, Restaurant and Hotel	1,045.1	1,257.9	1,363.4	1,467.5	1,564.9	1,614.3	1,645.0
Transport, Storage and Communications	785.5	925.5	1,105.6	1,167.2	1,345.4	1,306.8	1,372.1
Financial and Monetary Institutions	113.0	128.0	137.3	135.0	136.2	148.2	151.2
Real Estate, Specialized and Professional Services	1,249.4	1,383.5	1,777.5	1,804.0	1,730.8	1,756.8	1,834.1
Public Services	1,226.1	921.9	1,239.4	1,393.1	1,471.5	1,407.0	1,498.5
Social, Personal and Household Services	235.6	329.1	401.4	372.3	360.1	366.5	380.1
Less : Imputed Bank Service Charge	*48.4*	*120.7*	*58.3*	*76.7*	*29.5*	*32.1*	*32.8*
Terms of Trade Adjustment	*-830.8*	*-1,439.3*	*-1,574.4*	*-1,498.3*	*-1,503.8*	*-1,572.8*	*-1,487.3*
Gross Domestic Product (at 1988 constant prices)	9,861.7	11,824.8	13,884.0	14,694.0	16,194.4	15,474.0	15,967.8
% Increase compared to the previous year	-	19.9	17.4	5.8	10.2	-4.4	3.2

Source : Central Bank of the Islamic Republic of Iran, Iran Statistical Yearbook 1378(March 1999 - March 2000)

Recent issue is stagnant condition of Agriculture Sector, which has been contributed almost one-quarter of the national economy until 1995. Its share dropped to around 20 % of GDP during 1996 and 1997 and after relatively better performance in 1998, the sector suffered decrease of production mainly due to last year's severe draught. Rain-fed crops have failed and fodder production and livestock grazing have become unavailable. The draught conditions have still persisted until now and agricultural sector's recovery is not much expected. In fact, according to "Economic Trends", agriculture sector's growth in 2000 is only 0.3 % compared with the previous year.

As such, it is difficult to forecast the frame of national economy of the near future because international market conditions especially oil price is stagnant and one can not tell when the draught condition comes to an end. According to the "Third Socio-Economic and Cultural Development Plan 2000-2004", target growth rate is set at 6.0 percent/annum which is much higher than that of the previous Plan's 5.1 percent/annum. Considering the performance of previous Plans are lower than the targets and the growth rate of real GDP in 2000 is estimated to be 2.4 %, it may be difficult to attain the target figure stated in the current Plan unless considerable improvement in international market prices (especially oil price) occurs and considerable efforts to improve agricultural products be

taken place.

7.1.3 Content of Current Development Plan

Current Development Plan is "The Third 5-year Ecoonomic, Social and Cultural Development Plan" which came into effect in March 2000. For the implementation of current Plan, "The Third Development Plan Law" was passed and fund resources have been secured for the allocation to the various programmes and projects in the Plan.

Table 7-1-3 Comparison of Development Plans

	Plan Period	Target Growth Rate	Performance
First 5-year Plan	1989 - 1993	8.1 percent/annum	7.3 percent/annum
Second 5-year Plan	1994 - 1999	5.1 percent/annum	3.2 percent/annum
Third 5-year Plan	2000 - 2004	6.0 percent/annum	-

In determining the programmes and projects, fundamental consideration is given to economic development of the country. Social and Cultural aspects are emphasized to perform the society for attaining above target in practical and legal way.

7.1.4 Watershed Management and Rural Development Policies and Strategies in the Current Development Plan

(1) Watershed Management Policies and Strategies as the National Frame

This section is reffered in Chapter 13 Water and Agriculture Sector of which strategic policies are as follows;

a) Emphais on generalization and reduction of roles of the Government in order to optimize the office structure and organization.
b) Prevention of degradation, conservation, restoration, development and optimal exploitation of basic natural resources, so as to achieve substantial development.
c) Optimal exploitation of boundary rivers and common water resources.
d) Human resources development and optimization of production factors and resources.
e) Enhancement of capital security, and investment promotion.
f) Stabilization and secured support of production.
g) Improvement of exploitation system, so as to economize the scale of exploitation units.
h) Development of employment opportunity, by alterating agricultural activities.
i) Priority on education and research, and promotion and support of information system.
j) Development of agricultural product exportation.

On the basis of above strategic policies, "Executive Policies" and "Executive Strategies" for the Water and Africulture Sector have been formulated.

"Executive Policies" delineate financial arrangement to secure resources for the investment to various Plan programmes, guidance for optimal water exploitation by water users, and advantage to encourage private sector in investment in water resources development projects.

"Executive Strategies" for the Water and Agricultural Sector emphasizes 27 items in total, in which description on Watershed Management related one is found in the 10th item (priority No. 10 out of 27 items). It says that;

{Executive Strategies-10}
"Watershed management for the conservation and exploitation of soil and water resource, in the river basin having water supply projects (completed or on-going) shall be the priority to be implemented."

This description means "Watershed Management" occupies rather a fair significance in the Water and Agriculture Sector in the context of national development. It should be noted that the above {Executive Strategies-10} calls for the implementation of watershed management project specifically relating to water supply projects in the surrounding areas: which suggests a close relationship between watershed management and water resources management. So, it should be said that the {Executive Strategies – 10} is the national-level frame in formulating watershed management plans and projects. All the programmes and projects should be conducted in line with the above strategies.

(2) *Rural Development Policies and Strategies*

The Third 5-year Development Plan also provides Strategic policies and Executive Policies for Rural Development with the consideration of present conditions and future perspectives. Executive Policies, in its stipulations, give the activities and mandates of the Government /Public institutions in charge of Rural Development. The analysis has been carried out both for ordinary farming villages and the tribal (nomadic) societies.

7.2 Provincial Frame

7.2.1 Provincial Population

Table 7-2-1 Estimated Population by concerned Provinces

Province		Target Years			Applied An. Av. Growth Rates*		
		2001	2010	2020	1996/2001	2001/2010	2010/2020
Chaharmahal	**Total**	**855,450**	**1,056,460**	**1,329,740**	*2.36*	*2.37*	*2.33*
va	Urban	428,550	609,960	860,410	***4.56***	***4.00***	***3.50***
Bakhtiyari	Rural	426,900	446,500	469,330	***0.47***	***0.50***	***0.50***
Esfahan	**Total**	**4,306,230**	**5,104,940**	**6,236,170**	*1.88*	*1.91*	*2.02*
	Urban	3,315,650	4,140,790	5,300,560	***2.61***	***2.50***	***2.50***
	Rural	990,580	964,150	935,610	***-0.33***	***-0.30***	***-0.30***
Kohgiluyeh	**Total**	**646,200**	**886,390**	**1,241,110**	*3.49*	*3.57*	*3.42*
va	Urban	295,770	499,700	813,960	***6.73***	***6.00***	***5.00***
Boer Ahamad	Rural	350,430	386,690	427,150	***1.16***	***1.10***	***1.00***
Khuzestan	**Total**	**4,442,650**	**6,082,110**	**8,419,530**	*3.47*	*3.55*	*3.31*
	Urban	3,047,400	4,528,730	6,703,630	***4.91***	***4.50***	***4.00***
	Rural	1,395,250	1,553,380	1,715,900	***1.23***	***1.20***	***1.00***

* 1996/2001 figures are those of 1986/1996 ones (as shown in the previous

7.2.2 Provincial Economy

Shares against national total in agricultural major crops and livestocks of each Provinces are shown in Table 7-2-2. Because of the severe draught during 1998 and 1999, production of major crops decreased significantly as are shown in Table 7-2-3. However, Provincial shares in each items can be observed as the draught covered the whole country and has given almost same damages to each Provinces.

Table 7-2-2 Major Crops and Livestocks of Concerned Provinces (1999/2000)

Crops/ Livestocks	Content	Unit	Total Country	Chaharmahal va Bakhtiyari	Esfahan	Kohgiluyer va Boer Ahamad	Khuzestan
Wheat	Area under Cultivation	1,000 ha	4,739 (100.0 %)	64 (1.4 %)	124 (2.6 %)	58 (1.2 %)	353 (7.4 %)
	Production	1,000 tons	8,673 (100.0 %)	122 (1.4 %)	404 (4.7 %)	57 (0.7 %)	933 (10.8 %)
Barley	Area under Cultivation	1,000 ha	1,403 (100.0 %)	30 (2.1 %)	52 (3.7 %)	37 (2.6 %)	97 (6.9 %)
	Production	1,000 tons	1,999 (100.0 %)	25 (1.3 %)	192 (9.6 %)	17 (0.9 %)	89 (4.5 %)
Rice	Production	1,000 tons	2,348 (100.0 %)	16 (0.7 %)	90 (3.8 %)	44 (1.9 %)	147 (6.3 %)
Apple	Production	tons	2,137,041 (100.0 %)	10,337 (0.5 %)	271,008 (12.7 %)	29,461 (1.4 %)	52 (0.0 %)
Grape	Production	tons	2,342,111 (100.0 %)	55,316 (2.4 %)	65,625 (2.8 %)	14,899 (0.6 %)	2,339 (0.1 %)
Sheep	Number	1,000 heads	37,420 (100.0 %)	579 (1.5 %)	1,234 (3.3 %)	507 (1.4 %)	2,602 (7.0 %)
	Holdings	100 holdings	11,938 (100.0 %)	162 (1.4 %)	489 (4.1 %)	150 (1.3 %)	445 (3.7 %)
Goats	Number	1,000 heads	18,923 (100.0 %)	331 (1.7 %)	572 (3.0 %)	910 (4.8 %)	1,570 (8.3 %)
	Holdings	100 holdings	10,881 (100.0 %)	164 (1.5 %)	359 (3.3 %)	321 (3.0 %)	534 (4.9 %)
Cattle	Number	1,000 heads	5,128 (100.0 %)	92 (1.8 %)	227 (4.4 %)	59 (1.2 %)	373 (7.3 %)
	Holdings	100 holdings	13,764 (100.0 %)	339 (2.5 %)	715 (5.2 %)	203 (1.5 %)	897 (6.5 %)
Red Meat	Production	1,000 tons	721 (100.0 %)	23 (3.2 %)	40 (5.5 %)	12 (1.7 %)	40 (5.5 %)
Milk	Production	1,000 tons	5,564 (100.0 %)	140 (2.5 %)	57 (1.0 %)	196 (3.5 %)	290 (5.2 %)
Poultry	Production	1,000 tons	725 (100.0 %)	9 (1.2 %)	67 (9.2 %)	4 (0.6 %)	30 (4.1 %)
Eggs	Production	1,000 tons	570 (100.0 %)	5 (0.9 %)	35 (6.1 %)	3 (0.5 %)	11 (1.9 %)

Source : Statistical Center of Iran "Iran Statistical Yearbook 1378"

Table 7-2-3 Changes of Major Crops/Products in recent years

Major Item	Crop Year						
Production	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000
Wheat	10,732	10,870	11,228	10,015	10,045	11,955	8,673
Barley	3,058	3,045	2,952	2,736	2,499	3,301	1,999
Rice	2,281	2,259	2,301	2,685	2,350	2,771	2,348
Red Meat	500	595	685	685	720	747	721
Milk	3,530	4,035	4,705	4,705	4,895	5,105	5,564
Poultry	390	420	637	676	712	696	725
Eggs	300	340	467	486	470	498	570

Source : Central Bank of Iran, Ministry of Agriculture

In general, meats, milk and poultry production is increasing steadily. This tendency can be applied to each Provinces concerned here.

7.3 Master Plan Areas

7.3.1 Provisional Population Forecast

(1) Present Population

According to the Village Survey conducted by the Study Team in July/August 2001, present population of five (5) Master Plan Areas is verified as shown in Table 7-3-1.

Table 7-3-1 Present Population of the Master Plan Areas

Master Plan Area	Sub-Basin	Propurlation (pp.)		
		Villagers	*Nomads*	*Total*
Vastegan	K4-1-9	3,700	760	4,460
Chaman-Goli Bazaft	K5-19a	5,906	2,510	8,416
Sarbaz	K7-0-19-1	5,030	5,845	10,875
Tang Sorkh	K7-0-19-1	1,158	713	1,871
Zerass	K7-48	2,344	0	2,344
TOTAL	K8-28	18,138	9,828	27,966

Source : "Village Survey" by the Study Team (July/August, 2001)

(2) Provisional Population Forecast

a) Forecast of Population Growth Rates during the Project Term

Considering the above information and the socio-demographic condition of each Master Plan Areas, following average annual growth rates are tentatively projected.

Table 7-3-2 Projected Population Growth Rates

Master Plan Area	Av.An.Growth Rate (%/ annum)	
	2001/2010	2010/2020
Vastegan	0.89	0.89
Chaman-Goli Bazaft	2.48	2.00
Sarbaz	3.21	2.00
Tang Sorkh	0.85	0.85
Zeras	0.01	0.01

b) Projected Population of Master Plan Area

Projected populations of years 2010 and 2020 for each Master Plan Areas are shown as below.

Table 7-3-3 Projected Population of Master Plan Areas

Master Plan Area	Year	Tatget Years	
	2001	2010	2020
Vastegan	4,460	4,830	5,280
Chaman-Goli Bazaft	8,416	10,490	12,790
Sarbaz	10,875	14,450	17,610
Tang Sorkh	1,871	2,020	2,200
Zeras	2,344	2,350	2,350
TOTAL	27,966	34,140	40,230
(Av.An.Groouwth Rate:%)	-	*2.24*	*1.65*

7.3.2 Income Level

(1) Present Income Level

As the Master Plan Area is defined by sub-basin basis and does not necessarily cope with the administrative and/or statistical boundary, not much information/data is available for defining the trends of income level of the households within the area. However, by utilizing the results of the Inventory Survey conducted at the Phase I Study and the Village Survey in July/August 2001, present income level of households within the Master Plan area can be summarised as shown in Table 7-3-4.

Table 7-3-4 Income Level of Master Plan Areas

(unit : 1,000 Riyals/household/year)

Master Plan Area	sub-basin	1996 Census (Inventory Survey)			2001 (Village Survey)		
		Agricultural Income	Livestock Income	Total Income	Agricultural Income	Livestock Income	Total Income
Vastegan	K4-1-9	707	9,814	10,521	5,774	5,077	10,851
Chaman-Goli Bazoft*	K5-19a	209	7,529	7,738	587*	901*	1,488*
Sarbaz	K7-0-19-1	420	2,192	2,612	20,455	6,517	26,972
Tanghe Sorkh	K7-48	208	2,192	2,400	2,323	3,345	5,668
Zeras	K8-28	503	4,195	4,698	6,843	6,113	12,957

* Figures of Chaman-Goli Bazoft in 2001 may need verification as they are less than one-fifth of 1996 figures.

(2) Provisional Forecast of Income Level

Based on the following assumption, income level (of average households) in the target year (2020) of each Master Plan Areas is estimated as shown in Table 7-3-5.

Table 7-3-5 Projected Income Level by Master Plan Area

(unit : 1,000 Riyals/household/year)

Master Plan Area	sub-basin	2001 Base Income	*Av. An. Growth Rate (%)*		Income Level in 2020	
			Projected Rate	*80% Performed*	Ideal Growth	Actual Growth
Vastegan	K4-1-9	11,000	*6.0*	*4.8*	33,280	26,800
Chaman-Goli Bazoft	K5-19a	8,000	*6.0*	*4.8*	24,200	19,500
Sarbaz	K7-0-19-1	27,000	*6.0*	*4.8*	81,690	65,800
Tanghe Sorkh	K7-48	6,000	*6.0*	*4.8*	18,150	14,600
Zeras	K8-28	13,000	*6.0*	*4.8*	39,330	31,680

8 THE PROJECT AREA

8.1 Natural Condition

8.1.1 Location

Vastegan locates in the lower Vanak basin and the distance from Share Kord is about 65 km in south-east direction. Chaman Goli-Bazoft locates on the right bank of Bazoft River in the middle of Bazoft basin and the distance from Share Kord is about 80 km in west direction. Sarbaz locates on the left bank of Marboreh River and distance to Semiron is about 55 km in the north, about 30 km to Yasuj in the south. Tang Sorkh locates along Boshar River in the upper Boshar basin and distance from Yasuj is about 30 km in the south-east. Zeras locates on the right bank of Karoon River in the middle Karoon basin. General features of Master Plan areas are summarized as below.

Table 8-1-1-1 General Features of 5 Master Plan areas

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^2)	89.9	113.2	154.5	65.4	63.7
Longitude	51°02'00" - 51°10'00"	49°55'30" - 50°42'30"	51°32'30" - 51°42'00"	51°42'30" - 51°52'30"	50°13'00" - 50°22'00"
Latitude	31°50'00" - 31°43'00"	32°17'25" - 32°07'30"	30°58'00" - 30°47'00"	30°30'00" - 30°22'30"	31°40'00" - 31°33'00"
Plain Name	Boroujen -Sepidasht	Dareh Bazoft Khersan	Kahardan	Yasuj-Sisahkt	Dareh Bazoft Kersan
Main Tributary	Vanak	Bazoft	Marboreh	Marboreh	Karoon
Province	Chahar Mahal & Bakhtiari	Chahar Mahal & Bakhtiari	Esfahan	Kohgiluyeh va Boyerahmad	Khuzestan
District /Township	Gandoman /Boroujen	Bazoft /Farsan	Padena /Semiron	Central /Yasuj	Dehdaz /Izeh

8.1.2 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 Gela River, which originates in the mountains, enters the plain just near the Vastegan village. 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. River terraces and fans are developed locally at a small scale in areas adjoining the mountainous district in the western part of the Vastegan area.

b) Chaman Goli-Bazoft

About 85% of the Bazoft area is represented by mountain belt, whose altitude ranges between 1500 and 3000 m. The land features there are controlled by the geological structures and the distribution of rock strata. The Bazoft area extends along N-S direction. 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.

In contrast, the eastern side has ridges with lower altitudes 1500-2000 m. This side has generally smooth land features, which are used for grazing. Each tributary system constituting the drainage basin within the mountain region has a fan-like catchment area. Landforms such as small-scale fans, several levels of terraces, and scarps are seen along the tributaries. Within the eastern slopes dominated by sandstone, there is a narrow but long zone characterized by gullies with numerous scarps. Cases of minor debris flows that occurred some years ago and caused damage to houses located downstream are known.

c) Sarbaz

The Sarbaz area may be divided into two drainage basins, the northern basin includes the Sarbaz and Noorabad villages and the main drainage basin joining the major river at a point located at about 2.5 km upstream from the confluence. The southern basin incorporates Devergan, Kahangan, and Dangaz Loo villages.The eastern end of the mountain zone forming the Sarbaz 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. River terraces occur along the main river as well as its branches as steps forming up to three levels

d) Tang Sorkh

Within the Tang Sorkh area, the main river flows from SSE to NNW. A major tributary originating in

the east flows into this river at Tang Sorkh. The main river carries a vast amount of load during floods. However, 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, and it is used for supplying water to the fishculture ponds and also to irrigate the paddy fields located downstream.

Within an altitudinal range of 2200-2800 m along this tributary, there is a mountain area with gentle slope used for grazing. They may undergo secondary failure generating debris flows especially at times of snow-melting and concentrated downpours. Extensive damages by such processes to the drinking water canal, built over detrital deposits in the vicinity of Tang Sorkh, are evident.

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. On the other hand, large landslides and collapses are conspicuous within the belt adjacent to the main river. There are numerous landslides and collapses, although at a rather small-scale, along the tributaries.

8.1.3 Geology

There are two geological divisions: unconsolidated sediments formed during or after the Quaternary Diluvial age and the bedrock of Tertiary or older age. The unconsolidated sediments show conspicuous features that are relevant to the disasters induced by natural or man-made forces. They are briefly described below.

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.

Detrital deposits:

The detritus, which is mainly represented by angular clasts of 5-100 cm diameter, moving downslope from elevated parts constitutes these deposits. Such deposits have a low degree of compaction. Their lower parts (e.g. toes) may be cut off by river erosion or man-made forces during construction of roads or other public structures leading to slope instabilities or subsequent damages to the water canals or structures alike. If the hazards occurring at a small-scale are also taken into account, they are ubiquitous.

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.

Debris flow deposits:

These deposits are mainly composed of breccia of hard limestone. Although natural disasters in the past occurred in Tang Sorkh and Sarbaz, the latter requires attention in future. Although numerous sites within the Kroon catchment are known for the occurrences of the sediment debris flows in the past, they are not seen in areas other than those considered under the current pilot investigations. In general, these flows originate in areas characterized by hard limestone

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

In all five areas considered under the pilot plan, the unconsolidated deposits exhibit similarities in terms of the scale and mode of distribution of the unconsolidated deposits. However, there is a limited distribution of the large-scale debris flows and also the alluvial deposits that were derived by landslides. The bedrock types and their modes of occurrences in each pilot area have been given in Tables that summarize the geologic details. Hard limestone, which occurs in widely varying modes that range from massive to bedded, is the most widely occurring bedrock type. Marl, sandstone and conglomerate represent the other widely occurring lithologies. Rocks such as shale, dolomite and gypsum have a limited occurrence.

Limestone-dominated areas exhibit the presence of detrital deposits comprising boulders, whose linear dimensions vary between 30 cm to several meters. Such deposits were formed by the weathering of the surficial rock layer. Locally, they are prone to debris flow. In many cases, the colluvial blocks seem to have been derived by the past debris flows.

Areas characterized by marls that form peculiar landforms, exhibit features related to surface erosion and frequent land sliding. Here, most of the landslides are small and they could be managed by control and restraint works. However, any disaster reduction and prevention measures to be taken within a particular area should pay attention to a proper balance among the land use conditions, development objectives, and the risk factor involved.

8.1.4 Soil

Soil survey was carried out in order to grasp soil properties and infiltration rate for establishing development plan and soil and water conservation plan in the study area. Laboratory analysis is also carried out to grasp texture and chemical properties.

a) Vastegan

Vastegan sub-basin can be divided into two clear different basins. One is upper mountain area and the other is 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)Hapic 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 (FAO-UNESCO 1989). Soil texture is moderate to heavy and permeability is moderate to slow at most area.

b) Chaman Goli-Bazoft

Three soil units are observed in Chaman Goli-Bazoft, namely 1)Vertic Cambisols in hills, 2)Haplic Kastanosems in old alluvial fans and 3)Calcaric Cambisols in plateaus. All soils are heavy to very heavy in texture and slow in subsoil permeability. Soil depth is deep to very deep and soil contains stones and gravel in high percentage.

c) Sarbaz

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. Calcaric Cambisols and Haplic Calcisols are slow in permeability and heavy in texture. Soil depths are shallow in higher location and deep to very deep in lower location. Eutric Loptosols is marly and medium in permeability and texture, and soil depth is very shallow. Calcaric Regosols is gravelly texture and rapid in permeability.

d) 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. Eutric Leptosols contains high percentage of stones and soil depth is very shallow. Calcaric Cambisols is heavy in texture and it contains high percentage of gravel and stone.

e) Zeras

Zeras is formed mostly by very steep slope and flat area is very scarce. Red colour soils are extensively covering this area even at very steep slope so that all area is grazed and dry farming is carried out even at very steep slopes up to approximately 50%. Soil texture of slopes is heavy and

depth is generally very deep. Although soil contains high percentage of stone and gravel, permeability is slow due to heavy texture. Soils are easily eroded where heavily grazed or improperly cultivated.

8.1.5 Meteorology

(1) General Condition of Master Plan areas

a) Vastegan

Estimated annual rainfall is about 780 mm and rainfall concentrate from Mehr (October) to Ordivehesht (May). Minimum temperature is estimated to become less than 0℃ from Mehr to Farvardin and whole area is covered with snow in this period. On the other hand, minimum temperature exceed 0℃ from Ordivehesht (May) and maximum temperature reach about 30℃ in Tir (July). Lowest elevation of Vastegan is about 2,300 m and it is supposed that frozen days are more than 130 days at least according to data at Emam-Gheis. Annual mean humidity is 51 % and ranges from about 40 % in Dey (January) to 80 % in Tir.

b) Chaman Goli-Bazoft

Annual rainfall is estimated at about 1400 mm and rainfall concentrate from Mehr (October) to Ordivehesht (May). Minimum temperature is estimated to become less than 0℃ from Azar (December) to Esfand (March) and snow falls for 4 months. As for minimum temperature, it exceeds 0℃ from Farvardin (April) and maximum temperature reach about 30℃ in Tir (July). Lowest elevation of Chaman Goli-Bazoft is about 1,400 m and minimum temperature in Dey (January) is estimated to be -6 ℃. Then it is supposed snow covers whole area. And it is estimated that frozen days are about 130 days at maximum according to data at Koohrang. Annual mean humidity is 60 % and ranges from about 70 % in Dey (January) to 25 % in Tir.

c) Sarbaz

Annual rainfall is estimated at about 700 mm and rainfall which exceeds 50 mm concentrates from Azar (December) to Farvardin (April). Minimum temperature is estimated to become less than 0℃ from Mehr (October) to Farvardin (April) and snow approximately falls for these 7 months. As for minimum temperature, it exceeds 0℃ from Ordivehesht (May) and maximum temperature reach about 30℃ in Tir (July). Lowest elevation of Sarbaz is about 2,000 m and minimum temperature in Dey (January) is estimated to be -7 ℃. Then it is supposed snow covers whole area. And it is estimated that frozen days are about more than 120 days at least according to data at Hanna. Annual mean humidity is 50 %.

d) Tang Sorkh

Estimated annual rainfall is about 1,150 mm and rainfall which exceeds 50 mm concentrates from

Aban (November) to Ordivehesht (May). Minimum temperature is estimated to become less than 0℃ from Aban to Esfand (March). And minimum temperature exceeds 0℃ from Farvardin (April) and maximum temperature reaches about 30℃ in Tir (July). Lowest elevation of Tang Sorkh is about 1,900 m and it is supposed that minimum temperature in Dey (January) become -2 ℃. Frozen days are more than 50 days at least according to data at Yasuj. Annual mean humidity is 50 % and ranges from about 75 % in Dey (January) to 30 % in Tir.

e) Zeras

Estimated annual rainfall is about 770 mm and rainfall which exceeds 50 mm concentrates from Aban (November) to Farvardin (April). Minimum temperature temperature exceeds 0℃ through the year and maximum temperature reaches about 40℃ in Mordad (August). Frozen days are more than 5 days at least according to data at Izeh. Annual mean humidity is 45 % and ranges from about 65 % in Dey (January) to 20 % in Mordad (August).

(2) Probability and Intensity of Rainfall

The probability and intensity of rainfall are summarized as follows.

Table 8-1-5-1 Probability of Annual Rainfall

Area Name	Station	2 years (mm/year)	5 years (mm/year)	10 years (mm/year)	25 years (mm/year)
Vastegan	Emam Gheis	509	347	305	282
Chaman Goli-Bazoft	Goosheh Pol	1,426	1,064	965	910
Sarbaz	Dehkadeh Shahid	488	329	288	266
Tang Sorkh	Yasuj	836	570	501	465
Zeras	Barz	621	462	418	384

Source) Meteorological Organization

Table 8-1-5-2 Probability of Daily Maximum Rainfall

Area Name	Station	2 years (mm/year)	5 years (mm/year)	10 years (mm/year)	25 years (mm/year)
Vastegan	Borougen	30	47	54	59
Chaman Goli-Bazoft	Goosheh Pol	110	150	180	220
Sarbaz	Dehkadeh Shahid	63	110	133	148
Tang Sorkh	Yasuj	72	95	110	130
Zeras	Barz	67	85	97	115

Table 8-1-5-3 Rainfall Intensity in 60 minutes

Area Name	Station	2 years (mm/year)	5 years (mm/year)	10 years (mm/year)	25 years (mm/year)
Vastegan	Emam Gheis	12	21	26	33
Chaman Goli-Bazoft	Pol-e-shalu	14	19	22	26
Sarbaz	Yasuj	10	14	17	20
Tang Sorkh	Yasuj	10	14	17	20
Zeras	Izeh	18	28	35	44

Source) Department of Water Engineering and Khajeh Nassir-al-Deen Toosi University of Technology

(3) Evapotranspiration

Evapotranspiration were estimated at each representative station by Penman-Monteith. The results are summarized as follows.

Table 8-1-5-4 Evapotranspiration

Month	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Borougen	2.63	4.10	5.15	5.28	4.95	4.24	2.94	1.82	1.09	0.89	1.24	1.89
Koohrang	3.00	4.39	5.15	5.38	4.84	3.81	2.41	1.35	0.85	0.70	1.07	1.73
Hanna	3.10	4.10	5.27	5.80	5.80	5.06	3.58	2.23	1.45	1.23	1.54	1.77
Yasuj	3.51	4.80	5.87	6.70	6.10	4.12	3.97	2.40	1.55	1.35	1.71	1.97

Source) Master Plan for North Karoon Basin (MOA)
Study for Natural Resource Management in the Boshar and Marboreh River Basin (MOJ)

8.1.6 Hydrology

a) Vastegan

Major tributary in Vastegan is Bijeh Gerd, which originates in western mountain area and flow from the west to the east. After passing Vastegan village, which locates on the top of alluvial fan, it changes the flow direction and flows into the north-east. On this alluvial plain, surface water often disappear by infiltration in summer season. Specific discharge and annual discharge depth Godarkabk are 0.006 $m^3/s/km^2$ and 200 mm/year. Specific amount of sediment is estimated at 30 m^3/km^2/year based on sediment data at Tangzardalou station. Furthermore, specific amount of sediment is estimated at 16 m^3/km^2/year based on sediment data at Solegan.

b) Chaman Goli-Bazoft

Chaman Goli-Bazof basin can be divided into two (2) basins, namely Dareh Tavileh and Gusaleh Bar. Generally speaking, these basins have numerous springs as water sources and each tributary has perennial flow. Specific yield of Gusaleh Bar is supposed to be lesser than that of Dareh Tavileh. Especially surface water of Dareh Kusahid, which is major sub-tributary of Gusaleh Bar, disappears on the alluvial fan in summer. Specific discharge and annual discharge depth at Morghak are 0.030 $m^3/s/km^2$ and 960 mm/year. Specific amount of sediment is estimated at 23 m^3/km^2/year.

c) Sarbaz

Sarbaz basin can be divided into two (2) basins, namely Ly Sorkh and Tang Rigan basin. Generally speaking, Sarbaz basin has many springs as similar as Chaman Goli-Bazof. On the map with scale of 1/25,000, 29 springs in Ly Sorkh and 15 springs in Tang Rigan basin can be found. The annual discharge depths at Kakdaneh and Kata are 400 mm/year, 300 mm/year, respectively. Specific amount of sediment is estimated at 199 m^3/km^2/year based on sediment data at Khakdaneh station. Furthermore, sediment data are available at Kata. Specific amount of sediment is estimated at 51 m^3/km^2/year based on sediment data at Kata.

d) Tang Sorkh

Tang Sorkh basin is divided into 2 basins such as left and right bank basin. Right bank basin occupies major area of Tang Sorkh and its major tributary is Dareh Sorkh. Dareh Sorkh River has perennial flow and formulate alluvial fan at the mouse to Boshar river. On the other hand, left bank basin consists of small basin, which small tributaries flow down directly into Boshar River. Lengths of tributaries in these small basins, which locate on steep hillside, range from 1 km to 2 km. Then it is supposed that runoff in short term easily occurs in case of rain and water resource is poor. Specific discharge and annual discharge depth at Yasuj are 0.018 $m^3/s/km^2$ and 580 mm/year. The areal rainfall at Yasuj is estimated at about 870 mm and the runoff coefficient comes up to about 65 %. Sediment data are available at Yasuj. Specific amount of sediment at Yasuj is estimated at 60 $m^3/km^2/year$.

e) Zeras

Zeras locates at middle basin of Karoon river and is divided into many small sub-basins. Main stream in each sub-basin flows into Karoon River directly in rain. Almost all of these streams have no water without rain. And also there is only a few springs in the area. In consideration of these conditions, Zeras has poor water resource. The perennial flow can be found except one tributary which flows through Lir Siya Mozrom and Lir Siya Shapouri village. However, this tributary is little stream and its origin of water source is spring. Specific discharge and annual discharge depth at Barzbakhtiari are 0.013 $m^3/s/km^2$ and 400 mm/year. Sediment data are available at Barzbakhtiari and specific amount is estimated at 15 $m^3/km^2/year$.

8.2 Land Use and Vegetation

8.2.1 Land Use

Characteristics and current land use in master plan areas are as follows.

(1) Vastegan: 89.90 km^2

The most of west side area of the road which pass through the center of the area consist of rock and sandy stone, and they occupy about 45 % of total area. Sand and some size of stone on the slope area show as one of characteristics of the area. The area where is nothing to grow trees or no vegetation has in danger of stone fall and washed away of gravel. The secondary large land use is farmland and rangeland, but almost of east side of flat land are utilizing for farmland.

Some rocks which washed away from mountainous area are found a part of torrent, and there are waste of sand and rocks caused by rising river bed, and river bank trees and orchard situated along the irrigation canal, but some of trees withered by lack of water. Wet land which locate north part of land is utilizing as farmland or grazing land at present. There is no function of wet land without wet season.

(2) Chaman Goli-Bazoft: 113.2 km^2

The ratio of rocky area in the area shows about 65 % of the total area. Present other land use area such as farmland and orchard in this master plan area will not be expanded in the future, because there are quite small flat area retain. Quantity of water supply is abundant even though a small farmland, therefore, a small farmland can be expanded if irrigation canal will construct for cultivation of crops.

Farmers have been cultivated alfalfa and barley in between oak tree successfully, so that these production systems are good for cultivation of land use by way of future techniques. Most of villagers who live in this area are nomads and they stay out side of the area in general, and come back to village in wintertime.

In this area, most of the villages have poor access without paved, maintained and proper river crossing, although some villages are close to the main road. The lack of proper river crossing sometimes causes the traffic shut off for a few days during the winter or rainy season. In such circumstances, when a natural disaster breaks out in the area, the remedial works may not be commenced right away. Thus the consolidation of infrastructure is also an urgent issue as well as disaster prevention works.

(3) Sarbaz: 154.5 km^2

Apple production is very popular in this area as the irrigation canal network, the source of which originates in the hillside of Dena Mountains with the elevation of 3,000 m or so, is developed to a

certain extent. However, some villagers claim that the canal system is not enough as some of the orchard trees are found dead in the orchard farms.

The area of lowland part of present rangeland will be expanded for the cultivation area of apple in the near future. Motivation of this fact is to get much income than other agricultural products this is why most of farmers are recognizing needlessness of general farmland. In fact, very small area exists in this area at present. Villagers want to refuse nomad come into this area, but it does not succeed because wide rangeland occupy in this area.

(4) Tang Sorkh: 65.40 km^2

Amount of 844 mm annual rainfall is much in the five master plan area, therefore, trees grow somewhere in the rocky mountain with quite low density, and the same oak trees also scattered in rangeland, but the places where is thick and fertile soil grow trees with high density. These areas are the widest compare with other master plan area. It shows about 47 % of the area. Sub-basin with flow center of the area toward north is dry up river at the time of field survey but there are piled sand seems to be coursed by soil erosion. It is bigger sub-basin around there, so much water come down only short period at the beginning of spring.

Other sub-basin which separate on the way toward east direction has abundant water in the river and fish farm constructed at upper part of the stream and also irrigation canal already constructed both side of the river and water supply to farm. Walnut orchard cultivated for a long time in this area and recently started apple cultivation. For this reason, farmers want to construct water tank for stabilizing supply of water. Farmers want to change sheep and goat breeding to caw breeding for the land conservation. Villagers have interesting to plantation of tree for soil protection.

(5) Zeras: 63.70 km^2

Characteristics of this area has differences of 1000 m above the sea revel between higher and lower place where lives villagers, accordingly, land use area and its ratio is so high but entrance road to the area close during the winter season by snow fall. Rocky land exists only along the Karoon River look like cliff. Grazing is doing wide area and farmland used to gentle slope from half way down to the mountain to river side. Many of sub-basins also used to grazing area, so those areas are easy to have soil erosion because uncovered with plant vegetation.

Table 8-2-1-1 Present Land Use in the Master Plan Area

(unit : k m²)

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	Chaman Goli-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	0.91	3.95	3.76	4.55	6.24	486.70

Source: JICA Study Team

8.2.2 Land Capability

There are two different criteria for evaluating land capability in Iran. One is the evaluation from an aspect of topography, and the other is from an aspect of irrigation suitability. For the analysis of Master Plan areas, land capability is analyzed based on irrigation suitability to prepare rather detail plan for development.

(1) Land Classification by Irrigation Suitability

For evaluating irrigation suitability, lands are classified into six (6) classes as below:

Table 8-2-2-1 Land Class by Suitability for Irrigation

Land Class	Restriction	Explanation
Class I Land	Arable	Lands without apparent hazards or limitations.
Class II Land	Arable	Lands with slight hazards or limitations.
Class III Land	Marginal Arable	Lands with moderate hazards and/or limitations.
Class IV Land	Restricted Arable	Lands with severe hazards and/or limitations.
Class V Land	Undetermined Arable	Lands with severe hazards and/or limitations for any irrigation farming, requiring further studies.
Class VI Land	Non Arable	Lands with severe hazards and limitations for any irrigation farming, which cannot be corrected as yet.

(Source) Soil Institute of Iran

There are no limitations in Class I land, but severe limitations in Class IV land. Class VI land will not be utilized for irrigation farming. As the results of study based on above criteria, the land capability of each Master Plan area is summarized as shown in Table 8-2-2-2.

Table 8-2-2-2 Land Classification for Irrigation Purpose

Land Class and Area (ha)	Vastegan	Chaman Goli-Bazoft	Sarbaz	Tang Sorkh	Zeras	Total
Irrigable lands						
I	497	0	0	0	0	497
II	872	253	1,130	29	69	2,353
III	2,157	0	2,255	833	289	5,534
III+IV	0	1,015	0	0	0	1,015
IV	81	1,187	1,859	259	176	3,562
Total of Irrigable Land	3,607	2,455	5,244	1,121	534	12,961

Class I land, no limitations for irrigation, exists only in Vastegan. Class II land, slight limitations, is extending in Vastegan and Sarbaz. Class II land is limited in other areas. Class III land, moderate limitations, is largely extending in Vastegan, Sarbaz and Tang Sorkh. Class IV land, severe limitations, is the major land in Chaman Goli-Bazot. Major limitations are heavy texture, slow permeability and stoniness in most areas. Class III and IV lands are burdened with steepness of slope other than said limitations. Irrigable land is very limited in Zeras. It is only 534 ha, that is equivalent to only 8% of total area. In Zeras, remaining 92% area is classified into Class VI, non arable.

8.2.3 Vegetation

Natural vegetation provides feed to livestock and contributes in prevention of soil erosion. 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, being distributed on localities with elevation more than 2200 m. Grasses are chiefly scattered in parts with slope less than 40%. Astragalus (milkvetch), Gundelia (artichoke) and Bromus (brome) are common vegetation in five master plan areas. Localities denuded of vegetation are susceptible to erosion, threatening the rangeland sustainability.

Table 8-2-3-1 Land Cover (%) in Rangeland of Master Plan Areas

Land cover	K4-1-9 Vastegan	K5-19a Chaman Goli-Bazoft	K7-0-19-1 Sarbaz	K7-48 Tang Sorkh	K8-28 Zeras
Vegetation	44.3	45.5	49.6	39.7	40.9
Rock	11.1	20.8	9.8	17.0	1.6
Stone	14.3	5.5	11.7	12.8	7.1
Litter	6.0	11.2	4.6	5.0	11.9
Bare soil	24.3	17.0	24.3	25.5	38.5

In forests most of trees (oak) are old, infected with pathogens (gall) and show on sign of regeneration.

8.2.4 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 in master plan areas is far less than present demand, inducing negative impacts on livestock production. This low productivity can be partly attributed to following factors:

- Removal of pasturage vegetation (shrubs) for fuel and other purposes
- Overgrazing, under which vegetation get no opportunity to regenerate
- Occurrence of large % of rock, which limits expansion of vegetation
- Soil erosion, which bring-about decline in land productivity.

Table 8-2-4-1 Herbage Production and Herbage Demand (ton) in Master Plan Areas

K4-1-9 Vastegan	K5-19a Chaman Goli-Bazoft	K7-0-19-1 Sarbaz	K7-48 Tang Sorkh	K8-28 Zeras
208.5 (182)* 1,205.4	306.8 (163)* 2,253	865.7 (161)* 3,390.6	604.2 (194)* 1,415.7	638.9 (190)* 1,990.2

( )* : production in kg/ha

8.2.5 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. Increase in human population, which bring about increase in meat demand and thus enlargement of herds stimulates the overgrazing.

Table 8-2-5-1 Optimum and Presently Grazed Number of Animals in Master Plan Areas

K4-1-9 Vastegan	K5-19a Chaman Goli-Bazoft	K7-0-19-1 Sarbaz	K7-48 Tang Sorkh	K8-28 Zeras
3,475 20,090 (5.78)*	5,113 37,550 (7.34)*	14,429 56,510 (3.91)*	10,069 23,595 (2.34)*	10,648 33,170 (3.11)*

( )* Overgrazing rate

8.3 Socio-economic Condition

8.3.1 Administrative Division

The selected Master Plan Study areas belong to four provinces, two Study Areas in Chaharmahal va Bakhtiyari and each one Study Area in Kohgiluyeh va Boyerahmad, Esfahan and Khuzestan respectively. Administrative division of the area is in accordance with the Law of Administrative Division, promulgated in 1992. Province (Ostan) is divided into several townships (Sharestan), each township into several districts, (Bakhsh) each District into several rural districts (Dehestan), and each rural district into several villages (Deh). Rural district consists of 15 to more than 100 villages.

Table 8-3-1-1 Administrative Division and Target Villages of Master Plan Study Areas

Master Plan Area	Proviuce	Township	District	Target Villages
K4-1-9 Vastegan	Chaharmahal va Bakhtiyan	Boroujen	Gandoman	Konark Olya, Konark Sofla, Nasir Abad, Vastegan
K5-19a Chaman Goli-Bazoft	Chaharmahal va Bakhtiyan	Farsan	Bazoft	Arteh, Baghchenar, Chemghaleh, Dorak, Fariak, Ghale Tabarak, Kachooz, Khiyarkar, Tabarak Olya, Tabarak Sofla
K7-0-19-1 Sarbaz	Esfahan	Semiron	Padena	Deh Bozorg, Dangazloo, Dorahan, Devergan Olya, Devergan Sofla, Kahangan,Noghel, Noorabad, Sarbaz, Telmohamad, Zabih Abad
K7-48 Tang Sorkh	Kohgiluyeh va Boyerahmad	Yasuj	Central	Allah Abad, Cheshmeh Chenar, Hassan Abad, Islam Abad, Mehrab Abad, Sar Tang Sorkh, Tang Sorkh
K8-28 Zeras	Khuzestan	Izeh	Dehdaz	Ali Bandeh, Badelon, Bardkal, Behoz, Cham, Dareh Sohrab, Dareh Zangi, Dawodiha, Gard Lidan, Lir Siya Mozrom, Lir Siya Shapouri, Sartuf, Sebalutak, Shahghaz, Zeras

8.3.2 Population

The population of the Study areas was surveyed in village basis by villagers and nomad and summarized in the following table

Table 8-3-2-1 Population

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

Because the whole study area is situated in the mountainous area and the upstream of the Karoon River, the overall population density is low and shows 38 persons per km^2 in the whole study area. Table 8-3-2-2 shows the population density of the average village population size in the Study Area. The population density is lower than the average of the whole Study Area in K7-48 Tang Sorkh and K8-28 Zeras, because K7-48 Tang Sorkh has vast mountainous area and K8-28 Zeras extends over the very steep slope with scarce water resources.

Table 8-3-2-2 Population Density and Population per Village

Sub-basin	Total Population	Sub-basin Area (km2)	Population Density (No./km2)	Number of Village	Population /Village
K4-1-9 Vastegan	4,460	89.9	49.6	4	1115.0
K5-19a Chaman Goli-Bazoft	8,416	113.2	74.3	10	841.6
K7-0-19-1 Sarbaz	10,875	154.5	70.4	11	988.6
K7-48 Tang Sorkh	1,871	65.4	28.6	7	267.3
K8-28 Zeras	2,344	63.7	36.8	15	156.3
Total / Average	27,966	486.7	57.5	47	595.0

Source: Study Team 2001 August

8.3.3 Income Level

Main income of farmers including nomadic people in the study area derives from agriculture and animal husbandry. In order to grasp the living condition of farmers and nomadic people and to reflect to formulate the master plan, village surveys were carried out. Table 8-3-3-1 shows the average annual income level of both villagers and nomad in the Study Areas separating the income source of crop production and livestock.

As a whole, the income source of crop production to the total income of village people is 74 %, whereas the income source of crop production of the nomad occupies 26 % and livestock occupies 74 %. However, the ratio of income source of crop production is largely affected by the high income study areas such as K4-1-9 Vastegan and K7-0-19-1 Sarbaz. In the low income areas like K5-19a Chaman Goli-Bazoft and K7-48 Tang Sorkh, even village people get the more income from the livestock than crop production

Table 8-3-3-1 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

8.3.4 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 neighboring towns as employees. They also have disadvantage to get the information of employment.

Table 8-3-4-1 Unemployment Ratio

Sub-basin	Village			Nomad			Total		
	Popu lation >10 yr	Un Employ ment	Ratio (%)	Popu lation >10 yr	Un Employ ment	Ratio (%)	Popu lation >10 yr	Un Employ ment	Ratio (%)
K4-1-9 Vastegan	3,100	220	7	655	0	0	3,755	220	5.9
K5-19a Bazoft	4,553	990	22	1,802	755	42	6,355	1,745	27.5
K7-0-19-1 Sarbaz	4,162	210	5	5,218	97	2	9,380	307	3.3
K7-48 Tang Sorkh	1,078	121	11	635	28	4	1,713	149	8.7
K8-28 Zeras	1,513	356	24	0	0	0	1,513	356	23.5
Total / Average	12,893	1,541	12	8,310	880	11	21,203	2,421	11.4

Agriculture and livestock keeping are the main occupation in the study areas, and other occupation is quite few except for government employee, and small shop owner, etc. According to the village survey, conducted by the study team on August 2001, 89% of households in the study area earn from agriculture and livestock production, and other occupations are government employee: 5%, merchant/ technician: 3%, craftsman and others: 3%. Among the master plan areas, K8-28 Zeras is the lowest in occupational diversification, and 94% of households engage in agriculture and livestock. On the other hand, K4-1-9 Vastegan is the highest in the occupational diversification, and 82% of families engage in agriculture and livestock, and 10% of household are employed by local government. Vastegan is located near Bourjen (20km distance), Arbal (50km), and Sharekord (80km), which is capital city of Chaharmahar va Bakhtiyari province. It is possible for peoples in the Vastegan area to commute to large town such as Share Kord.

8.3.5 Land Tenure and Land Holding

After the Revolution, the government has made the priority policy for an independent farm, instead of large-scale farm such as agricultural corporation and agribusiness. Consequently, own farmer takes leading part in agricultural production. However, it produced a large number of small scale farmers who have less than 2 hectares of farmland. Land tenure in the study area is also presented the same situation. All farmers in the area are own farmers.

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

Table 8-3-5-1 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

It is known from the Phase I study that the average land holding size in the whole study area is 3.3 ha. Smaller sizes of land holding than the average of the whole study are found in the Study areas of K4-1-9 Vastegan and K5-19a Chaman Goli-Bazoft. Those two Study Areas belong to Chaharmahal va Bakhtiyari. The problem on land tenure and land holding is a subdivision of farmland by inheritance. This subdivision produces a difficulty and limitation of farm management by rural family.

8.3.6 Structure of Rural Community and Process of Its Decision Making

(1) Administrative Structure

There are following National Public Organizations concerning the administration of Rural Communities,

Ministry of Jihad-e-Sazandegi (Jihad and Agriculture)
- Nomadic Affairs Organization
- Forest and Rangeland Organization
- Livestock Organization
- Handicraft Organization
- Silat Company (Public Company for Fishery)

Ministry of Education

Ministry of Health and medical Education

Plan and Budget Organization

Statistical Center of Iran

At the Province level, there are such Provincial Organizations as the extention of National level organizations,

Provincial Jihad-e-Sazandegi Organization
- Nomadic Affairs Office
- Forest and Rangeland Office
- Livestock Office
- Handicraft Office
- Silat Company (Provincial Public Company for Fishery)

Provincial Education Organization

Provincial Health Organization

Provincial Plan and Budget Organization

(2) Unit of a Village

A village is basically composed of a single community. However, there are some cases when several communities within a proximity make up a village.

(3) Rural organizataion

Each Village(Community) is having the Islamic Council (Shora) as the lowest reach of administration. This Shora is conducting general village administration under the Ministry of Interior with three councillors directly elected by the villagers of which the chairman as the village-chief.

In some cases, there organized Revolution Defence Body under the strong influence of the Ministry of Jihad-e-Sazandegi. At present its main purpose and function is changed to develop remote rural communities.

In either case, most councillors are elders and/or seniors of the village. As such, it is said that the development of each villages mainly depends on the quality and initiative of its councillors. However, band and kin relationships with central and/or provincial government sometimes works an important role in the development of the village as well.

(4) Consciousness of Villagers

Because of traditional and religional community systems, decision is exclusively made by the elders and family-heads until recently. At present, such systems seem changing gradually with increasing numbers of youths who are going out to urban areas for seasoinal works, development of education and information dissemination through mass-medias such as radio and T.V. Also the change of life-style with improved production and distribution systems gives impetus to this tendency.

(5) Opinion Leaders and Reformers in the Rural Area

Teachers and medical/health personnels in villages are representing intellectual group of the rural area and are playing important role in abovementioned changes. However, as the old customs die hard, the movement is taking a course of not much radical but moderate and gradual improvement of life-styles. In other cases, farmers with higher education levels and outside traders are inducing newer and improved life-styles.

8.3.7 Fuel Source of Households

Present situation of fuel consumption in households has been surveyed by the village survey from an aspect of forest conservation in the Master Plan areas. 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. Following problems are pointed out on fuel consumption at the household level.

1) Nomad households: There is no stable market system of gas/petrol due to migrant life system.
2) Chaman Goli-Bazoft: Village households are low in purchase power of gas/petrol due to low income and remoteness.
3) Zeras: Village households are in difficulty to purchase gas/petrol due to difficulties in village access roads to the main road.

Above problems are to be solved as early as possible from the viewpoint of river basin preservation. Although exact consumption amount of fuel wood consumption could not be obtained in the Village Survey, it is estimated at about 3 tons for one household in a year based on amount of stock of fuel wood.

8.4 Rural Infrastructure

8.4.1 Rural Road

(1) Vastegan

The National Road from Shahre kord to Yasuj through Burujen and Gandoman is the main access to Vastegan area, and the road is in very good condition. The road distance from Shahre kord to the entrance of Vastegan on the National Road is around 90 km. From the entrance on the National Road, a paved road is connected to the villages of Konark Sofla, Konark Olya, Vastegan and Nasir Abad, however, the road is not so good condition because of poor maintenance.

(2) Chaman Goli-Bazoft

There are two access roads to the area from Share Kord. One is to approach from the north passing through Sureshjan, Farsan and other towns. The road section crossing the valley of Khurang River is mainly gravel and the others are asphalt paved roads. Another is to approach from the south passing through Karaji, Tange Darkesh Varkesh, Rostam abad, Dashtak and Doab Samsami. The road from Shahre kord to Karaji is the National Road, which is connected to Ahaz. This road is generally paved.

The villages of Chemghaleh, Khiyarkar, Arteh, Dorak, Baghchenar, and some houses of Fariyak and Kachooz are located along this main road. The access to Tabarak Olya, Tabarak Sofla, Ghale Tabarak located in the south, and the major village of Fariyak and Kachooz is dirt road and some sections of the road are in bad condition. The Tabarak River borders Ghale Tabarak, located in the southern tip of the area, and only the concrete panel is placed on the riverbed at the crossing. During the flood season, the crossing is sometimes not passable.

(3) Sarbaz

The National Road from Shahre Kord to Yasuj through Burujen is one of the main access roads to Sarbaz area, and the road is in very good condition. From Burujen, the local paved road connects to Bideh, the center of the area, through Semirom. There is a national road, which connects from Esfahan to Semirom. On the other hand, the local road from Yasuj through Si sakhit, and the pass with elevation of 3,200 m also connects to Bideh. This road is paved from Yasuj through Si sakhit, around 30 km, however, the rest is gravelly-dirt road and the improvement of this section is carried out near Si sakhit.

Noorabad is located along the Yasuj-Bideh road, while Sarbaz is connected from the road along the Marbor River. A new bridge crossing Marbor River and connecting to Bideh is under construction. The major access to the eastern part of the area, such as Deh Bozorg, Dangazloo, Dorahan, Devergan Olya, Devergan Sofla, Kahangan, Noghel, Telmohamad, Zabih Abad is the local road, the most part of

which is mainly paved and also crosses the Marbor River.

(4) Tang Sorkh

There are two access roads to Tang Sorkh. The new access is a part of the National Road; Teheran-Esfahan-Yasuj-Shiraz, which runs near the Shah ghasemi Dam and aligned along the Parikdoon River. Another is the old National Road, which connects Yasuj to Shiraz. The both routes are paved, in good condition and join at the village of Allah Abad, located in the western part of the area. The access to the western part of the area, such as Allah Abad, Cheshmeh Chenar, Hasan Abad, Islam Abad, Mehrab Abad is the old road, which runs on the left bank of the Boshar River. The access to Sar Tang Sorkh and Tang Sorkh is the local dirt road branching off the National Road and crossing the Boshar River.

(5) Zeras

The National Road from Shahre Kord to Ahaz is the main access to Zeras area and the road is in very good condition. The main entrance of Zeras, named De dez, which functions as the center of the area. A paved road branches off at De dez, climbs up the slope of the mountain range along the Karoon River, passing through Dawodiha, located on the ridge of the mountain range, and reaches the bridge on the Karoon River.

The dirt roads from this access connect Zeras, Shahghaz, Sebalutak, Sartuf, Lir Siya Shapouri and Lir Siya Mozrom. A dirt road from Dawodiha also goes down to Ali Bandeh and Behoz, however, deep gully erosion is well developed along the road in the middle part of the slope and the car is not passable.

The rest of the area located on the east such as Badelon, Cham, Dareh Sohrab, Dareh Zangi and Gard Lidan has two accesses. One is the dirt road from the bridge at Karoon River to this area, the condition of which is very poor and critical because of gully erosion, rough surface and its steep gradient. Another access is also a dirt road which branches off the National Road and crosses the mountain range aforementioned on the eastern part of the area.

8.4.2 Water Supply and Sewage

(1) Vastegan

Vastegan has 4 villages in the area, namely Vastegan, Nasir Abad, Konark Olya and Konark Sofla. Each village has spring as its source of rural water supply except Konark Sofla, which depends on well as water source for rural water supply. In these village, Konark Olya, Nasir Abad and Vastegan request to improve condition of water supply because of turbidity in winter season. Spring yield in the area is estimated at about 0.10 m^3/s based on discharge measurement.

(2) Chaman Goli-Bazoft

Chaman Goli-Bazoft has 3 villages in Dareh Tavileh basin and 7 villages in Gusaleh Bar basin. In Dareh Tavileh basin, each village has spring for water supply and 2 villages, namely Ghale Tabarak and Tabarak Olya, complain shortage of water supply. In Gusaleh Bar basin, every village except Kachooz complain shortage of water. Generally speaking, every village is supposed to be under the condition of water shortage with its water supply system.

(3) Sarbaz

Sarbaz has 8 villages in Ly Sorkh basin and 2 villages in other basins. Every village except Dangazloo, Devergan Olya complains shortage of water. In addition, Kahanghan village have two water supply system. One was constructed 20 years ago to supply water to 140 households and the other was constructed in cooperation with Jihad 8 years ago for 50 households. This village request Jihad to construct new water supply system.

(4) Tang Sorkh

There are 2 villages, Tang Sorkh and Sar Tang Sorkh on the right bank of Boshar river and 5 villages on the left bank. In these villages, Hassan Abad, Mehrab Abad and Islam Abad depends on 1 spring which locates at north eastern mountain in the distance of about 15 km from Hassan Abad. This water supply system was constructed 20 years ago and has no capacity to supply water to these all villages. As for Cheshneh Channar, new storage tank is under construction.

(5) Zeras

There are 15 villages in Zeras and many of them depend on small springs and Karoon River for drinking and domestic use. In this area, only 9 small springs, which yields are averagely 0.5 liters/sec., have been used and Bardkal, Behoz, Cham, Gard Lidan depend on Karoon water and suffer from not only deficit of water but also high turbidity in flood. And Shagaz have no water supply system. There is plan that water from Karoon No.4 dam will be supplied to some of these villages in the future.

8.4.3 Electrification

All the villages within the selected five (5) Master Plan Study Areas is electrified. According to the Behavioral Survey conducted by the Study Team through RRC, 181 households out of 204 (88.7 %) within the Master Plan Study Areas is using electricity. Major purpose of electricity usage "Lighting" (all the users) followed by mass-communications (Radio and TV) and "Refrigirator". Not much usage for "Cooking" and "Heating" is answered may be because more than 60% of people feel the electricity charge to be "Expensive".

8.4.4 Irrigation

(1) Vastegan

Irrigated farmland and orchard are informed to be 924 ha and 25 ha, respectively. In Vastegan, 4 major irrigation scheme and many pumping wells for irrigation are found. These 3 irrigation schemes out of four (4) have been improved by MOA. Water resources of these canals are surface water of Bijeh Gerd and springs. Pumping wells have been constructed by villagers in cooperation with MOA and are scattered in north east area of Vastegan. Depth of groundwater table is averagely 50 m from the surface. However, recently, groundwater table is goes down by over pumping and it becomes to be necessary to drill again up to 60 m in depth.

(2) Chaman Goli-Bazoft

Irrigated farmland and orchard of Chaman Goli-Bazoft are informed to be 672 ha and 77 ha, respectively. Especially, orchard without irrigation is not found. Major villages except Dorak, Kachooz and Tabarak Olya, request to improve irrigation facilities for the deficits of irrigation water. In the area, 5 major irrigation schemes exist and one is under construction by MOA. Major water conveyance canals of these irrigation schemes have been lined with concrete.

(3) Sarbaz

Irrigated farmland and orchard of Sarbaz are informed to be 541 ha and 2,472 ha, respectively. And almost all farmlands and orchards are also informed to be irrigated. Complain of major villages except Devergan Olya/Sofla, Kahanghan and Zabih Abad is unstable water supply for irrigation. In Sarbaz, there are 6 major irrigation scheme and total lengths of each canal is much longer than that of the other Master Plan area. Majors of conveyance canals in Ly Sorkh basin are lined with concrete, nevertheless main canal in Tang Rigan is not lined with cocrete.

(4) Tang Sorkh

Irrigated farmland and orchard of Tang Sorkh are informed to be 116 ha and 243 ha, respectively. The farmland on right bank of Boshar River occupies around 90 % in the area and there are two major irrigation schemes in this area. Deficit of irrigation water is not found in the right bank area, but all villages on the left bank request to develop water source for irrigation and improve irrigation facilities. Then, MOA is now improving irrigation scheme with pipeline and pump station, which locates near Cheshmeh Chenar and its water source is Boshar River. And, it is informed this irrigation scheme will cover the left bank area.

(5) Zeras

Farmland is reported to be 2,465 ha and all of them are dry farmland or fallow land. And it is difficult to find irrigation facilities in Zeras and water source for irrigation. Of course, it is possible

to utilize water in reservoir of Karoon No.3 Dam after its completion. However, it is not feasible to pump water up for irrigation in the consideration of high pump head more than 300 m.

8.5 Agriculture, Livestock and Inland Fishery

8.5.1 Agriculture

1) 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.

Table 8-5-1-1 Cultivation Area of Major Crops

Unit: ha

Sub-basin	Barley Wheat	Alfalfa	Sugar beat	Legume	Vegetable	Potatoes	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

Cultivation area under major crop has changed significantly in the past decades. According to the data in Statistic Section, Ministry of Jihad-Agriculture, the acreage under wheat (non-irrigation) has decreased significantly in the every Study Area. Generally, the cultivation area of wheat and barley has been fluctuating from year to year due to the weather conditions

2) Land Holding

According to the village survey, 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 in Sarbaz.

3) Farming Practice and Farming

Generally, farming activities in the Study Area mainly take place in the rainy season and farming practice is the same as almost all areas. The majority type of agriculture is under mono-cropping system and farming practice is still traditional.

4) Cropping Calendar of Major Crops.

The cropping calendar of annual crops is slightly different by locality according to the weather conditions, availability of water for agriculture and the readiness of farmers. In rain fed areas, when there is a drought or dry spell at the period of sowing or cultivation, the farmers have to wait for the rainfall, eventually the actual cropping calendar would be delayed.

While Provincial Agricultural Office, Charharmahal-va-Bakhtiyari recommends proper cropping schedule for cereals, root crops, beans, vegetables and forage crops. According to this cropping schedule, chick bean and beans such as soybean, long bean and cowpea could be planted after wheat harvested in the same field. However, lentil and pea could not be planted because their growing periods are same as that of wheat.

5) Extension

According to the Provincial Agricultural Office, they promote and extend the agricultural technologies to the farmers; land reform and establishing cooperative, changing to irrigated land by pumping with subsidy, transferring technical knowledge and training, changing to garden on slope areas, promotion of productive cooperation among farmers, etc. by mean of extension with farmer training, staff training as well as providing credits with help of Agricultural Bank, National Bank, Export Bank and Mellat Bank for horticulture, infrastructure, irrigation facilities, etc. However, in the Study Area, it seems that extension services are not enough on the frequency for training or visit to the farmers as well as technologies to be transferred.

8.5.2 Livestock

Typical production of livestock in villages is carried out by traditional methods. Raising livestock is not of cooperatives operation but of individual activity. Raising livestock in the Areas has secondary importance and play a supplementary role in agricultural production. Animal husbandry in villages is realized by pasturage with free grass and farmland grass and residue after harvesting. Production of milk in rural areas has been increasing year by year. Some villagers process milk to butter, oil, kashk, etc. and sell these products in the nearby market, although this is still rare. Poultry is also popular in villages for the production of eggs and meat. Families use livestock dung as fuel for cooking and stable manure.

On the other hand, nomads live on livestock farmers and scatter in the Study Area traveling from one rangeland to another. Major nomadic tribes in the Study Area are the Haft Lang Bakhtiyari, Gashghay and Boyerahmad-olia tribes. The period of nomadism of these tribes including nomadic migration is four to six months, staying in the Study Area in summer season from late April to mid-October. Shortage of feed for nomadic livestock frequently occurs for these years because of

overgrazing and sometimes draught, therefore, nomads are obliged to purchase feed such as alfalfa and wheat straw from farmers, even for feed in winter on their way to home. Recently, nomads have obtained permits of settling from the Office of Forest and Rangeland, the Provincial Jihad Organizations.

According to the Livestock Office, Provincial Jihad, Charharlmahal-va-Bakhtiyari, shortage of feed is the main problem in whole areas, which is caused by shortage of water and lack of grazing land. Therefore, Provincial Five Year Plan 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. Artificial insemination was started 30 years ago, but strongly promoted from 15 years ago. Training of AI is conducted every year and ID card is issued. Now, there are 45 ID holders in the Province.

As for Apiculture, beekeeping is carried out in Sarbaz and in some villagers. However, families participated are very few. Some nomads are also conducting by government's help. Two types of beehives are seen in areas; a local one and a modern one. Recently, modern beehive becomes popular by mean of promotion and extension by the government officers' help. The Office provides a training course from education & extension department and supplies good bee queens from other provinces. In the Study Area, the production of honey from one beehive in a year would weigh 6 to 7 kg. It is quite low comparing to other countries because of limited nectar sources such as flowers, bush and trees in the Areas. In winter, as the snow covers in the Areas and temperature becomes cold, it is necessary sugar and/or honey are given as artificial feed to bees in order to being able to spend over winter.

8.5.3 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 fry production is carried out by the Freshwater Fish Multiplication Center and fry are distributed to fish farms on cost basis. There is one private feed company in Shahr-e-kord around the Study Area. The ownership of fish culture firms takes two forms: one is by village cooperative and other by entrepreneurs living in cities. In the Study Area, it is possible to find some fish culture. Among them, only in Charman Goli-Bazoft, ownership of fish culture firms belongs to villagers, those in other areas belongs to aggressive entrepreneurs. One of the two fish firms in Chaman Goli-Bazoft is now under construction with the help of Fishery Office.

According to the Fishery Office (Silat Company), the Provincial Jihad Organizations, Charharmal-va-Bakhtiyari, the Office gives permission for inland fishery for promotion of fish culture. The Office provides the inspection of water quality, evaluation of capacity, help to bank loan, training to applicant, etc before construction of fish culture firm. After construction, the Office conducts

regular inspection of every three months by veterinary and fishery officers. At present, approximately 100 applicants are submitted application forms and 49 firms ID cards issued with bank loan in the Province. In future, ID card issuance might be finished in 2-3 years because of shortage of expected places for obtaining suitable fresh water, the Office said. In the Study Area, it seems that there are no more expected places for fresh good quality water for fish culture.

8.6 Marketing/Processing/Rural Industry

8.6.1 Agriculture Products Marketing System

Products in the Study Area, are wheat, barley, rice (only in Zeras area), legumes, tomatoes, potatoes, alfalfa, apple, walnut, almond, grape, pomegranate for agricultural products, sheet, goat, cattle, house, donkey, chicken, egg, honey for products of animal husbandry and rainbow trout for product of fishery. Moreover, there are produces of the secondary industries such as carpet, gilim, jojin, hats, shoes for handicraft and yogurt, cheese, butter and cake of Kashk by processed milk.
Residents in the Study Area consume these products by themselves as well as sell to get earnings for their livelihoods. Main products for selling are wheat, barley, rice, alfalfa, apple, walnut, sheet and goat.

Agricultural Products

Some amounts of wheat and barley are consumed by farmer themselves, but almost all of them are sold, on the other hand, wheat flour to be consumed are bought from shops. Because wheat flour, which is a stable food in Iran, is distributed by the government subsidy and is sold in cheap price. Moreover, farmers prefer the distributed wheat four of high quality to the processed flour in the village, which includes wheat bran and is low quality. On the other hand, since rice is found in the limited area, it is consumed or sold as same as wheat and barley.

Products are sold through agricultural cooperatives or traders. Selling prices of them are guaranteed by the government, but it is found that the actual farm gate prices have been less than the guaranteed depending on the market conditions. Farmers are not satisfied the selling price, however since the traders have a decision-power, farmer cannot help selling the products. Other agricultural products such as legumes, tomatoes, potatoes are sold in the near around cities and their traders. As for transportation, since the Study Areas are located insides and are mountainous, transportation is carried out by truck using the roads. Since roads are not paved, steep, is narrow and meandering, it is hard enough to transport. It is usually used synthetic fiber bags for packing.

Fruit

Apple as fruit is produced in some Study Area, especially Sar Baz a great deal, is sold to big cities

through traders. Selling prices are set by the government regulation, however, since it is dependant the market situations, some are sold at higher price than the designated prices. It may be that the tripartite meetings are held among farmers, traders and local governments and prices are determined at that meeting. Though roads in the Study Area are rough and selling prices are fluctuated, farmers intend to convert to crops farming to fruit farming by means of expanding and reclaiming the field, because that the fruit farming can give higher earnings than other crops farming.

However, since the fruit farming needs irrigation in the Study Area, water resources and irrigation facilities are required. As farmer want to sell all products even in good quality or poor quality and maybe reduce their labor cost, they divide the field for each trader to sell the products ready to be harvested. Traders carry out the collection of the labor force to harvest, pack and transport. Harvested apple are packed in wooden case and transported by the trucks. Traders usually come from big cities and products are carried there such as Tehran, Esfahan or Shiraz.

Livestock

Livestock products in the Study Areas are mainly sheep and goat. They are sold to traders near around or transported to sell to governmental trading places at Esfahan or Shahrekord by farmers' themselves. Minimum trading prices are determined by the government and they are stable. Products are usually transported by means of trucks. Chicken are usually consumed at home in the Study Area, and sold in very rare case. Selling price is less than a half price of sheep to within the village or near around. Other activities for livestock, bee-keeping are conducted in the Study Area. Modern beehives were introduced around 5 years ago and apiculture is hoped to develop. However, limited nectar sources in the Study Area and long winter season prevent from developing.

Fishery Products

Fishery products in the Study Area is only rainbow trout which are grown at the fish culture farms using spring water from the foots of mountains. Fish-culture is usually conducted by individual private firms from big cities. It is rare case that the village people are conducting the fish-culture such as Sar Baz area. Construction and operation of fish-culture are regulated by the Provincial Fishery Organization and its permission and license are required. Fish firm person is required to training at the beginning and every year.

Almost all fish-culture firm were received the loans. Fish products are sold by firm themselves and transported to the warehouse owned by the Fishery Organization in the central Tehran and Esfahan. They use trucks for its transportation and sometimes refrigerator trucks are used. Almost of fish products are transported to central, then distributed to rural. Prices are determined by the government and stable. However, prices in summer and winter are different. Fishery organization determines the wholesale prices and retail prices, so marketing prices are not dependant on the market situation.

8.6.2 Agricultural Processing

Agricultural processing activities belong to the next section, however, it is more closely mentioned in the section. Agricultural processing activities in the Study Area are mainly conducted for crop processing and livestock product processing. Main crops are wheat and rice, of which rice is only in Zeras area. In Zeras areas for crop processing, simple wheat four mill and rice mill are installed by means of investment of users themselves in almost all villages, for this area are closed the access road to the near town by the snowfall in winter. Operation and maintenance of these processing facilities are in good order and active. However, high quality factory wheat four have been distributed recent year, village mill flour is getting disliked to the villagers, because its flour contains wheat bran and its color is black. Other areas such as Vastegan has village mill. On the other hand, in Sar Baz area where apple are largely grown, villagers buy wheat flour for their consumption from the near town and village mill are not installed. Other processing activities conducted by the villagers are productions from milk of sheet, goat or cow. They make milk, butter, cheese and Kashk as cake. Especially, in Vastegan and Sar Baz area, these processing activities from cow's milk are popular. However, they are conducted within the family, not by the cooperatives or by the company. Villagers are willing to promote these processing activities. Although, at present, there are no first processing activities (collecting, grading, packing, distribution, etc.) for agricultural products (example: apple or vegetable) grown in the area, there is a possibility to be developed by growers' themselves by means of establishing groups and/or cooperatives in the area.

8.6.3 Rural Industry

Handicraft

Handicraft in the Study Area is mainly manufacturing carpet and gilim. These productions are prevented from developing because of high price of raw materials, far distance of market places and lack of budget for buying raw materials and weaving machines. Other handicrafts manufacturing has same problems and is in same conditions as the carpet manufacturing. Though he government has conducted training, loan supply as well as marketing support to develop the rural handicraft, its limited budget prevent from properly supporting. Since the Study Area is far from large cities and government support cannot reach within the area, it is found that the handicraft activities are conducted by only one forth of village households and they are reducing.

Handicraft promotion is conducted several governmental departments such as Deputy of Rural Industry and Development (Jihad), Ministry of Industry, Ministry of Cooperatives and Ministry of Health, their activities are independent not cooperate or not make up each other. A part of activities is conducted together by Deputy of Rural Industry & Development (Jihad) and Ministry of Health for

repairing workshops, procuring equipment and training and education by supplying loans (Tarheh Bagha and others). In Chaharmahal va Bakhtiyari Province, area of which accounts for 50.5% of total Study Area of Phase I, carpet production is reported increasing at 103.23% per year by rural weavers and at 114.26% per year by carpet cooperatives in Provincial Statistic Data Book.

The some villagers in convenient places around the Study Area can be obtained by the government supports. However, since the government support cannot reach five Study Area, villagers in these areas have not yet established the cooperatives or are not conducting group selling. Since selling volume is small, they usually use bus or sell to traders using trucks. Marketing places are big cities such as Esfahan, Shahrekord, Shiraz, etc. There are developing areas where villagers have established cooperatives and sold as group selling.

For example, Semirom carpet cooperative supported by Deputy of Rural Industry and Development (Jihad) are conducting buying carpets from members of cooperative and selling them retail shops within the area or exhibition market at the near towns and cities. However, it is found that said cooperative have stopped the activities on that survey's day of July 2001 for recovering the good marketing conditions and stable trading prices. In Vastegan area, there is a carpet cooperative in Borojen near Vastegan, villagers sell carpet through said cooperative.

Rural Industry

Government considers that the rural industry is one of the essential sectors for rural development, increment of employee rate and stability and sustainability of socio-economic and have been promoting. Rural industry promoted by Deputy of Rural Industry and Development (Jihad) is categorized as 115 types for food industry, 59 types for mineral (non-metal) industry, 78 types for textile, 118 types for chemical and cellulose and 57 types for metal as well as employee of which are less than 50 persons and investment value of which is less than 3 billion Rials in 1999. It is reported that 14,350 permissions were applied, 6.82 trillion Rials were invested and 195,000 persons were employed during 12 years from 1987 to 1999. And of which, it is reached that 4,318 industry were operated with 53,000 employees.

Moreover, industry areas were developed and 90 industry areas out of 170 were reached to operation with 3,490 employees. It is expected to create newly 76,000 employees. It is reported that 130 permissions were accepted from 1995 to 1999, 58 actual credits with 469 employees were accomplished from 1995 to 1998 and 202 industry plants with 298 employees were exploited by reports of Chaharmahal va Bakhtiyari Province. Moreover, 5 categories of industry and industrial area have been developed year by year are reported by Annual Report 2001.

Also, training and education have been conducted, they were 220 man-day about marketing, 150

man-day about project control and 45 man-day about meeting of producers in the year of 2000. However, as five Study Areas are scattered located in the mountainous areas as well as socio-economic infrastructure such as transportation and communication in the Study Areas have not yet developed enough, rural industrial plants have not yet installed. On the other hand, rural industries near the Study Areas have been developing. 43 plants in Gandoman near Vastegan Area, 33 plants in Semirom near Sar Baz area, 121 plants in Boyerahmad (Yasuj) near Tange Sork and 25 plants in Izeh near Zeras area have been obtained the permissions (ANNEX K-10, Rural Industry around Study Area). In the Study Areas, it is expected that rural industries (collecting, grading, packing, distribution, etc) using agricultural products and the local materials can be established coordinated with the existing rural industries (for employment, incentives, human development, development of infrastructure, etc) near the Study Areas.

8.7 Natural Disaster

8.7.1 Flood and Debris Flow

The detailed survey on flood and debris flow is included in the Sub-contract Works; Natural Disaster Survey, and the details of the results of the survey are explained in the Report. Thus the outline of flood and debris flow is excerpted here as in the followings.

(1) Vastegan (K4-1-9)

The topography of the master plan area is generally divided in three parts, upland on the west with the elevation of more than 2,500m up to 3,600m, lowland on the east consisted of alluvial fan and plain with the elevation of around 2,300m down to 2,200m, and the steep cliff in between. The western upland is also divided into two parts; one is northern part which is sloping south formed with limestone and the other is southern part consisted of Marl and limestone.

There are two major rivers in the master plan area. Gela River collects the water from upland, the catchment area of which is around 35 km2, and flows into the lowland causing a lot of flood and debris flow damage, while R.Aghabolugh, that flows through the marsh located north, borders eastern part of the master plan area. Upstream of R.Aghabolugh is the marshland and it functions as a retarding pond, therefore, there is no severe flood damage along this river. In addition, there are several valleys on the steep cliff that borders the upland and the lowland.

1) Southern Part of Western Upland

The elevation of this part is from 2,500m to 3,500m and the mountain slopes consisted of Marl generally face toward north. Many tributaries are dissected here just as dendritic drainage pattern and the lower part of these tributaries are filled with debris because of sever erosion on Marly slopes. Therefore, 43 check dams have been constructed in order to store the debris and to stabilize the foot of

the slopes. This is obviously clear that the extent of erosion is very large and that debris flow causes a lot of problem in the downstream.

2) Steep Cliff Area

Among the valleys on the steep cliff area, the two northern tip ones, near Nasir Abad, have larger catchment area and a small alluvial fan is extended downstream. Two small valleys are also located behind the village of Nasir Abad. According to the interview with the villagers, small-scale debris flows occur in these valleys during the heavy rain, however, the damage is limited.

3) Eastern Lowland

Originally this area used to be a lake or marsh, however, debris from western upland, especially the debris from Gela River filled the area and finally alluvial plain is formed. Gela River carries a lot of debris with floodwater and spread over the lowland adjacent to the village of Vastegan located at the outlet of narrow gorge and it's downstream. The materials consist of debris from the upland are mainly fine particles and fragment of shale and the farmland along the river course of Gela is covered with such sediments.

4) 1998 Flood

On March 30th, 1998, Gela River flooded with a few days continuous heavy rain, and the muddy water overflowed the bridge beside Vastegan village, which connects Vastegan and Nasir Abad, and covered mainly on the left bank of Gela River, where the elevation is slightly lower than that of the right bank. Around 100 ha. of farmland had been inundated, and 80 ha. of it is still covered with debris and left behind. The inundation reached as far as Nasir Abad and its depth was at around one meter near the bridge. Flood and debris flow damage is summarized as shown in the following table;

Table 8-7-1-1 Summary of Flood and Debris Flow Damage

Time of occurrence	Location	Damage	Source of information
60 years ago	Vastegan, Konark Olya, etc.	Farmland, fort	Villagers in Konark Olya
17 or 18 years ago	Vastegan, Konark Olya, etc.	Farmland	Villagers in Konark Olya
6~7 years ago	Vastegan, Konark Olya, etc.	Farmland; 20 ha	Villagers in Konark Olya
March, 1998	All Vastegan area	Road,cereals,farmland;100 ha	Villagers in Vastegan & Nasir abad, Provincial Office
			Time of investigation; September, 2001

5) Rainfall Record

On March 30th, 1998, the daily rainfall was recorded 51 mm while the monthly amounted to 111.5 mm, which marks the maximum record in this area. The elevation of unmelted snow on the day of heavy rainfall was at around 2,650 m and the cause of flood is clearly derived from heavy rain and snow melting. Another cause of flood inundation is the two irrigation canals, which are aligned on the low embankment and cross Gela River almost perpendicular. The crossing points become "bottle necks" and then floodwater is retarded and inundated in the surrounded areas by these low

embankment and Gela River.

On the other hand, the maximum daily rainfall, the maximum monthly rainfall and the date of occurrence at Brujen meteorological station are as follows;

Table 8-7-1-2 Maximum Daily/ Monthly Rainfall at Boroujen

Max. daily rainfall	Date of occurrence	Max. monthly rainfall	Date of occurrence
40 mm	March 1, 1971	116 mm	May 22 ~June 21, 1990 (Iranian month: Khordad)
45 mm	February 17, 1980		
80 mm	June 3, 1970		

6) Existing Disaster Prevention Facility

As is discussed in the previous section, various sizes of 43-check dams have been constructed in the southern part of the Western Upland. The two out of 43 are stone check dams and the rest are generally gabion type dams. Around 80 % of these check dams have the height of 2~3 m, however, most of them function efficiently in trapping sediment and stabilizing the riverbeds. According to the Natural Disaster Survey, the vacant volume of these check dams is estimated around 120,000 m3.

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

Chaman Goli-Bazoft area is generally bordered by the mountain ranges except for the eastern part, the border of which is the Bazoft River. The west and south mountain ranges are consisted of the peaks of 3,000 m to 3,400 m, while the northern mountain range becomes lower to 2,500 m to 2,000 m

There are three sub-basins in the master plan area. All the basins are drained into the Bazoft River. 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. The damage from flood and debris flow in the master plan area is as follows;

1) Fariak River basin

In the upper and middle reaches of Fariak River, oak trees are rather well vegetated, and farmland is extended along the lower reaches of the River. No village is located, however, there are a few houses of Fariak village.

2) Gusale Bar River basin

From the upstream of this river, the villages of Kachooz, Baghchenar, Dorak, Arteh, Khiyarkar, Chemghaleh and Fariak are located and each village receives flood and debris flow damage.

Kachooz; In 1996, a severe debris/muddy flow occurred from the upper reaches of Gusale Bar River,

one of the Nomad tents was washed down, and three nomads were killed and two or three were missing. In 1996 and 1998, some small-scale flood and debris flow and rock falls occurred on the slope of the trunk road beside the village and caused damage to some houses located below the road.

Baghchenar; There are two small tributaries joins into Gusale Bar River from the left bank. The village is located along these two tributaries. The catchments are rather small, poorly vegetated on the steep slope, and very erosive. Eventually, the riverbeds become deeper and deeper and the riverbanks are extended into the farmland adjacent to the rivers.

Dorak; The village, located on the left bank of Gusale Bar River, has gully erosion and frequent flood damage. One water mill located on the riverbank of Gusale Bar River, 4 m higher than its riverbed, had been washed away

Arteh; The village is located on the right bank of Gusale Bar River. This village has also too much problem from flood and sometimes people are killed.

Khiyarkar; The village is also located on the right bank of Gusale Bar River. This village has also too much problem from flood.

Chemghaleh; The village, the center of the master plan area, faces to the Bazoft River on the right bank. Gusale Bar River bends sharply at the northern part of Chemghaleh and joins the Bazoft River. This sharp bent causes problems such as overflow in the farmland, riverbank erosion, etc.

Fariak; The village is located on the left bank of Gusale Bar River and also faces to the Bazoft River on the right bank. After the river course bends sharply at Chemghaleh, the river turns to the village of Fariak, and joins the Bazoft River. The flood in 1998 and the following flood seriously eroded the riverbanks, especially on the left bank where graveyard and farmland of Fariak village are located, as far as around 70 m. Similar floods will threaten the houses and the village road to Fariak.

3) Tabarak River basin

This basin has three villages, Tabarak Olya, Tabarak Sofla and Ghale Tabarak, from upstream to downstream, and all the villages have flood and debris flow damage.

Tabarak Olya; The village is located on the left bank of Tabarak River. This village had too much problem from flood in 1998, which caused a lot of damage in orchard gardens and farmland. This flood was so strong that the villagers living near the river had to evacuate to safer places and that 6 check dams have been constructed since then.

Tabarak Sofla; The village is located on the hillside or hilltop of the left bank of Tabarak River. Thus the village itself has little problem with flood and debris flow. However, the flood in 1998 caused a lot of damage on orchard gardens and farmland along Tabarak River, and to domestic animals, especially sheep. It is reported that this flood triggered many landslides, made two house half-wrecked, and washed 40 sheep and 5 goats away.

Ghale Tabarak; The village is located on the small hilltop of the right bank of Tabarak River. The village has little problem with flood and debris flow. However, the flood in 1998 caused severe erosion on the rivers, which flow front and behind the village. Four check dams have been constructed on the river in front of the village in order to prevent further damage for the village road and farmland. In addition, the river behind the village deepened its riverbed and caused erosion on surrounding farmland.

4) Existing Disaster Prevention Facility

Twenty-one check dams have been constructed on the Tabarak River basin, especially in and around Tabarak Olya. Almost 70% of these check dams have the height of only up to one meter and their storage volume is very limited. The total storage volume is 1,100m³, stored sediment volume is 300m³, and vacant capacity is 800m³.

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

Sarbaz area is generally bordered by the Dena mountain ranges except for the northeastern part, the border of which is the Marbor River. The southern mountain range is consisted of the peaks of 4,000 m to 4,100 m, while the east and west mountain ranges descend to around 2,100 m near the Marbor River.

There are two major sub-basins in the master plan area, one is located in northern part and anther is in the southern part. All the basins are drained into the Marbor River.

The damage from flood and debris flow in the master plan area is as follows;

1) North Sub-basin

This basin has two villages, Noorabad and Sarbaz, and 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, where villages, farmland, and even Nomad camps are located, is generally covered with Marl and eroded severely, especially the farmland along the tributaries of Marbor River.

Noorabad; The village is located on the hill and has no flood and debris flow damage, however, the two tributaries running down along the both side of the hill sometimes cause flood and debris flow

damage on the farmland.

Sarbaz; The village is located on the slope of the hill and has seldom flood and debris flow damage. One tributary with small catchments flows down below the village through the farmland and sometimes small-scale floods occur with minor damages.

2) South Sub-basin

Lee Sorkh River, which flows from south to north in the South sub-basin, is one of the major tributaries of the Marbor River. From the upstream of this river, the villages of Noghel, Dangazloo, Kahangan, Deh Bozorg, Telmohamad, Zabih Abad, Devergan Olya, Devergan Sofla and Dorahan are located. The most downstream village, Dorahan, is also faces to the Marbor River

On the upper reaches of Lee Sorkh River, one of the valleys is filled with debris consisted of big boulders, which were derived from the huge rockslide on the slope of the Dena Mountains around 30 years ago. On the most upper reaches of the debris-filled valley, a small pond was formed at the time of the slide and remains stable since then. Judging from the size of boulders in the debris-filled valley, rather smaller materials had been washed down and big ones had been left in the riverbed.

The flood that occurred during the last ten days of March 1998 damaged the villages and the orchard along Lee Sorkh River. Some landslides also happened because of the flood. Most of the damage was incurred to the orchard gardens along the River from Kahangan down to Marbor River.

The flood and debris flow damage in this basin occurs in Kahangan, Deh Bozorg, Telmohamad, Zabih Abad, Devergan Sofla and Dorahan. Other areas are very scarce.

The damage from flood and debris flow in the concerned villages is as follows;

Nogel; The village is located on the hill and has little flood and debris flow damage, however, the old village located around 3 km upstream was hit by the debris flow, most of the houses were destroyed, and they resettled here.

Kahangan; The village is located on the right bank of Lee Sorkh River and flood and debris flow sometimes occur. One of the inhabitants of this village, who is about 65 years old, explained that about 30 years ago, a severe flood that took place in the area and caused a lot of damage to the area and the villages .

Deh Bozorg; The village is located on the left bank of Lee Sorkh River and flood and debris flow sometimes occur.

Telmohamad; One left tributary, which drains the center of the master plan area, runs near this village located on the left bank of Lee Sorkh River, caused a lot of damage for lower lying orchard gardens, and uprooted and washed away during the flood in 1998.

Zahid Abad; The village is located on the left bank of Lee Sorkh River and flood and debris flow sometimes occur because the village is located near the River.

Devergan Sofla; The village is located on the left bank of Lee Sorkh River and flood and debris flow sometimes occur because the village is located near the River.

Dorahan; The village is located on the right bank of Lee Sorkh River and the Marbor River, therefore, flood and debris flow frequently occur.

3) Flood Information

There are no climatologic nor river gauging stations in the master plan area. Some data are available from the Shahid station, a little upstream from the master plan area.

The flow data recorded in this station show the big flood occurred about 30 years ago (in 6th of March, 1972, the river discharge was recorded 400 cubic meters per second).

The maximum daily, monthly, annual rainfall and the minimum annual rainfall are summarized as follows;

Table 8-7-1-3 Maximum Daily / Monthly Rainfall (Sarbaz)

Max. daily rainfall	Date of occurrence	Max. monthly rainfall	Date of occurrence
209 mm	Jan. 28, 1968	464 mm	Bahman, Iranian month (21 Jan - 19 Feb) in 1967
208 mm	Feb. 4, 1968		
200 mm	March 21, 1969	352 mm	Jan. 1975-76, Feb. 1977-78
150 mm	May 10, 1978		

Table 8-7-1-4 Maximum / Minimun Annual Rainfall (Sarbaz)

Max. annual rainfall	Year of occurrence	Min. annual rainfall	Year of occurrence
998.5 mm	1975-76	262 mm	1988-89
941mm	1977-78	268 mm	1969-70
920 mm	1965-66	269 mm	1981-82

4) Existing Disaster Prevention Facility

Revetment and spur dikes are partially installed on the banks of Lee Sorkh River.

(4) Tang Sorkh (K7-48)

Tang Sorkh area divided into three sub-basins. In the east, the biggest one is Tang Sorkh River basin, and the other is the rest of the catchment consisted of several small right tributaries of Boshar River. In the west, there are also several left tributaries of Boshar River.

Tang Sorkh River carries a lot of debris from its catchment and forms a large alluvial fan at the confluence of the Boshar River. Thus, the river course of Boshar River pushed westward at the confluence.

The villages of Tang Sorkh and Sar Tang Sorkh are located in the Tang Sorkh River catchment, while the other villages are in the left bank of the Boshar River.

The damage from flood and debris flow in the master plan area is as follows;

1) Boshar River

About 25 years ago, Boshar River flooded and had completely covered all the surrounding lands. Tang Sorkh River had also been flooded and had destroyed many farmlands. According to the investigation on the flood data at Pataveh station located on Boshar River, downstream of the master plan area, in 1977-78, the peak flow was recorded as much as 1,363 m^3/s.

One of the inhabitants of Hassan abad said that Boshar River over flowed about 10 years ago and destroyed the farmlands around the River.

2) Tang Sorkh River Catchment

During the 1998 flood, many parts of the farmland beside the Tang Sorkh watercourse in the vicinity of the Bashar River were destroyed.

Tang Sorkh; Flood and debris flows from the upper reaches of Tang Sorkh River cause a lot of problems here. The main source of debris is in the right tributary, which has seasonal flow in the river. The bridge crossing Tang Sorkh River has been washed away three times. The existing one was constructed three years ago (1998).

Sar Tang Sorkh; The village is located on the right bank of Tang Sorkh River. Judging from the riverbed condition, debris flow is limited, but flood occurs frequently.

3) Right Bank of Boshar River

There is no village in the area, however, farmland is extended in the basins formed by several

tributaries. Flood and debris flow occur in the area and cause damage on farmland.

4) Left Bank of Boshar River

According to the interviews with the villagers, a severe flood occurred in the area, however, it didn't cause a lot of damage to the villages.

Allah Abad; Behind the village, there are several streams flowing down from the hills consisted of Marl. Flood occurs frequently here.

Cheshmeh Chenar; The village is located at the foot of steep mountains, and flood/debris flow occurs frequently. The flood damaged some houses last year.

Hasan Abad; The Boshar River has frequent floods and causes damages on their farmland. One of the inhabitants of this village remembers one flood that happened about 10 years ago and said, " The flood was so strong that the water flowing from the mountain passed the asphalt road and covered the front of the houses but the damage to the villagers were not very great.

Mehrab Abad; Flood sometimes occurs in spring when snow melts due to rain from the upper part of mountains and Boshar River.

Islam Abad; Flood sometimes occurs in spring when snow melts due to rain from the upper part of mountains and Boshar River.

5) Existing Disaster Prevention Facility

This area has no disaster prevention facility at all.

(5) Zeras (K8-28)

Zeras area is located on the right bank of the Karoon River, where very steep slope is formed in the northwest, while there are two mild plateaus in the southeast.

Generally, the land in the area slopes down to the Karoon River towards south. The lack of vegetation cover on the steep slope easily causes floods and the fertile soil is to be carried down to the Karoon River, and causes surface and watercourse erosion. The damage from flood and debris flow in the master plan area is as follows;

1) Northwest Area

This area has many small villages, such as Dawodiha, Ali Bandeh, Behoz, Bardkal, Zeras, Lir Siya Shapouri, Lir Siya Mozrom, Lir Siya Mozrom, Sartuf, Shahghaz and Sebalutak.

Dawodiha; The village is located on the top of the mountain range and free from flood and debris flow damage. However, according to the interviews with the villagers, about 24 years ago two villages named Ghaleandaroon and Darrehgazoon, each had about 50 families, were destroyed by flood and the villagers migrated to this place, that is now named Davoodiha. The old villages were deserted and fell into ruin.

Ali Bandeh; The village is located on the right bank of the Karoon River. Flood occurs frequently and causes many problems.

Behoz; The village is located just on the right bank of the Karoon River. Floods in the Karoon River directly affect the village. This village will be submerged after the completion of the Karoon No.3 Dam.

Bardkal; The village is located in the valley of the right tributary of the Karoon River. Flood/debris flow occurs frequently and causes many problems.

Zeras; The village is located on the steep slope of the Valley and gully erosion is well developed around the village. There is a danger of flush floods on these gullies.

Lir Siya Shapouri; The village is located at the most downstream of the deepest valley of the right tributary of the Karoon River. Flood and debris flow occurs frequently and causes many problems.

Lir Siya Mozrom; The village is located on the deepest valley of the right tributary of the Karoon River. Flood and debris flow occurs frequently and causes many problems, especially on road. Sometimes, the village transportation is completely stopped.

Sartuf; The village is located on the deepest valley of the right tributary of the Karoon River. The land around the village is easily eroded.

Shahghaz; The village is located on the right bank of the Karoon River, the location of which is the mild plateau, and no flood occurs.

Sebalutak; The village is located on the right bank of the Karoon River, the location of which is the mild plateau, and floods causes less problems.

2) Southwest Area

This area has several villages, such as Gard Lidan, Dareh Zangi, Dareh Sohrab, Badelon and Cham.

Gard Lidan; The village is located on the right bank of the Karoon River, the location of which is the mild plateau, and floods causes less problems.

Dareh Zangi; The village is located on the western side of the mild plateau and there is a watercourse in the middle of the village, which is hazardous for some houses during flood.

Dareh Sohrab; One tributary, which passes through the village, is easily flooded and threatens the village during the intense rainfall.

Badelon; A few tributaries join above the village and the upstream has scarce vegetation. Thus erosion is severe here, and flood and debris flow occurs frequently and causes many problems.

Cham; The village is located just on the right bank of the Karoon River. Floods in the Karoon River directly affect the village. This village will be submerged after the completion of the Karoon No.3 Dam.

3) Existing Disaster Prevention Facility

This area has no disaster prevention facility at all.

8.7.2 Landslide

The detailed survey on landslide is included in the Sub-contract Works; Natural Disaster Survey, and the details of the results of the survey are explained in the Report. Thus the outline of landslide survey is excerpted here as in the followings.

(1) Vastegan (K4-1-9)

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

(2) 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.

(3) 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 such as south of Kahangan, a small hill facing to Lee Sorkh River between Kahangan and Dorahan, and west of Zabih Abad adjacent to the North Sub-basin.

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 such as south of Kahangan, a small hill facing to Lee Sorkh River between Kahangan and Dorahan, and west of Zabih Abad adjacent to the North Sub-basin.

(4) 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.

In 1973, a large-scale landslide occurred on the right bank of Boshar River, the location of which is immediate downstream of the master plan area. The size of the slide was 160 m in width, 480 m in length, and the collapsed earth volume was 768,000 m3. The collapsed earth blocked up the Boshar River and a temporal pond was created with the water depth of around 10 m. After a short time, the blocked earth was collapsed and washed down.

(5) Zeras (K8-28)

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

8.7.3 Surface Soil Erosion

Surface soil erosion has been analyzed based on USLE, in order to grasp soil erosion as well as to grasp factors which largely affect to erosion. For appling USLE, soil, vegetation, land use and land capability surveys are carried out in the study area.

(1) Soil Loss Estimation by USLE

Since the Study Team could not obtain the actual application of USLE in Iran, equation of USLE and factors for estimation of soil loss are referring to "Farmland Conservation, Engineering Manual for Farmland Conservation, The Japanese Institute of Irrigation and Drainage, March 1992". The equation and its factors are as follows:

$$A = R \times K \times LS \times C \times P$$

A: Soil loss (tf/ha), given by following factors. (tf=metric ton)

R: Rainfall erodibility index (tf m^2/ha hr), given by energy of rainfall in certain period.

K: Soil erodibility factor, given by properties of soil.

LS: Topography factor, given by slope length (L) and slope steepness in angle (S).

C: Crop management factor, given by bareness of land by crop and its growing stages. In case of bare land, factor C is set at 1 and reduced by land cover of crops or vegetation. Factor C differs by crops and their growing stages.

P: Conservation practice factor, given by cultivation method relating to conservation farming techniques such as contour cropping. In case, the land is left without any conservation practices.

(2) Present Surface Soil Erosion

Based on USLE, present surface erosion of each study area has been assessed and estimated. The results are summarized as in Table 8-7-3-1 and shown in Figure 6-1 to 6-5 as erosion hazard map in Database Map.

Table 8-7-3-1 Present Soil Erosion Estimation by USLE and Comparison to PSIAC

Master Plan Area	Soil Loss by Areas											
	Vastegan		Chaman Goli-Bazoft		Sarbaz		Tang Sorkh		Zeras		Weighted Average	
Rainfall Erodibility Index (R)	67.40		140.06		78.40		144.51		37.25		93.52	
Soil Erodibility Factor (K)	0.11 - 0.35		0.14 - 0.35		0.19 - 0.35		0.19-0.37		0.41 - 0.49		0.11 - 0.49	
Land Use	(t/ha)	(mm)	(t/ha)	(mm)	(t/ha)	(mm)	(t/ha)	(mm)	(t/ha)	(mm)	(t/ha)	(mm)
Farmland	0.5	0.04	17.0	1.21	3.7	0.26	6.3	0.45	41.1	2.94	12.7	0.91
Irrigated Farmland	0.3	0.02	1.4	0.10			1.6	0.11			0.5	0.04
Dry Farmland	11.1	0.79	25.3	1.81	32.8	2.34	18.1	1.29	41.1	2.94	34.1	2.44
Orchard	0.0	0.00	5.2	0.37	0.7	0.05	1.6	0.11			0.8	0.06
Tree Plantation	*0.0*	*0.00*			*1.0*	*0.07*	6.5	0.46			0.5	0.04
Rangeland	55.5	3.96	33.8	2.41	26.8	1.91	48.4	3.46	63.0	4.50	42.5	3.04
Rock	46.4	3.31	13.7	0.98	9.7	0.69	9.7	0.69	9.7	0.69	17.7	1.26
Total Soil Loss (USLE)	27.7	1.98	17.7	1.26	14.6	1.04	29.0	2.07	48.1	3.44	24.0	1.71
Total Sediment (PSIAC)	9.1	0.65	6.2	0.45	4.6	0.33	7.6	0.54	9.7	0.69	7.4	0.53
USLE/PSIAC	3.1		2.8		3.2		3.8		5.0		3.2	

(Note) 1) Soil density is estimated at 1.4 t/m^3 by soil analysis.
2) Soil loss of rock is estimated based on the result of GIS erosion map prepared by the Phase-1 Study except Vastegan.
3) Detail analysis is shown in Table D-5-2-8 in Annex D.
4) Sediment amount by PSIAC is derived from Inventory by Phase-1 Study.

1) Comparison to PSIAC

The erosion amount by USLE is larger than the sediment amount by PSIAC in any cases in this Study. The differences vary from 2.8 times larger in Chaman Goli-Bazoft to 5.0 times larger in Zeras, and 3.2 times larger in average. The result of PSIAC is sediment, and that of USLE is soil loss or erosion. Erosion is the source of sediment so that erosion is usually larger than sediment because the eroded soil is deposited in the channels and the depressions, and some parts are drained as the sediment. It is difficult to grasp the ratio between sediment and erosion amounts, because it may differ by physiography, channel gradient, size of particles, etc. As far as the results obtained in this Study, it can be roughly said that about 1/3 of erosion amount is drained out to the downstream basin as the sediment and the remaining 2/3 is

deposited in the depressions or the channels to mitigate the steepness of landform. Average annual erosion amount is estimated at 24 t/ha/yr or 1.7 mm/yr against 7.4 t/ha/yr or 0.5 mm/yr of sediment discharge.

2) Evaluation of Overall Erosion

From the aspect of basin-wise erosion, the heaviest erosion is observed in Zeras as 48 t/ha/yr or 3.4 mm/yr, and followed by Tang Sorkh as 29 t/ha/yr or 2.1 mm/yr. In Zeras, heavy erosion is caused in spite of low rainfall erodibility (R=37.25), because soils are sensitive to erosion due to high soil erodibility (K = 0.41 to 0.49), steep land slope (up to over 50%), high bare land ratio of about 40% in the rangeland due to heavy grazing and bareness by dry farming. On the other hand in Tang Sorkh, since rainfall erodibility is very high at R=144 tf·m^2/ha·hr due to high intensity of rainfall, heavy erosion is caused especially in the wasteland and the rangeland. In Tang Sorkh, the reasons of heavy erosion other than high intensity of rainfall are the existence of the erosive marl hills in the wasteland and the highly inclined rangeland. Vastegan follows Tang Sorkh by 28 t/ha/yr or 2.0 mm/yr. In Vastegan, since the weathered marl formation extensively covers the upstream basin, erosion is very high at about 80 t/ha/yr or 5.7 mm/yr in the marl formation. It is, however, difficult to control and protect such geological weathering by the present technology level. Soil losses in Chaman Goli-Bazoft and Sarbaz are relatively small as 18 t/ha/yr (1.3 mm/yr) and 15 t/ha/yr (1.0 mm/yr) respectively.

4) Evaluation of Erosion by Land Use

From a viewpoint of land use, rangeland is severely high in soil loss as 43 t/ha/yr or 3.0 mm/yr in average of 5 areas as shown in Table 8-7-3-1. It is caused by poor vegetation and over grazing. Soil loss of dry farmland follows the rangeland. Its soil loss reaches 34 t/ha/yr or 2.4mm/yr in average. From the aspect of soil loss amount, following classification has been set as shown in Table 8-7-3-2. As shown in the table, most rangeland and dry farmland are classified into more than Fair (over 15 t/ha/yr). Rangeland of 12,788ha (85% of total rangeland) and dry farmland of 2,936 ha (78% of total dry farmland) are classified into more than Fair. On the other hand, there are no or less problems for irrigated farmland, orchard and tree plantation.

Table 8-7-3-2 Soil Loss Severity by Land Use in 5 Master Plan Areas

Land Use	Area by Soil Loss Amount (ha)								Average Soil Loss (t/ha/yr)
	Trace	Little	Moderate	Fair	High	Severe	Very Severe	Total	
(t/ha/yr)	(0-5)	(5-10)	(10-15)	(15-20)	(20-30)	(30-50)	(50-)		
(mm/yr)	0-0.4	0.4-0.7	0.7-1.1	1.1-1.4	1.4-2.1	2.1-3.6	3.6-		
Farmland	6,683	659	170	84	933	1,220	699	10,448	12.7
Irri. Farmland	4,304	0	0	0	0	0	0	4,304	0.5
Orchard	2,353	23	0	0	0	0	0	2,376	0.8
Dry Farmland	26	636	170	84	933	1,220	699	3,768	34.1
Tree Plantation	87	4	0	0	0	0	0	91	0.5
Rangeland	0	1,237	990	1,171	2,724	5,085	3,808	15,015	42.5
Rock	0	10,360	7,491	0	0	2,184	1,855	21,890	17.7
Others	911	0	0	0	0	315	0	1,226	10.3
Total	7,681	12,260	8,651	1,255	3,657	8,804	6,362	48,670	24.0
	(Ratio of Area by Soil Loss)								15 t/ha<
Farmland	64%	6%	2%	1%	9%	12%	7%	100%	28%
Irri. Farmland	100%	0%	0%	0%	0%	0%	0%	100%	0%
Orchard	99%	1%	0%	0%	0%	0%	0%	100%	0%
Dry Farmland	1%	17%	5%	2%	25%	32%	19%	100%	78%
Tree Plantation	96%	4%	0%	0%	0%	0%	0%	100%	0%
Rangeland	0%	8%	7%	8%	18%	34%	25%	100%	85%
Rock	0%	47%	34%	0%	0%	10%	8%	100%	18%
Others	74%	0%	0%	0%	0%	26%	0%	100%	26%
Total	16%	25%	18%	3%	8%	18%	13%	100%	41%

(Note) 1) Others: Village, River bed, Waste land
2) Tables of sub-basin wise are in Table D-5-1-9 (1) to (5) in Annex D

(3) Considerations on the Factors of Erosion

From a viewpoint of factors which affect to erosion, following important issues are elaborated for soil protection measures in the area.

R: Rainfall erodibility index is not able to change because of natural climate condition.

K: Soil erodibility factor is possibly to be changed by improvement of infiltration rate by putting organic matters, but basically difficult to be changed in large areas such as rangeland.

L: Slope length is possible to change by providing the contour bunds in the slope by the farmers, but understand of farmers and supporting system to them are essential.

S: Slope steepness factor is possibly to change like as by terracing, but it needs a lot of cost for earth work.

C: Crop management factor is possible to change by converting crops to more protective crops like as alfalfa in the farmland and protecting or seeding in the rangeland, but understand of farmers and supporting system to them are essential as same as contour bund.

P: Contour cultivation is essential to improve conservation practice factor, but understanding of farmers is strongly required. Most farmers are employing contour cultivation in the area, while slope direction cultivation is carried out in some places where mechanized cultivation is introduced in the Karoon river basin.

(4) Further Study on Surface Soil Erosion Protection

For the practice of soil conservation and the selection of proper measures, the most important are to

know what factors are governing erosion and to grasp correct erosion amount not only at present stage but also in future. As mentioned in the previous paragraph, many factors are affecting to surface erosion. Those factors can be classified into two categories, namely the factors not able to change by human activities and the factors able to change. Important and essential factors are the those able to be changed by human activities like as the topography factor (LS), crop management factor (C) and conservation practice factor (P). Estimation of erosion amount varies largely by those parameters. For deciding the correct parameters, it is necessary to grasp the correlation to the actual erosion amount. In order to grasp correlation and to decide correct parameter, it is necessary to carry out a large quantity of experimental work. In Iran, such experimental work has not been yet carried out so far.

On the other hand, the unchangeable factors like rainfall erodibility index (R) and soil erodibility factor (K) are to be grasped correctly and adequately for proper conservation practice. For grasping the correct rainfall erodibility index, it is necessary to provide enough number of the recording type rain gages to grasp short duration rains which cause the major part of erosion. Regarding to the soil erodibility factor, adequate soil survey has to be carried out to grasp soil properties and infiltration rate. For this purpose, experimental research works are to be considered:

8.8 Environment

In general natural environment of five master plans areas has been degraded. 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. Poisonous snakes and scorpions are also commonly seen in the areas.

No national park or cultural assets exist in the areas.