PHASE I INVENTORY STUDY

1. INTRODUCTION

1.1 Authority

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

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

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

1.2 Background

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

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

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

1.3 Objective and Scope of Study

1.3.1 Objective of the Study

The objectives of the Study are:

(1) to formulate a master plan on integrated watershed management for the selected area in Karoon watershed to prevent further degradation of natural resources and promote sustainable development.

(2) to carry out technology transfer to the counterpart personnel in the course of the Study.

1.3.2 Study Area

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

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

1.3.3 Scope of the Study

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

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

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

2. SOCIO-ECONOMIC BACKGROUND

2.1 National Economy

The economy of Iran is characterized by its huge dependence upon the oil exportation. The

fluctuation of oil price in the international market seriously affects the economic performance, specifically towards balance of payments and debt services.

Sectoral contribution ratios to GDP are: oil, 14%; agriculture, 21 %; mining and manufacturing, 19 %; and, services, 35 %. The oil sector earns more than 80% of foreign exchange from the exports, in the country. In the first decade after the 1979 Islamic Revolution, Iran has experienced a population explosion. A sudden drop of international oil price in 1986 aggravated the already declining growth trend of the economy, leading to economic shrink by 9 % after 2 years. During the period of 1988 to 1990, the oil price rose sharply and the oil sector enjoyed the doubling in the earnings. The real GDP growth in the years of 1990 and 1991 registered 11-12 %; however, it returned to around 5 % in the succeeding years, because the distorted economic structure could not sustain the development.

Recent figures of the overall economic performance, since 1995 onward, are disappointingly low, if compared to the aimed targets of 5-year Plans.

Agriculture sector contracted by 0.3 % in the fiscal year 1999/2000. This is the direct impact of the last year's severe drought; the conditions being persisted, the hope of rapid agricultural recovery has begun to retreat.

2.2 Development Plan

2.2.1 Previous Development Plans and Implementation

Upon the coming to end of Iran-Iraq War, an ambitious reconstruction and economic reform programme was formulated in the form of the First 5-year Development Plan. The Plan aimed at market liberalization, through resolving complex price and quantity control of commodities, withdrawing a quota system in the importation, and gradually relaxing the foreign-trade restrictions with the fixation of exchange rate. From 1995 to 1999, the Second 5-year Development Plan was implemented, which was formulated on the basis of the review and reflection of the First Plan.

The target of economic growth in the First and Second Plans were, 8.1 % and 5.1 %, and their attainment, 7.3 % and 3.2 %, respectively. The year 1994 was not covered by either Plan, when an entrenchment policy was adopted in the government budget. The current Third 5-year Development Plan puts up the targeted economic growth of 6.0 %.

2.2.2 Current Development Plan and Its Contents

The Third 5-year Development Plan came into effect in March 2000, committing the government to a range of fiscal and structural reforms. For implementation, the Third Development Plan Law was

passed by the Majlis (the parliament), and the fund resources have been secured in the allocation to the programmes of the Plan.

2.3 Policy on Watershed Management and Rural Development

2.3.1 Watershed Management Policy and Strategies

Watershed management is touched upon in Water and Agriculture Sector in the Third 5-year plan. Based on 10 Strategic Policies, prepared are Executive Policies and Executive Strategies. Among 27 Executive Strategies, description of watershed management could be found in the 10th item, that is:
[Executive Strategy - 10]
"Watershed management for the conservation and exploitation of soil and water resources; especially, in the river basins having water supply project (completed;on-going) shall be the priority to be carried out."

Out of total of 27 Executive Strategies, watershed management is 10th priority. This means that watershed management occupies a rather fair significance in Water and Agriculture Sector, as well as in the context of national development.

2.3.2 Rural Development Policy and Strategies

The Third 5-year Plan carries Strategic Policies and Executive Policies for rural development, formulated on the basis of analysis of present conditions and future perspectives. Analysis has been carried out, divided by the ordinary farming villages and the traditional tribal society. Executive Policies stipulate the activities and mandates of the governmental / public institutions in charge of rural development. The following are Strategic Policies:

- To provide rural improvement, in attention to operation and rolling of the village economy, to be attained by structural reform of the production system, for favourale exploitation of the existing production resources;
- To support in creating the small credit-suppliers group, to facilitate presentation to the villagers, and to find out new financing source;
- To reorganize the existing establishment for rural improvement, for creating required condition;
- To avoid over-centralized institutional set-up and duplicate activities of the entities in charge of rural improvement, for obtaining clear roles duties;
- To reduce the incumbency surrounding executive activities in rendering services rural villages;
- To accord with the standards/criteria in rendering services and for approval of rural improvement;
- To provide visiting works, based on rangeland-livestock balance, for social and economic

requirement;

- To provide the settlement sites for tribes at the voluntary basis;
- To improve the existing management/organization, for the reduction of incumbency, enhancement of effective cooperation, and promotion of tribes to become active in the the performance in the tribal region, or favourable local management-running area, to maintain tribal biosphere.

The mission of Ministry of Jihad-e-Sazandegi is to increase people's welfare through rural development, and main field of their activities are rural area. Ministry of Jihad-e-Sazandegi keeps close communication with rural peoples, and has been attached importance to villager's willingness to development. It can be said that the Ministry have been taken Islam-style participatory approach. This participation approach can be set a high valuation on, and much useful to realize sustainable development in the Karoon watershed.

2.3.3 Organization Structure of Ministry of Jihad Agriculture

Ministry of Jihad-e-Sazandegi was founded in the form of a revolutionary organization, Jihad-e-Sazandegi, in 1979. It becomes an independent ministry in 1988. The present form of ministerial structure was determined in 1990, with the functional separation from Ministry of Agriculture. In 2001, Ministry of Jihad-e-Sazandegi and Ministry of Agriculture were united, and Ministry of Jihad Agriculture was formed.

3. THE STUDY AREA

3.1 Physical Feature

3.1.1 Location

The Study area is located in the Southwest of Iran and whole the area is about 27,000km^2 and is included in the upper Karoon river basin. Share-Kord is convenient as the base-camp for the field investigation. It takes about one hour from Teheran by air and it takes about eight hours by car (abouto 770 km). The road network in the Study area develops comparatively. However, the road condition is not so good in the rural area and there are many passes in a high altitude of 3000-4000m, therefore 4WD car is necessary for the site investigation.

3.1.2 Topography

Most of the area is located in a high altitude from 1000 to 4000m in Zagros mountain range and the mountain area occupies about 76% of the entire area. Mountains are steep and karoon river makes deep valleys between mountain ranges. 19% of the area consists of the alluvial fan, river terrace, and

alluvium deposits and these area are flat plane which are used for the farm land, town and for other human life. The hills are distributed to the foot of the mountains.

Geographical features in the Study area is influenced by the geological features condition. Therefore, the flow of the river and the mountain range indicate the direction of the southeast from the northwest. Karoon river basin is divided in to 8 sub-basin according to the tributaries. The geographical features of each sub-basin are shown in the following table.

Table 3-1-2-1 Summary of Topographical Division

Name of Sub-Basin	Area (km2)	Geographical Features						
		Mountain area A %	Hill area B %	Riverside terrace C %	Alluvium flat plane D %	Large-scale fan E %	Special geographical features F %	Remarks %
K-1	3,920.2	43.5	11.2	0.2	13.6	31.5		
K-2	1,223.7	83.4	3.2	6.5	0.6	6.3		
K-3	2,509.2	87.7	0.4	0.6	1.4	9.1	0.8	
K-4	3,214.8	61.8	6.8		3.6	27.8		
K-5	2,174.9	96.9	0.5	0.1	0.7	1.8		
K-6	1,474.3	67.1	7.0		7.7	18.2		
K-7	9,021.2	76.9	6.8	1.0	2.0	13.3		
K-8	3,273.2	90.6	1.9	0.7	1.5	4.4	0.9	
Total average	26,811.5	76.0	4.7	1.1	3.9	14.1	0.2	

3.1.3 Geology

Karoon basin is located in the two different zone, consisting of Paleozoic and Mesozoic lithology area and Cenozoic lithology area. The base rock area accounts for about 78% of all regions and 65% of these lithology is Paleozoic consisting of limestone and sandstone. In addition, 12% of the base rock is sandstone and shale in Precambrian. 20% of the base rock consists of Mesozoic rock , mainly distributing soft marl. For Marl, a lot of clay minerals and the carbonate are included. The other 3% is a metamorphic rock and an intrusive rock. In addition, the rock salt dome is scattered, too.

The bedrock of Paleozoic is very hard and the collapsing rock is a source of the debris flow. The rock of the Mesozoic is extremely weak, and its causes the landslide and erosion easily. 22% of the Study area consists of the alluvial fan, the riverside terrace, and the alluvium deposits in surface of the earth. These layers consists of gravel, sand, and clay, and consolidation is weak. The talus deposit with a gentle inclination is contains in these layers.

The axis of folding is from the northwest to southeast and many folding is repeated. Therefore, many faults which run parallel to this direction and some orthogonal are also seen. This direction is geological weak lines, and the flow of the river is along this direction too.

In the Study area, a lot of limestones are produced and they are used as cement and architectural materials. The mineral water, the fireproof material and the salt, etc. are produced in a special stratum in the region

3.1.4 Meteorology

The basin rainfall varies from 250 mm to 1700 mm depending on elevation, slope orientation/exposure. Annual rainfall is about 650 mm on an average in the Study area. In general, upper basins of K5 and K8 have rainfall more than 1,500 mm. And rainfall amount has trend to reduce toward south east in the Study area. The majority of precipitation occurs from Azar to Ordibehesht (from December to May). Especially, heavy precipitation falls from Dey to Esfand (from January to March). The high mountain zone exceeding EL. 2,000 m above mean sea level is covered with snow every year.

In the Study area, winter season is moderate and short, however summer season is long and hot. And temperature reaches its highest point generally in the month of Tir (July) and its lowest point in the Bahman (February). The annual average temperature is about 25 ℃. The monthly maximum temperature in the Study area is about 40℃ and monthly minimum temperature is −14℃. Mean annual evaporation varies from 1,000 mm to 3,000 mm. Distribution of annual evaporation in the Study area has similar characteristics to those of temperature.

3.1.5 Hydrology and River Regime

(1) General Conditions of River Regime

Karoon river is one of the longest river in Iran. The total length of Karoon is about 840 km and its catchment area is about 70,000 km^2. Annual discharge is estimated at 453 m^3/s. Lowest downstream point of the Study area is located at the upstream of Shahid Abass Pour Dam and its catchment area is 27,000 km^2. Main tributaries of Karoon river are listed up as Ab.Vanak, Beheshtabad, Bazoft, Khersan and Monji river.

(2) Hydrological Conditions

Average monthly discharge at Karoon I dam site ranges from 190 m^3/s to 710 m^3/s. The highest monthly discharge of Karoon river occurs during Favardin (April) due to snowmelt in the upper sub-basins which altitudes are higher than 2,000 m above sea level. Extreme floods had been observed mainly between Dey and Farvardin (January and April). Hydrological characteristics of each river in the Study area are shown as following table.

It is recognized that specific sediment volumes in K7 sub-basin shows high amount compared to other sub-basin. And also specific sediment volumes in K1, K3 and K8 show comparatively low value. As for average volume of sediment in unit discharge, sediment amounts at Yasuj, Shahmoktar and Tangzardalou show high value.

Table 3-1-5-1 Specific Sediment Volume

Basin No.	River Name	Station Name	Catchment Area (km2)	Average Volume of Sediment (kg/m3/s)	Specific Volume of Sediment (ton/km2/year)
K1	Ab Kiar	Behstabad	3,825	0.015	27
K3	Khersan	Barzbakhtiari	8,900	0.003	26
		Armand	9,900	0.003	18
K4	Solegan	Tangzardalou	1,045	0.580	63
		Solegan	1,992	0.020	31
K5	Ab Bazoft	Morghak	2,355	0.003	45
K7	Boshar	Yasuj	803	0.150	121
		Shahmoktar	1,187	0.128	200
		Darshahi	1,609	0.082	66
		Botari	885	0.087	52
		Kerik	128	0.079	304
		Pataveh	2,800	0.004	63
	Marboreh	Khakdaneh	801	0.013	199
		Kata	4,015	0.009	51
K8	Karoon	Poleshaloo	24,210	0.002	12
		Outsadekaro	25,850	0.001	5

3.1.6 Soil

In the Study Area, major soils are Lithic Leptosols, Gypsic Regosols, Calcaric Regosols, Calcaric Cambisols and Haplic Calcisols. Their distribution is related to the topography as summarized in Table 3-1-6-1.

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

Table 3-1-6-1 Major Soils and Distribution in the Study Area

Land Type		Lithic Leptosols	Gypsic Regosols	Calcaric Regosols	Calcaric Cambisols	Haplic Calcisols	Calcaric Kastanozem	Eutric Cambisols	Calcaric Fluvisols	Haplic Kastanozem	Area Ratio
Mountains	1.1	O									66.7%
	1.2	O		O							
	1.3	O		O							
	1.4		O								
	1.5			O							
	1.6				O						
Hills	2.1	O									9.9%
	2.2			O							
	2.3		O								
	2.4		O	O							
	2.5			O							
	2.6						O				
Plateaus and Upper Terraces	3.1			O							12.0%
	3.2				O						
	3.3			O							
	3.4		O	O							
	3.5			O							
	3.8					O					
Piedmont Plains	4.1				O	O					3.1%
	4.2				O	O					
Elluvial Plains	4/5							O			0.6%
Lowlands	6.1								O		0.7%
Gravelly Colluvial Fans	8.1			O							3.2%
	8.2			O							
	8.5									O	
Gravelly River Fans	9.1			O							0.5%
	9.2			O							
Others											3.3%

(note) Refering to "Volume 23 Soil and Resources Evaluation and Land Capability in the Upper Karoon Basin" YEKOM/MOA 1999

3.2 Land Use and Vegetation

3.2.1 Concept of Land Use

Generally, land use plans start with two procedures, i.e., a land classification and a site classification by the capability of development. The land classification shows the current state of the land, while the site classification is a classification by the potential use of the land

(1) Natural conditions

The major factors fo natural conditions include topography, geology, climate, soil, vegetation, etc.

(2) Condition of transportation

For the analysis of the condition of transportation in the land use study, it is practical to make a list of each sub-basins classified by accessibility to markets.

(3) Site classification

The site classification identifies each sub-basin by its capabilities in consideration of natural, socio-economic and political criteria, or in other words, by its future development potential.

Regarding the natural site classification, the current land use categorized in the previous section is considered to be representative of each natural site classification both in the current and future situation. The natural site class of each sub-basin, therefore, could be classified into 3 classes.

3.2.2 Land Use Category and Outline of Current Land Use

(1) Land Use Category

Several land use categories have been applied in the studies conducted by the Ministry of Jihad-e-Sazandegi and the Ministry of Agriculture since the 1980s.

a) Farmland

The farmland consists of paddies and fields with several kinds of crops such as cereals vegetables, sugar beet as well as grasses. The farmland sometimes includes orchard planted with almond trees, apple trees, pear trees, apricot trees, peach trees, grape vines, pomegranate trees, walnut trees.

b) Rangeland

Rangelands are generally located higher places than Farmlands, have stony and rocky soil, and much of them are on steep slopes. The vegetation here consists of Astragalus spp., which are creeping woody legume and dominant plants in this area, associates with natural herbal plants as well as a low tree. The Astragalus and the herbal plants are fed to goats in seasonal ranging (from May to October). Sometimes the Rangeland associates with open forests which provide fuel wood for local people. The Rangeland is the largest type of land use in the Study area although its soil productivity is generally lower than Farmland and Forest because of its edaphic and climatic conditions.

c) Forest

Generally, the forest type is classified as "open forest" in the category of forest resources by FAO. Growing species in the Forests are naturally regenerating deciduous hardwood species The hardwood species are lopped and utilized for fuel wood by local people. The Forest is also divided into several sub-types depending on the dominant and associated tree species;

d) Forest with Intercropping

Some parts of forest area are converted to "Forest with Intercropping". Due to the overexploitation of forest trees, the tree density has become low and agricultural cropping (mainly with wheat) has been introduced by local people. The forest with intercropping is a kind of primitive agroforestry system, but the absence of succeeding seedlings, the erosion of top soil and the degradation of forest resources are negative impacts by this system. Some technical approaches, therefore, should be taken to enrich the succeeding young trees and to conserve soil erosion in this land use system.

e) Rock

The rocky land has no vegetation cover, with exposed bare rocks and having ground surfaces covered

only with debris. Due to steep and poor ground conditions, the rocky land is not suitable for agricultural use.

f) Others

The category "Others" includes water bodies such as rivers, lakes, ponds, marshes, etc., permanent snow, villages & towns, waste land, barren, mines, and facilities concerning oil and other industries. Among them, water bodies are utilized for water resources. Permanent snow is located at approximately 4000 m in elevation and one of various water resources.

(2) Outline of Current Land Use

Referring to the attached map of land use, proportion of current land use of the study area is summarized as follow:

Table 3-2-2-1 Proportion of Current Land Use in the Study Area

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

3.2.3 Land Capability

Two different methods are common for land capability analysis in Iran. One is the topography-base method, and the other is the irrigation-base method. The former one is applied based on the classification of topography with such data of altitude, slope, soil, vegetation and current land use. It is utilized for the potential analysis of agricultural development in the large extent of area. The latter one is applied based on the details of soil with data of soil texture, permeability, slope and current erosion etc.. It is utilized for the potential analysis of irrigation development by means of classification into six classes in the particular area. Land capability has been already studied in most part of the Study Area by several studies with the former method under JIHAD and MOA. However, northan part of K7 river basin has not been studied yet. Preliminary study, therefore, has been given for evaluating land capability of this study blank area in order to evaluate whole study area. The preliminary study employed also the former method in order to harmonize with the previous studies.

Land capability has been studied mainly by compiling the existing previous report as well as additional studies of the study blank area.

Mountains are extending largely in the study area and share the land of 17,874 km2, that is 67 % of the study area as shown in Figure below. Plateaus and upper terraces follows the mountains, and its area is 3,205 km2 or 12 % of the Study Area. Area of hills is the third largest share, that is 2,647 km2 or 9.9 %. The piedmont plains, the gravelly colluvial fans and the complexes are the fourth group of area, that is at 3 % mark. Areas of other categories are smaller as less than 1.0 %.

a) Mountains (1.1, 1.2, 1.3, 1.4, 1.5, 1.6)

Total area of mountains is 17,874 km^2 which is equivalent to 67 % of the Study Area. Mountains are distributed largely in K7, and followed by K8. Out of total mountains, as shown in Table 3-2-1, forest mountain (1.5) shares the largest area of about 8,010 km^2, that is 45 % of total mountains. Forest mountains are commonly covered by oak tree forests in most parts of the mountain. High mountains (1.2) shares the area of 6,961 km^2, that is equivalent to 39 % of total mountains. Total area of forest mountains (1.5) and High mountains (1.2) shares most area of mountains as about 84 %. Very high mountains (1.1) follows them, and the area of very high mountains is 1,354 km^2, that is 7 % of the total mountains. Most mountains are formed by very hard limestone without soil cover. The mountains are to be conserved properly by watershed management, and afforestation and controlled grazing are recommended.

b) Hills (2.1, 2.2, 2.3, 2.4, 2.5, 2.6)

Total area of hills is 2,647km^2, that is 10 % of the Study Area. Hills are distributed mainly in K7, K1 and K4. Small hills (2.3) are sharing the largest area of hills, about 1,292 km^2 equivalent to 49 % of total hilly area. High forest hills (2.5) follows small hills (2.3), and the area is 526 km^2, that is 20 % of total hilly area. Main limitations of hills are shallow soils, steep slope and erosion. Hills are to be conserved as forest and utilized under controlled grazing and dry farming.

c) Plateaus and Upper Terraces (3.1, 3.2, 3.3, 3.4, 3.5, 3.8)

Plateau and upper terraces are located along hills and mountains commonly in K1, K4 and K7. Total area of plateaus and upper terraces is 3,206 km^2, that is equivalent to 12 % of the Study area. Among plateaus and upper terraces, plateau buried by fixed dunes (3.3) shares the largest area of 1,579 km^2, that is 49 % of total area of plateaus and upper terraces. Following this type plateaus, the upper terraces with moderate to high relief (3.1) and the old plateaus with a little relief (3.2) share large area of 1,092 km^2 in total. In the plateaus and upper terraces, grazing and dry farming are extensively conducted, and irrigated farming and paddy cultivation are carried out in some areas. Limitations of the lands are relief in topography, erosion and soil depth. Forest and controlled grazing are suited and dry farming and irrigated farming are moderately suited after improvement in this type of land.

d) Piedmont Plains (4.1, 4.2)

Piedmont plains share 822 km^2, that is only 3.1 % of total area of the basin, but the piedmont plains

are very important for agriculture. Grazing, dry farming and irrigated farming are extensively carried out in the area. Main limitation of this area is relief and gravel in some part, and water. In this area, irrigated farming is suited when water is ensured and lands are leveled.

e) Elluvial Plains (4/5)

Elluvial plains are mostly located along rivers in K1. The area of elluvial plains is limited only at 0.6 % of the Study Area. Although the area is small, elluvial plains are important for agriculture as well as piedmont plains. Major limitations of this area are water and erosion, so that irrigated farming is the most suited land use when water is ensured.

f) Lowlands (6.1)

Lowlands are formed along the rivers generally surrounded by the piedmont plains. Lowlands are abundant in K1 as well as in K4 and K6. Agriculture and grazing are major activities in the lowlands, and floods and poor drainage are the major limitations. The area of lowlands is small only at 177 km^2 or 0.7 % of the Study Area. According to the previous studies, more studies are recommended for development of the lowlands.

g) Gravelly Colluvial Fans (8.1, 8.2, 8.5)

Gravelly colluvial fans are located at the foot of mountains mainly in K1, K4, K6 and K7. Total area of the gravelly colluvial fans is 853 km^2, that is equivalent to 3.2 % of the Study Area. Major activities in this area are grazing and dry farming as well as irrigated farming in some places. Major limitations of this area are gravel, shallow soil depth, slope and erosion. The lands are suited to controlled grazing, planting of fruit trees and protected forest.

h) Gravelly River Fans (9.1, 9.2)

Gravelly river fans are generally located at the foot of mountains and hills. Distribution of area is concentrating in K1, K4 and K6. Total area of the gravelly river fans is 121 km^2, that is only 0.5 % of the Study Area. Present utilization of this area is grazing, dry farming and cereal irrigation as well as fruit tree planting in some places. Major limitations of this area are soil depth and erosion. When grazing and erosion are controlled and prevented, grazing and dry farming are suited. If water is ensured, irrigated farming is also recommended.

(3) Evaluation of Land Capabilities

a) Weight of Land Capability

Productivity of land is varied largely by the land capabilities as explained above. Since land capability is presented by categorized acreage, it is difficult to compare differences of productivity among sub-basins. For evaluating land capability and productivity of each sub-basin, following weights are given to the respective land categories.

Table 3-2-3-1 Evaluation Weights of Land Capability

Land Type	Code	Weight	Land Type	Code	Weight
Mountains	1.1	0	Piedmont Plains	4.1	10
	1.2	1		4.2	10
	1.3	0	Elluvial Fans	4/5	10
	1.4	1	Lowlands	6.1	5
	1.5	1	Gravelly Colluvial Fans	8.1	3
	1.6	1		8.2	5
Hills	2.1	0		8.5	3
	2.2	3	Gravelly River Fans	9.1	3
	2.3	3		9.2	5
	2.4	1	Complexes	C1	4
	2.5	1		C2	3
	2.6	1		C3	1
Plateaus and Upper Terraces	3.1	4		C4	4
	3.2	5		C5	1
	3.3	6		C6	1
	3.4	3		C7	1
	3.5	6	River Bed	RW	0
	3.8	6	Water/City	Ma, City	0

b) Weighted Land Capability and Land Capability Index

Weighted land capability is estimated by summing the multiplication of acreage and weight of respective land capabilities.

Weighted land capability is generally large for large sub-basins so that the land capability index has been created to compare capability and productivity easier. Land capability index is an averaged weight of each sub-basin.Productivity and capability of sub-basins can be relatively compared by their land capability indexes.

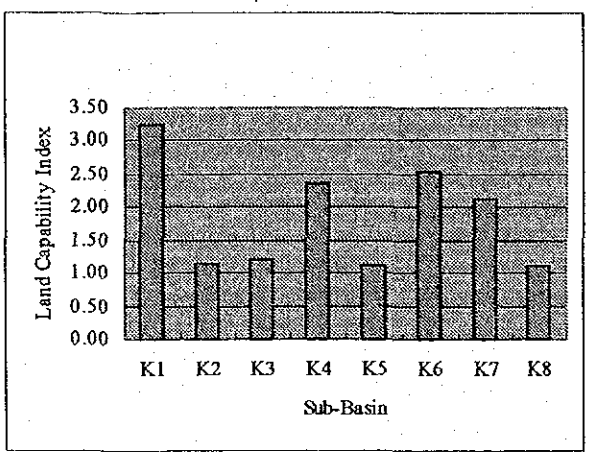

Figure 3-2-3-1 Land Capability Index by Sub-Basins

c) Comparison of Land Capability and Productivity by Sub-basins

Land capability and productivity have been compared utilizing the land capability index as shown in Table below. Average land capability index varies largely by sub-basins from 1.12 in K8 to 3.24 in K1. It means that productivity or capability of unit land in K1 might be approximately three times of it in K8. The comparison of 8 sub-basins can be summarized as shown in Figure at right side hand. Four sub-basins, namely K1, K4, K6 and K7, are considered as relatively high productive or capable sub-basins, and other four sub-basins, K2, K3, K5 and K8, are relatively low from an aspect of land capability.

Table 3-2-3-2 Weighted Land Capability and Land Capability Index by Sub-Bains

Sub-basin	Area (km^2)	Weighted Land Capability by Land Types (Weighted Capability =Area x Weight)										Average Land Capability Index	Maximum Land Capability Index	
		Mountains	Hills	Plateaus and Upper Terraces	Piedmont Plains	Elluvial Fans	Lowlands	Gravelly Colluvial Fans	Gravelly River Fans	Complexes	Total			
	(A)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(T)	(T/A)		
K1	3,920	551	881	3,630	3,108	1,604	467	1,062	186	1,221	12,709	3.24	6.70	K1-2-6i
K2	1,224	826	152	154	0	38	0	115	0	117	1,402	1.15	2.05	K2-5-4
K3	2,509	2,058	261	193	151	0	0	177	0	206	3,046	1.21	3.60	K3-1-17
K4	3,215	1,287	1,344	3,198	671	0	307	444	106	245	7,603	2.36	4.53	K4-1-11
K5	2,175	2,080	57	178	135	0	0	0	0	0	2,451	1.13	3.38	K5-13-1b
K6	1,474	811	183	781	1,230	0	112	392	158	73	3,741	2.54	5.89	K6-1-8
K7	9,021	5,531	2,273	7,695	2,865	0	0	832	2	0	19,196	2.13	6.55	K7-0-10-6b
K8	3,274	2,406	78	760	57	0	0	9	0	354	3,663	1.12	3.04	K8-2
Total	26,812	15,550	5,229	16,589	8,217	1,642	887	3,031	452	2,217	53,812	2.01	6.70	K1-2-6i

(Note) derived from Land Capability Inventory.

Major reason of differences on capability and productivity is considered to be the differences of weighted land capability ratio of the mountains and the flat plains such as piedmont plain, plateau and terrace. High productive group, K1, K4, K6 and K7, has a large ratio of the weighted land capability on piedmont plain, plateau and terrace. On the other hand, low productive group, K2, K3, K5 and K8, has a large ratio of it on mountains.

As explained above, land capability analysis is very important for understanding the capability of land and for studying the future regional plan.

In the sub-basins classified into high productive group, the area has relatively rich soil and flatter land. Such sub-basins may be easier for mechanization and be more competitive than sub-basins classified into low productive group. Following tow figures show the relation between land capability index and incomes of agriculture and livestock presented in Section 3.3.4.

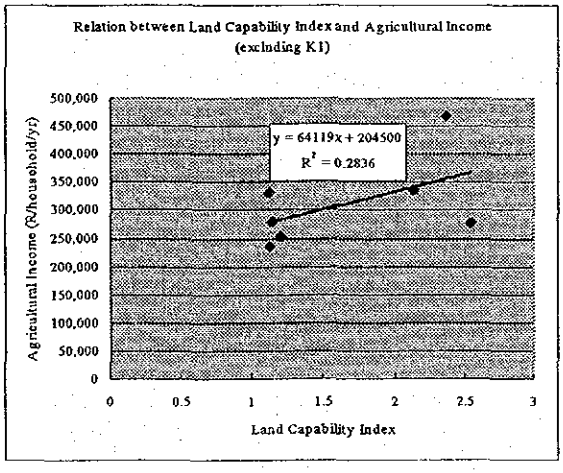

Figure 3-2-3-2 Relation between Land capability Index and Agricultural Income

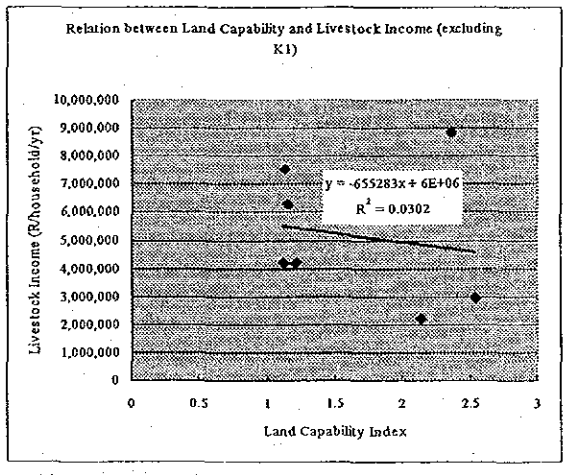

Figure 3-2-3-3 Relation between Land capability Index and Livestock Income

(Note) K1 sub-basin is excluded in this analysis because of relatively higher non-agricultural income than other sub-basins.

From above result, it may be understood followings;

a) Agricultural income is high in the sub-basins where land capability index is high.
b) On the other hand, opposite phenomena is resulted in the relation to livestock income. It is difficult to explain this phenomena clearly by land capability index.

When livestock income is compared with the over-carrying ratio of livestock that is analyzed in Section 3.2.7, it is understood that livestock income increases in proportion with the increase of over-carrying ratio. It can be said that livestock income is kept by deprivable grazing in the area.

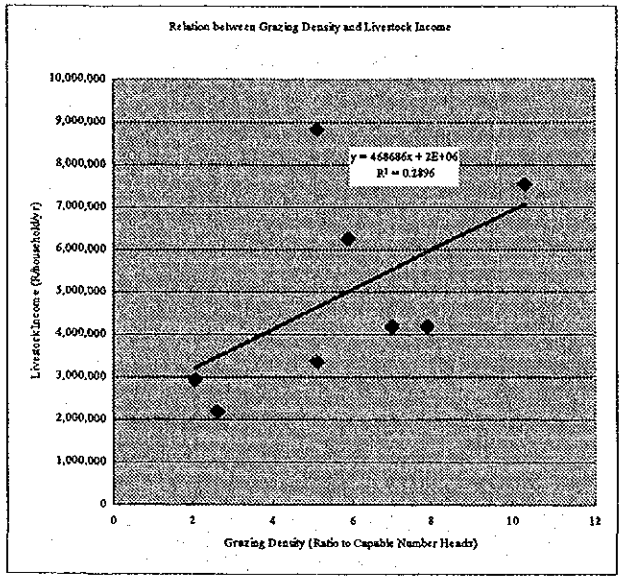

Figure 3-2-3-4 Relation between Over-Carrying Ratio and Livestock Income

3.2.4 Vegetation

In the Study Area, where changes in topographical condition are very significant, varieties of natural vegetation grow. At altitude more than 4,000 m in places where there are weathered materials, and rocks provide protection and some cold resistance grasses grow for a short time. At 3,500 m altitude scattered trees such as Juniper, and shrub can be seen. Owing to their inaccessibility, the vegetation growing at these altitudes have no pasturage benefit. The 2,500 m is the altitude where the vegetation is most concentrated.

Based on dominance and pasturage benefit, eleven plant species are recognized in the Study Area. Bromus (bromegrass) among the grasses, Astragalus (milkvetch) among the shrubs and Quercus (oak) among the tree are the wide spread plant species. In addition to pasturage value, some plants such as Glycyrrhiza(liquorice) have medicinal and industrial value, as well as contribute in soil conservation through their root system.

The Astragalus species cover 9,534 km^2 (36 %), and Quercus species cover 3,501 km^2 (13 %) of the Study Area. Weeds occupy 1,970 km^2 (7 %) of the area. Presence of weed indicates the destruction of native vegetation and provision of a none competitive environment for unwanted plants to grow. Some parts are non-vegetated, and covered by rocks, buildings, and water bodies such as lake and ponds. These cover 6,807 km^2 (25 %) of the Study Area.

In an average, the natural vegetation of the Study Area have poor condition, decreasing trend, and a carrying capacity of 155 Animal Unit Month (AUM)/km^2. One AUM is equivalent to 60 kg of dried forage. This disappointing situation can be attributed to over exploitation and unwise utilization of natural resources.

3.2.5 Right of Common

Forest and rangeland which is nationalized is taken a responsibility by the Forest and Rangeland Organization of the Ministry of Jihad-e- Sazandegi, under the Forest and Rangeland Law. The main role of the organization is forest and rangeland management; establishments of reserve rangeland and its management and mini-scale rural development.

The provincial forest and rangeland organization decides the rangeland use and migration route for nomadic people after discussion with the provincial office of nomad affair. Based on this decision, the office issues a permit of rangeland use for nomadic people. On the other hand, this provincial organization is carried out the renovation of rangeland, establishments of reserve rangeland and its management and opening of reserve rangeland. When grass shortage in rangeland occurs by a drought, the reserve rangeland will open for nomadic people. At village level, within territory of village is permitted as common land for grazing. However, animal grazing in wide forest area is prohibited due to the reservation of natural environment.

3.2.6 Nomadism

In the study area, the nomadic society has widely existed since ancient time. Main nomadic tribes forming of the society are Bakhtiyari, Boyerahmad-olia and Ghashghay. The Bakhtiyari tribe is distributed mainly in the Chaharmahal va Bakhtiyari province and Khuzestan province. The Boyerahmad-olia tribe lives in the Kohgiluyeh va Boyerahmad province. Although the Ghashghay tribe lives in the Fars province, they migrate to the Esfahan province in the summer season.

The nomadic migration system is characterized by traditional method of animal husbandry; grazing animal at rangeland in summer season, and raising animal at village in winter season. Annually, there are two nomadic migrations such as from winter settlement (village) in springtime and migration in autumn. Nomadic migration period in spring and autumn is about 15 days respectively, i.e., about one month annually. The grazing period in rangeland of summer time is about five months (May to September). The provincial forest and rangeland office, in line with traditional custom principally permits the grazing place. Traditional custom and rule establish the camping place. Therefore, it cannot see any big change of the camping place.

The government promotes a construction of settlement (village), provision of living infrastructure as social and welfare support for pastoral nomadic people. However, the permanent settlement throughout year makes slow progress caused by characteristics of a traditional nomadism. Also, they have the lack of farming technology. According to the Socioeconomic Census of Tribal Nomads 1999, there are 7,931 families settled in the sub-basins of K1, K2, K3, K4, K5 and K6. Among them, 82.6% of nomadic families are concentrated to the sub-basin K6 and they settled at mountain area since old time. In the sub-basin K7, the most concentrated place of nomadic people is the Boyerahmad Township, Kohgiluyeh va Boyerahmad province. There are settled 2,400 families. The settlement of nomadic people in the province makes relatively progress. Other provinces related to the K7 are Esfahan and Fars. There are 12 families in Esfahan and 200 families in Fars. Most of inhabitants in the sub-basin K8 are the Bakhtiyari tribe and they migrate between Chaharmahal va Bakhtiyari province and Khuzestan province seasonally. Settled family in the K8 is 15,269. By the census, in the K8, about 4,000 nomadic populations were moved to other provinces between 1988 and 1998.

Economical condition, in addition to consciousness for a traditional nomadism, is another reason for slow progress of settlement. Livestock means not only a way of livelihood but also stock for future expenditure. Because farming has not been their own way of livelihood, livestock means security of life for nomads. However, nomads has changed their lifestyle, and they gradually accept new way of life. Nowadays, some of family member are engaged in farming activities and/or bee keeping, on the other hand, another member keeps animal in rangeland. The number of settled nomads assumed to be more than the number in the census.

Nomadic people already have own land for farming through the land reform and the governmental policy of the settlement of tribal nomads. They own 2ha to 3ha of farmland for one family. The government provides farmland to nomadic people under the mentioned policy. By cultivating the land for 30 years (99 years in some areas), the land will be donated to the family. The cultivation period by nomadic family is provided by free of charge.

Pastoral nomadic tribal community is strong by high identification with nomadic people, and it has confederacy. In the nomadic life, elders' intention dominates an all-round mode of living and it maintains traditional patterns of behavior. The government promotes a construction of settlement (village), provision of living infrastructure as social and welfare support for pastoral nomadic people. In the nomadic life-style, the cultural change can be seen in eating habits (the same as rural people) and introduction of radio, TV, sewing machine and so on.

Generally, nomadic people use firewood for cooking collected around the camp. But some nomadic families have converted from firewood to propane gas and/or kerosene oil which are provide by low price through the provincial office of nomad affair. This office promotes a conversion of cooking

fuel in order to preserve the natural resources. Besides, water for drinking and living is available in the camping place. Excepting animal husbandry, nomadic people are engaged in farming in their winter residence of the village. However, the village is located at mountain area and is unfavorable condition of farming due to lack of water and limited farmland. In addition, its productivity is extremely low because of lack of farming technology. Living foundation of nomadic people depend on profits from traditional animal husbandry.

In the residential area of nomadic people, there are organized cooperative and tribal youth camp. Supporting authorities to nomadic people are the Nomad Affair Organization, Ministry of Jihad-e-Sazandegi, Islamic Revolution Committee, Police, Provincial Governor, District Head, Heads of the Provincial Agricultural Organization, Provincial Education Organization, Provincial Jihad Organization and Ministry of Culture and Islamic Guidance.

3.2.7 Present Grazing Situation

In the study area, sheep and goats are grazed widely in the rangeland. It is suffered that the area is over grazed beyond its carrying capacity. Consequently, present grazing situation is studied roughly based on the following conditions.

(1) Livestock Feeding Conditions

Based on the data of fodder crops and rangeland in the area, the Iranian standard of animal unit and the nutrient requirement standard of Japan due to lack of the Iranian standard, livestock feeding conditions are assumed as follows:

- Livestock will be fed by forage in the rangeland, straw of barley and wheat produced in the rainfed farmland, and hay-cube of alfalfa in the irrigated farmland.
- Animal unit is calculated for the adult female goat/sheep weighing 40 kg.
- Cow and horse are equivalent to 5 animal units and sheep is equivalent to 1 animal unit.
- Number of livestock is converted into the number of goat.
- Animal units in month by each vegetation are adopted based on values mentioned in inventory of natural vegetation.
- Barley and wheat will be planted in dry farming land, alfalfa will be planted in irrigated land.
- In this estimation, it is not considered that nomad with livestock trips to the outside of the Study area because settlement of nomad progresses.
- Total daily nutrient requirement and coarse protein requirement are calculated based on "Japanese Feeding Standard for Sheep (1996)"

(2) Evaluation of Grazing Condition

In the results of the study, it is recognized that shortages of fodder and over-grazing are found in the study area widely. The results of study are as shown in the following table.

Table 3-2-7-1 Livestock Feeding Situation by Sub-Basins

Sub-basin	Total Heads of Livestock (animal units)	Carrying Capacity in the Area (animal units)				Over-Carrying Ratio (Total heads/Carrying Capacity)		
		Grazing	Straw	Alfalfa	Total	Min	Ave.	Max
K1	2,002,018	22,113 6%	2,167 1%	369,672 94%	393,952	2.9	5.1	25.3
K2	401,122	8,572 13%	2,308 3%	56,540 84%	67,419	3.4	5.9	14.0
K3	687,325	18,435 21%	9,208 11%	59,159 68%	86,801	1.4	7.9	25.9
K4	1,504,027	20,206 7%	3,832 1%	270,144 92%	294,181	3.0	5.1	25.9
K5	483,724	17,330 37%	4,383 9%	25,195 54%	46,909	4.9	10.3	33.0
K6	554,796	10,369 4%	3,996 2%	246,572 94%	260,937	1.0	2.1	18.7
K7	2,630,567	158,998 16%	18,695 2%	839,528 83%	1,017,221	0.0	2.6	36.3
K8	1,129,807	60,229 38%	23,512 15%	76,867 48%	160,608	3.4	7.0	40.1
Total	9,393,386	316,252 14%	68,101 3%	1,943,676 83%	2,328,028	0.0	4.0	40.1

(Note) derived from the Inventory of Grazing Situation.

Although above table is based on very rough estimation, following results can be pointed out;

- In the study area, over-carrying ratio is estimated at about 4 times of the carrying capacity of the area, and the area is over grazed as a whole.
- In the sub-basins K6 and K7, over-carrying ratio is about 2 times of the carrying capacity.
- In the sub-basins K1, K2 and K4, over-carrying ratio is 5 to 6 times of the carrying capacity.
- In the sub-basins K3 and K8, over-carrying ratio is 7 to 8 times of the carrying capacity.
- In the sub-basin K5, over-carrying ratio is about 10 times of the carrying capacity.
- Total feed of the study area is mostly composed of alfalfa that is equivalent to 83% of total. Grass of rangeland and straw of barley and wheat share only 14% and 3% respectively.

Taking above results into consideration, following issues are considered to be important subjects in the study area.

- Encouragement and stabilization of production of alfalfa.
- Proper management of rangeland to increase carrying capacity for grazing.

3.3 Socio-economic Condition

3.3.1 Administrative Division

The study area extends over five provinces of Chaharmahal va Bakhtiyari, Kohgiluyeh va Boyerahmad, Fars, Esfahan and Khuzestan. Especially, most of the area are covered by the Chaharmahal va Bakhtiyari province.

Administrative division in the study area is tabulated as follow:

Table 3-3-1-1 Administrative Division

Province	Township	Town	District	Rural district
Chaharmahal va Bakhtiyari	Share Kord	6	4	7
	Borujen	3	2	3
	Farsan	4	3	5
	Ardal	2	2	6
	Lordegan	2	3	9
Kohgiluyeh va Boyerahmad	Kohgiluyeh	0	1	4
	Boyerahmad	2	4	13
Esfahan	Semiroum	1	2	6
	Lanjan	0	1	3
	Mobarakeh	0	1	2
	Shahreza	0	1	2
Fars	Eghlid	0	1	2
	Sepidan	0	1	2
	Mamasani	0	1	2
	Abadeh	0	1	1
Khuzestan	Izeh	0	2	7
	Masjed Soleyman	0	1	7
	Dezful	0	1	1

Source: Census 1375 (1996), Statistical Center of Iran

On the other hand, the administrative division by sub-basin is as follow:

Table 3-3-1-2 Administrative division related to Study Area

Sub-basin	Province	Township
K1	Chaharmahal va Bakhtiyari Esfahan	Share Kord Lanjan, Mobarakeh
K2	Chaharmahal va Bakhtiyari	Farsan
K3	Chaharmahal va Bakhtiyari	Ardal
K4	Chaharmahal va Bakhtiyari Esfahan	Boroujen Shahreza, Semiroum
K5	Chaharmahal va Bakhtiyari	Farsan
K6	Chaharmahal va Bakhtiyari	Lordegan
K7	Kohgiluyeh va Boyerahmad Esfahan Fars	Kohgiluyeh, Boyerahmad Semiroum Eghlid, Sepidan, Mamasani, Abadeh
K8	Khuzestan	Izeh, Masjed Soleyman, Dezful

3.3.2 Population

Population structure by sub-basin is as shown in the following table.

Table 3-3-2-1 Population, Economically Active Population Literacy and Unemployment Rates

Sub-basin	Total population	Male	Female	Less than 9 years old	10 years old and over	Literacy rate (>age 6)	Unemploy-ment rate
K1	420,520	212,462	208,058	123,212	297,308	79.0%	9.5%
K2	29,000	14,715	14,285	9,115	21,995	66.8%	1.7%
K3	54,235	27,297	26,938	15,273	36,852	62.5%	4.0%
K4	55,303	27,113	28,236	16,204	39,099	71.4%	4.2%
K5	19,154	9,687	9,536	5,612	13,542	54.9%	2.5%
K6	79,103	40,518	38,595	23,177	55,926	63.8%	3.7%
K7	363,266	190,674	183,687	128,233	235,033	67.7%	48.2%
K8	68,732	37,040	36,676	22,682	46,050	52.5%	26.2%
Total/average	1,089,313	559,527	546,010	343,508	745,805	64.8%	12.5%
Ratio	100%	51.4%	48.6%	31.5%	68.5%		

Source: Census 1375(1996), converted into sub-basin area

Based on the census 1375(1996), total population of the study area is estimated at 1,089,313. It includes the population of nomadic people. The ratio of male and female on the population structure indicates 51.4% (male) and 48.6% (female). Only the sub-basin K4 is reversed such ratio. Viewing from the age group, the group of less than 9 years old accounts for 31.5% and this shows high percentage among the population. The percentage of the group of less than 9 years in the study area is higher than national figure of 24.4%. The ratio of the group of more than 65 years accounts for 4.6%, and is not so different from national figure of 4.4%.

Annual population growth rate of the country presents 2.5% from 1986 to 1991, but 1.5% from 1991 to 1996. The growth rate has a tendency to decrease. However, the population increase in the area is considerably high and shows 2.5% in the census 1996. According to the master plan report of Ministry of Agriculture, concentration from rural area to urban area in the sub-basins of K1, K2, K3, K4, K5 and K6 was about 125,000 inhabitants in the decade (from 1976 to 1986) and 73,000 inhabitants for five years (from 1986 to 1991).

Life expectancy in Iran has been increased from 61.1 in 1988 to 69.5 in 1997. The most important factor in increasing life expectancy in the decade is the decline in the mortality rate among children. Expansion of primary health care services, provision of safe drinking water, promotion of immunization programs, and increased care for women and mothers has contributed to reduce in child and infant mortality. The mortality rate among children under 5 years has been decreased from 85.3 per 1,000 live births in 1988 to 37.3 per 1,000 live births in 1997. On the other hand, infant mortality fell from 63.5 per 1,000 live births to 30.7 in 1997. Life expectancy among provinces related to the study area is disparate, ranging from a high of 70.3 years in Esfahan province to a low of 61.6 years in Khuzestan province. Expansion of health care services is urgently needed especially for such provinces as Khuzestan and Kohgiluyeh va Boyerahmad. Life expectancy in the related provinces is lower than national average except for Esfahan province, however, it should be noted that the increase of life expectancy becomes one of factor of population pressure in the study area. Life expectancy both male and female in related provinces is as shown in the following table.

Table 3-3-2-2 Life Expectany

Province	Total	Male	Female
Chaharmahar va Bakhtiyari	65.9	65.0	66.9
Kohgiluyeh va Boyerahmad	63.4	63.0	63.7
Esfahan	70.3	69.6	71.0
Fars	67.5	66.1	68.9
Khuzestan	61.6	60.5	62.7
Country (Iran)	69.2	68.2	70.3

Source: Human Development Report of the Islamic Republic of Iran, 1999

Economically active population (age 10 and over) in the study area is 68.5% of the total population and the average unemployment rate shows 12.5%. High unemployment rate of the sub-basin K7 and K8 indicates 48.2% and 26.2% respectively. Literacy rate is low in the sub-basin K5 and K8. It is caused by remote mountainous area. Average rate in the area is 64.8%.

Because the study area is situated in the mountainous area and the upstream of the Karoon River, population density is low and shows 38 persons per km2 in the study area. The sub-basin K4 is lowest population density and shows 8.9 persons.

Nomadic people in the study area concentrate in the provinces of Chaharmahal va Bakhtiyari, Kohgiluyeh va Boyerahmad and Khuzestan. According to the socio-economic census of tribal nomads 1999, the sub-basin of highest nomadic population is K8 (43.4%) and follows K6 (26.4%), K7 (25.5%), and only 24 persons (4 families) in K1.

3.3.3 Land Tenure and Land Holding

According to the land reform, all farmers in the study area are own farmers. Average land holding and land use conditions per farmer in the area, according to the data of Rural Research Center, Ministry of Jihad-e- Sazandegi, are presented as following table.

Table 3-3-3-1 Land Holding by Sub-basin

Unit: ha

Sub-basin	Cultivated area w/irrigation	Cultivated area w/dry farming	Fallow area	Orchard	Total
K1	0.5	0.1	0.4	0.1	1.1
K2	0.9	1.1	0.8	0.1	2.9
K3	0.5	1.9	1.6	0.1	4.1
K4	1.5	1.1	1.8	0.3	4.7
K5	0.4	1.7	1.3	0.1	3.5
K6	1.0	0.8	0.7	0.0	2.5
K7	1.0	0.9	1.2	0.2	3.3
K8	0.2	3.3	1.1	0.1	4.7
Average	0.7	1.3	1.1	0.2	3.3

Source: Rural Research Center, Ministry of Jihad-e- Sazandegi, Data 1372
Note: Data is converted from rural district to sub-basin

The land tenure and land holding system in rural area is brought about a subdivision of farmland by inheritance. This subdivision produces a difficulty and limitation of farm management by rural family.

3.3.4 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, the inventory concerning income level has been made. The income level has been computed in the whole rural area including nomadic people. (Refer to Inventory of Income)

Table 3-3-4-1 Income Level by Sub-basin

Unit: Rial

Sub-basin	Agriculture	Livestock	Total
K1	122,597	3,356,980	3,479,577
K2	278,912	6,262,120	6,541,032
K3	254,121	4,179,595	4,433,716
K4	467,003	8,814,330	10,281,333
K5	235,354	7,529,115	7,764,469
K6	276,145	2,933,175	3,209,320
K7	335,703	2,192,270	2,527,973
K8	330,608	4,194,525	4,525,133
Average	287,555	5,057,764	5,345,319

Source: Inventory of Income

As a result, income proportion of agriculture and livestock is 5:95, and it becomes clear that income derived from livestock occupies large amount within farmer's income. This is presented that traditional livestock is a property and a mean of livelihood for farmers and nomadic people, and this trend is more severe for nomadic peoples. Nomadic people already have own land for farming through the land reform and the governmental policy of the settlement of tribal nomads. And nomadic peoples has been change their lifestyle, and they gradually accept new way of life. However, nomadic peoples haven't had enough experience for farming, and livestock keeping still means their security of life.

The peoples in the study area, including both nomads and other peoples, tend to have livestock as property for future expenditure rater than money. According to the results of behavioral survey, families who stock money for future expenditure are only 4 among 205 samples families. Saving in the bank needs complicated procedure, and condition of access to the bank is poor in the study area. While livestock can be changed to money easily anytime they needs. For these reason, it can be said that livestock means a base of income structure in the study areas.

In the area, the sub-basin which is distributed most wealthy farmers is K4, and farmers earn more than 10,000,000 Rials. On the other hand, farmers who earn low income from their activities are distributed in the sub-basin K7, and it shows quarter of the K4.

3.4 Rural Infrastructure

3.4.1 Road Network

The road network in the Study area is generally subject to natural topography as the high mountain ranges are dominant in the basin. Chaharmahal va Bakhteyari Province is connected with adjacent provinces through 17 principal roads, including 12 with Esfahan Province, 4 with Khuzestan Province and 1 with Kohkilouyeh va Boyer Province.

Rural road network is undertaken by the Department of Road & Building, the Ministry of Jihad, however, the roads in Chaharmahal va Bakhteyari and Esfahan are managed by the office in Mashhad, Khuzestan and Fars are Teheran, and Kohkilouyeh va Boyer is in Yasuj.

3.4.2 Water Resources

(1) Surface Water Resource

In the Study area, surface water with 6,000 MCM volume can be utilized on the basis of estimation by JICA Study Team. And present volume for domestic water use and irrigation are estimated at 950 MCM. It is possible to mention that the Study area has high potential to develop water use project for irrigation and groundwater recharge projects. At each gauging station, water quality satisfies the standard of WHO. In Bazoft, Kiyar, Lordegan, the upper reach of Kersan, and especially Karoon river, saline density is higher than the basin-wide average.

(2) Groundwater Resource

Major sources of groundwater are springs and qanaats. The Karstic structure is superb in the Study area, then discharge volume of springs is abandunt and its quality is high. Qanaats have been traditional way to make access to water. However, qanaats have not developed compared to the central region of Iran and have been scattered around residential regions only. Wells have been developed in recent 30 years and mainly utilized for irrigation and industrial purposes.

In general, groundwater indicates alkalescence and high salinity in comparison with surface water. Especially, groundwater in Samirom plain which is located at northern part of K7 have TDS value of 639 mg/liter and EC value of 970 μ mhos/cm. Water quality satisfies the standard of WHO. However, it is necessary to pay attention for irrigation purpose in several plain to prevent farm land from saline hazard.

(3) Dams and Reservoirs

The Karoon River has abundant water resources and is considered to be one of the very important rivers in Iran, however, water resources development has not yet fully implemented and only several

dams for hydropower generation and irrigation have been constructed in the Study area. At present, Masjed Soleyman Dam is under construction with the loan from Japan, other two more dams are also under construction in the Study area, and several dams are in the waiting list for implementation. The status of these dams in and around the Study area is tabulated in Table 3-4-1.
MOE is responsible for major dams and irrigation canals on main rivers, and MOA and MJS are also engaged in dams with small scale.

3.4.3 Water Supply

In rural area, domestic water demand varies from 90 liter/day/person to 120 liter/day/person. It is considered to be low demand in K8 and southern part of K7 basin compared to the other basins. Main water source is groundwater and almost 100 % amount of total demand is supplied except K8 basin. In K8 basin, 50% of total amount is supplied by groundwater and the left is supplied by surface water. As to water supply for cities, groundwater is utilized in 100 %.

3.4.4 Irrigation

Gravity irrigation systems are largely conspicuous in the Study Area and furrow and border/basin irrigation method are general. Annual water demand for farm land varies from 4,000 m^3/ha to 9,000 m^3/ha. Water sources for irrigation are surface water and groundwater. It is reported that each ratio of surface water and groundwater is 65 % and 35 % respectively. Irrigation efficiency has range from 30 % to 35 %. MOA have some implementation plans to reduce water loss and increase irrigation efficiency by lining canal and introducing pressurized irrigation system.

3.4.5 Health Care

Public health care facilities for rural people in the study area are established on the basis of the national health care system. There is a health house at the village level. Health center is established based on rural population at the rural district level. There are some public hospitals in town and the center of the district. In provincial capital, some general hospitals with high medical facilities are established. Distribution ratio of health center and health house in rural area by sub-basin is tabulated as follow.

Table 3-4-1 (1/2) Status of Dams in Karoon River Basin

Dam	BASE	FOUND	Crest	Crest	Annual	Normal	Dead	USE	Control	Agri. Dev.		Dam	FLOOD (CMS)	
	EL.	EL.	Length	Width	inflow	Volume	Volume	Volume	Water	New	Upgra.		Design	10,000
	(m)				(MCM)					(ha)		Type		Return P.
Garmook	39.0		310		22.4	92.1						EF		190
Tange hana	30.0	36.0	230	10	45.0	50.0	10.0	40.0	42.0	2,500	2,500	GF	100	
Yasuj	60.0		600		457.3	32.5						EF		1,662
Shahghasem	36.0	42.0	220		26.5	9.0	0.4	8.6	12.0	2,000		EF	70	
Shahid	80.0	85.0	463	10	153.0	140.0	5.0	135.0	135.0	15,000		EF		1,200
Beaedeh	75.0	84.0	1395	10	390.0	210.0	10.0	200.0	241.0	25,000		EF		2,000
Khersan I	170.0		365		3,754.7	550.0						EF		6,300
Khersan II	199.0		440		3,229.0	1,940.1						EF		5,288
Khersan III	191.0		480		3,371.2	845.7						EF		5,777
Khersan IV	151.0		390		3,248.2	864.0						EF		5,630
Ab Garmak	70.0		160		587.5	67.9						EF		1,440
Karoon 8(747)	165.0		940		2,194.6	928.8						EF		3,203
Karoon 7(705)	171.0		600		3,336.2	1,296.8						EF		4,904
Agh bolagh 1	45.0		700		119.8	2,180.0						EF		541
Koohrang 1		10.0	70		300.0				300.0			CD		
(Dam & Tunnel)														
Koohrang 2		22.0	73		250.0				250.0			CD		
(Dam & Tunnel)														
Koohrang 3	47.0	52.0	475	12	250.0	120.0	45.0	75.0	250.0			EF		956
(W/Transfer Tunnel)														
Sulegan 4 (Vanak 1)	95.0	113.5	572	12	314.0	607.6	53.4	554.2	126.0			EF		2,870
Abadeen (Karoon 1)	50.0		200		1,356.0	370.6						EF		2,035
Vanak 2	76.0		300		571.7	21.4						EF		1,562
Chaghakhor	7.0	13.0	200	10	40.0	45.0	5.0	40.0	30.0	3,500	4,500	EF	7	
Naghan	12.0	13.3	506	8	6.0	6.0	1.0	5.0	6.0	500		EF	40	
Karoon 4	197.0	222.0	572	9	5,223.0	2,190.0	1,308.0	882.0	3,756.0			C-A/G	10,899	10,899
Kharadji (Kiar)		37.5	750	8	103.0	100.0	10.0	90.0	90.0	14,000		EF		520
Ghareh aghaj	32.4	36.4	450	10	14.5	16.0	0.2	15.8	14.0	1,500		EF	100	
Gargak	31.0	36.0	390	10	45.0	42.0	10.0	32.0	45.0	2,500	700	EF		
Bazoft	250.0		530		1,745.5	1,137.0						EF		4,211
Karoon 5	205.0		690		3,342.8	2,280.6						EF		5,408
Tashnavi	123.0		490		864.1	473.0						EF		2,142
Sulegan 2	60.0		190		138.1	114.0						EF		889
Marbaran & Tunnel	12.0	12.0	43		250.0				115.0			CD		8
Karoon 3	185.0	205.0	388	6	9,645.0	2,750.0	1,250.0	1,500.0	440.0	13,000		DA	21,400	
Shahid abbaspoor	177.0	200.0	380	6	12,000.0	3,139.0	1,275.0	1,864.0	12,800.0	98,000		DA	16,200	
Karoon 413	50.0		460		13,434.3	157.7						EF		12,519
Karoon 437	54.0		380		12,078.3	93.6						EF		11,267
Karoon 464	122.0		550		12,015.2	130.0						EF		11,100
Gedar landar	162.0	177.0	480	15	12,000.0	205.0	26.0	179.0				GF	21,700	
Masjed sulcyman														
Karoon 2	40.0	70.0	149	8	10,750.0	152.0	122.0	30.0				EF	12,706	12,706
Karoon 466.5	74.0		270		12,015.2	64.6						EF		11,100

Note: BASE EL=Dam height from river bed, FOUND EL=Dam height from foundation, Agri.Dev.=Agricultural Development, Upgra.=Upgrading, MCM=Million cubic meter, CMS=Cubic meter per second, Return P.=Return period, CONS=Amount of construction materials (1,000 cubic meters), MR=Million reals, M$=Million dollar

Dam Type: EF = Earth fill dams, GF = Gravel fill dams, CD = Concreate diversion dams, C-A/G = Conreate (arch or gravity) dams, DA = Double arch concreate dams, FOUND = Foundation, Waiting = Waiting for further decision

Table 3-4-1 (2/2) Status of Dams in Karoon River Basin

Dam	RES. Area	P. Supply		CONS(1,000m³)		COST(MR)		TOTAL COST		STATUS			Coordinate	
	(ha)	MW	GWh	Soil	Cement	Spillway	Body	(MR)	(MS)	Start	End	Status	LONG	LATT
Garmook	637			723	0	210	46,670	51,145				Waiting	514135	311825
Tange hana	850			570	0			26,000	2.6	92	97	In operation	514500	311300
Yasuj	200			2,528	0	2,000	119,940	133,351				Waiting	513700	303900
Shahghasem	900			575	200			10,000		94	96	In operation	513400	303400
Shahid	650			3,200	0			60,000		94	98	Under study	514500	305000
Beaedeh	900			8,100	0			120,000		94	98	Under study	513800	305600
Khersan I	2,275			11,769	0	25,550	382,470	450,312				Waiting	502640	313010
Khersan II	2,460			16,653	0	28,360	496,890	578,705				Waiting	503555	312515
Khersan III	1,445			22,919	0	28,495	632,175	726,342				Waiting	504640	311925
Khersan IV	5,055			10,809	0	19,685	358,685	416,715				Waiting	505830	311455
Ab Garmak	297			942	0	2,260	56,955	65,634				Jamab Suggestion	512325	310840
Karoon 8(747)	1,513			29,515	0	14,755	764,990	853,139				Waiting	503730	315225
Karoon 7(705)	2,249			21,659	0	21,380	605,785	688,270				Waiting	504325	313900
Agh bolagh 1	11,563			1,751	0	565	90,940	99,864				Waiting	511200	314535
Koohrang 1				0	0					48	53	In operation	500500	322900
(Dam & Tunnel)				0	0									
Koohrang 2				0	16					73	85	In operation	500600	322600
(Dam & Tunnel)				0	0									
Koohrang 3		36		1,900	0			220,000		91	2001	Under construction	502000	321400
(W/Transfer Tunnel)				0	0									
Sulegan 4 (Vanak 1)	1,838	4	31	9,140	0			126,000		88	92	Waiting	511500	313900
Abadeen (Karoon 1)	1,362			639	0	1,770	42,540	48,684				Waiting	503630	320020
Vanak 2	77			1,909	0	2,715	97,040	109,325				Waiting	510620	313805
Chaghakhor	1,490			150	0		2,500	2,500		90	92	In operation	505600	315500
Naghan	200			400	0					84	88	In operation	505000	315700
Karoon 4	2,700	1,000	2,170	0	2,400			1,207,000		96	2002	Under construction	502500	313600
Kharadji (Kiar)				3,500	0			40,000		95	99	Under study	504100	320500
Ghareh aghaj				800	0			11,207		93	99	Under study	513300	313200
Gargak	125			847	0			16,900		95	99	Under study	503700	321700
Bazoft	1,325			38,879	0	33,635	941,645	1,070,388				Waiting	501750	315015
Karoon 5	3,488			35,047	0	30,145	870,785	988,585				Waiting	504105	313920
Tashnavi	119,750			8,985	0	7,050	312,035	352,545				Jamab Suggestion	495335	322045
Sulegan 2	847			824	0	1,255	51,485	57,760				Waiting	512555	313820
Marbaran & Tunnel				0	0			3,736		75	87	In operation	501000	322000
Karoon 3	4,600	3,000	4,137	0	1,984			1,934,000		94	2002	Under construction	500600	314700
Shahid abbaspoor	5,500	2,000	4,024	0	1,230			13,500		69	76	In operation	493600	320300
Karoon 413	806			1,796	0	15,095	92,685	120,771				Waiting	490705	321505
Karoon 437	494			1,380	0	15,525	75,980	103,125				Waiting	491625	321000
Karoon 464	630			9,463	0	39,680	324,455	405,557				Waiting	492430	320120
Gedar landar	600	2,000	3,700	13,463	760			1,134,000		94	2000	Under construction	492700	320100
Masjed soleyman				0	0									
Karoon 2		232		1,200	0					93	98	Under study	495000	320400
Karoon 466.5	215			1,986	0	22,195	99,965	137,993				Waiting	492630	320030

Note: BASE EL=Dam height from river bed, FOUND EL=Dam height from foundation, Agri.Dev.=Agricultural Development, Upgra.=Upgrading,
MCM=Million cubic meter, CMS=Cubic meter per second, Return P.=Return period, CONS=Amount of construction materials (1,000 cubic meters), MR=Million rials, MS=Million dollar

Dam Type: EF = Earth fill dams, GF = Gravel fill dams, CD = Concreate diversion dams, C-A/G = Conreate (arch or gravity) dams,
DA = Double arch concreate dams, FOUND = Foundation, Waiting = Waiting for further decision

Table 3-4-5-1 Distribution of Public Health Facilities in Rural Area

Unit: %

Sub-basin	Health center		Health house	
	(%)	(person/place)	(%)	(person/place)
K1	31.6	13,300	58.6	7,200
K2	19.6	3,500	41.7	1,700
K3	13.0	4,300	31.1	1,800
K4	19.5	3,500	46.4	1,500
K5	5.9	5,700	31.4	1,100
K6	8.2	16,400	39.7	3,400
K7	4.1	25,900	16.8	6,300
K8	1.2	41,800	11.6	4,300

Source: Census 1375 (1996), converted into sub-basin

Population ratio of health center (person per place) shows there is large gap between sub-basins, which exist under the lowest condition and highest condition. The lowest sub-basin is K8 with 41,800 peoples per one health center, while the highest sub-basins are K2 and K4. K8 belongs to Khuzestan province, and a part of K7 belongs to Kohgiluyer va Boyerahmad province. Life expectancy in these two provinces is rather low compared to the national average, as mentioned in 3.3.2. Due to distribution of scattered small village in the remote mountainous area of the sub-basin K5, K7 and K8, distribution ratio of these facilities presents considerably low. Number of village in the sub-basin K5, K7 and K8 is estimated 51, 1,220 and 540, respectively. Distribution ration in K8 is the highest, however, population ratio shows the condition of K8 sub-basin is the lowest. The main reason of the result is Sharekord Township, capital city of Chaharmahar va Bakhtiyari province, is located in the K8 sub-basin.

3.4.6 Post, Telecommunication and Transport

At the village level, post office and public telephone, as post and telecommunication facilities, is established. There are public and private transport facilities which links with towns, center of the district and other villages. A ratio of villages in the study area, which have access to these facilities, is shown in Table 3-4-6-1.

Table 3-4-6-1 Post, Telecommunication and Transport

Unit: %

Sub-basin	Post office		Public telephone		Transport facilities	
	(%)	(person/place)	(%)	(person/place)	(%)	(person/place)
K1	43.5	9,700	67.8	6,200	62.7	6,700
K2	16.1	4,300	27.1	2,500	43.8	1,600
K3	10.5	5,300	23.9	2,300	47.5	1,200
K4	30.2	2,300	39.8	1,700	54.8	1,200
K5	5.9	5,700	15.7	2,100	23.5	1,400
K6	7.4	18,100	26.6	5,000	46.7	2,900
K7	3.0	35,400	11.6	9,200	33.7	3,200
K8	1.1	45,600	3.1	16,200	12.2	4,100

Source: Census 1375 (1996), converted into sub-basin

Note: K7 of post office excluded Kohgiluyeh va Boyerahmad Province because of no data.

Telecommunication facilities in the sub-basin K5, K6, K7 and K8 are scarcity compared with other sub-basins. While conditions in the sub-basin K1 and K4 are better than these sub-basins which located in the south-west part of Zagros mountain range. From these circumstances, it can be said that social development in remote and mountainous areas is far behind the other rural area in the study area.

3.5 Agriculture and Other Rural Industry

3.5.1 Agriculture

The main crops in this area are wheat, barley and forages. In some areas with abundant water, paddy rice, beans and vegetables are cultivated. On the other hand, on some hillsides in the area, spreading from the border of plains to places between mountains, grapes, apples and nuts are cultivated. The distribution of farmland in each sub-basin is tabulated as follows:

Table 3-5-1-1 Distribution of Farmland

Unit: ha

Sub-basin	Cultivated area w/irri.	Cultivated area w/dry f.	Total cultivated area	Fallow area	Orchard w/irri.	Orchard w/dry f.
K1	12,985	3,334	16,309	10,846	2,281	9
K2	1,986	3,551	5,535	3,201	286	0
K3	2,078	14,168	16,250	11,021	640	0
K4	9,489	5,896	15,384	9,977	1,627	0
K5	885	6,745	7,633	4,327	203	0
K6	8,661	6,149	14,810	5,797	241	0
K7	29,489	28,767	58,259	29,894	6,161	243
K8	2,700	36,178	38,881	11,179	1,009	0
Total	68,273	104,788	173,061	86,242	12,448	252

Source: Rural Research Center, Ministry of Jihad-e- Sazandegi
Note: Data is converted into sub-basin.

Table 3-5-1-2 Cropping Rate of Main Crops

Unit: %

Sub-basin	Cultivated area w/irri.	Cultivated area w/dry f.	Total cultivated area	Fallow area	Orchard w/irri.	Orchard w/dry f.
K1	12,985	3,334	16,309	10,846	2,281	9
K2	1,986	3,551	5,535	3,201	286	0
K3	2,078	14,168	16,250	11,021	640	0
K4	9,489	5,896	15,384	9,977	1,627	0
K5	885	6,745	7,633	4,327	203	0
K6	8,661	6,149	14,810	5,797	241	0
K7	29,489	28,767	58,259	29,894	6,161	243
K8	2,700	36,178	38,881	11,179	1,009	0
Total	68,273	104,788	173,061	86,242	12,448	252

Source: Data of Ministry of Agriculture

Table 3-5-1-3 Crop Yield of Main Crops

Unit: kg/ha

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

Source: Data of Ministry of Agriculture

Farming conditions of main crops are as follows.

(1) Wheat

Wheat is cultivated in dry farmland in alternate years under a "wheat-fallow-wheat" or "beans-wheat - barley" or "beans-wheat-barley" cropping system. The average yield of non-irrigated wheat is 1,280 kg/ha in the study area, and it is not largely different among areas. On the other hand, its yield in the country is relatively low at 821kg/ha, equivalent to 3/5 of the study area. It may be caused by difference of rainfall amount, 650 mm in the study area and 300 to 350 mm (Almanac Iran 1992) in the country. It is supposed that wheat of the country is cultivated in more sever condition than in the study area. In the case of irrigated wheat, its yield is not much different as 3,180 kg/ha in the study area and 3,149 kg/ha in the country. It means that cultivation condition is moderated by irrigation and resulting in less difference.

(2) Barley

Barley is also cultivated in dry farmland and planted in alternate years, similarly to wheat. In some places, there is a system of "barley-fallow-wheat-barley". The average yield of barley in the study area is 1,120 kg/ha that is higher than its average of 834 kg/ha in the country. It may be caused by difference of rainfall amount as same as wheat. In the case of cultivation with irrigation, the average yield is 2,990 kg/ha.

(3) Alfalfa

Alfalfa, which is used as feed for domestic animals, is cultivated in irrigation areas and planted continuously or in alternate years. The yield per hectare is 9,780 kg on an average.

(4) Pulses

Pulses, including kidney beans, lentils and green peas, are cultivated mainly in irrigated areas. The system of planting is wheat or barley after pulses. The yields per hectare of kidney beans, lentils and green peas are 2,470 kg, 1,350 kg and 1,230 kg, respectively. The yield of green peas, which are cultivated in non-irrigated fields, is 120 kg per hectare.

(5) Rice

Paddy rice is cultivated in places of 1,500 m or lower altitude where water sources are abundant. The

yield per hectare is 4,710 kg.

(6) Grapes

Grapes are widely cultivated in semi-dry land on the slopes of mountains in areas spreading from the border of plains to places between mountains. The yield per hectare is 4,710 kg.

(7) Apples

In Semirom District (located at the sub-basin K4 and K7) in Esfahan Province, the cultivation of apples is the most flourishing in the sub-basins and special production localities are formed. The yield per hectare is 18,245 kg/ha on average.

3.5.2 Livestock

The numbers of main livestock classified by sub-basins in the study area are as shown in the following table.

Table 3-5-2-1 Number of Livestock

Sub-basin	Sheep and lamb	Goats and kids	Cows and calves	Equines	Poultry	
					Natives of farm	Industrial
K1	826,565	287,514	95,960	64,944	1,741,674	408,000
K2	300,000	70,000	2,200	1,700	17,600	0
K3	280,290	185,645	31,602	17,697	145,100	0
K4	444,621	900,420	24,863	5,165	116,570	10,000
K5	320,000	150,000	750	2,100	46,970	0
K6	261,283	171,622	13,590	8,912	343,500	0
K7	860,727	1,010,375	101,262	50,631	2,936,600	0
K8	526,512	438,760	10,969	21,938	449,730	0
Total	3,819,998	3,214,336	281,196	173,087	5,797,741	418,000

Source: Livestock organization of the Provincial Jihad Organization

Note: Data is converted by sub-basin. In order to no classified data by poultry farm and industry in the sub-basin K7, number of poultry is evaluated by farm

(1) Representative animal husbandry

a) Sheep

Fifty percent of the sheep raising in the study area are Lori Bakhtiyari. Other breed of sheep include Turki Ghashghay, Naini, Iraqe and Dober. Lori Bakhtiyari breed is bred for meat and milk, and these sheep give lambing to two lambs per year. They produce milk of 10 to 15 lts monthly. Wool (white fleece) of 1.0 kg to 1.5 kg is produced in a year. Turki Ghashgay breed is also bred for meat and milk; these sheep produce milk of 15 lts monthly. They produce brown long wool of 1 to 1.5 kg in a year. Sheep of this breed are resistant to diseases.

b) Cows

Milk cows are mainly bred. Due to the recent import of pure milk cows, the ratio of pure breeds to

breeds mated with local ones is 1 to 2. Among pure milk cows, while the percentage of Holsteins is low, that of Brown-Swiss is increasing rapidly. Besides these, there is Danish Jersey. Cows of local breeds produce milk of 4 to 6 lts a day, and the grade of their fattening is middle.

(2) Animal husbandry of nomads

The main nomadic tribes in the study area are the Haft Lang Bakhtiyari, Gashghay and Boyerahmad-olia tribes. The period of nomadism of these tribes in summer including nomad movement is about six months, from late April to mid-October. Nomadism in a day continues from 4 o'clock in the morning to 10 o'clock in the evening, with a break of 1 to 2 hours, seeking grass of good quality. In these years, there are many cases where pasturage is carried out in summer by borrowing cultivated fields that have finished harvesting. Nomads purchase alfalfa and wheat straw as feed in winter from farming houses on their way home. Some nomadic families now borrow farmland near their camping places and cultivate grains for feed. Recently, it can be found that some nomadic families are settled surrounding villages. However, because the destruction of grassland is severe and because goats are not economical, recently there is a tendency that the ratio of sheep to goats has become four to one.

(3) Production of livestock in villages

Typical production (establishment type) of livestock in villages is carried out by traditional methods. The method of livestock production in the area is not different from the general one, but is influenced by the method employed by neighboring nomads. In this method, the ratio of sheep to goats is 2 to 1, and the number of milking cows is 5.83 times larger than that of nomads. In the case of village, the possibility of forage crops supply from cultivated places is high, and such villages are close to the consumption market where demand for sheep meat is large. These circumstances are considerably related to production.

Though production of milk in rural areas was not a custom before, it has increased year by year. Families in villages have begun to consume milk by making yogurt and are shipping it to market. Some villagers process milk to butter, oil, whey, etc. and sell these products in the market, although this is still rare. A poultry is also a usual practice for the production of eggs and meat.

Beekeeping is carried out in villages. The production of honey from one beehive in a year weighs 6 to 7 kg. Beekeeping in rural areas is conducted by the traditional method around villages when alfalfa and white Dutch clover, which are farm products, bloom. Sugar is given as artificial feed in winter.

3.5.3 Inland Fishery

The Silat Company (Office of fishery), the Provincial Jihad Organizations manages inland fishery in the area and is promoting fishery. Species of freshwater fish are rainbow trout and red trout, but rainbow trout farming is dominated in the area.

The fish multiplication center of the Jihad Organization exists in the sub-basin K7 and produces fry of freshwater fishes. The center is distributed to fish farms in the Karoon river basin. The main bodies operating fish farms take two forms: village cooperative and capitalists living in towns.
The number of fish farms registered in the Office of fishery and the quantity of production in a year are as follows.

Table 3-5-3-1 Registered Fish Farms and Production

Sub-basin	Fish farms	Annual production(ton)	Remarks
K1	1	5	Fishculture center
K2	10	175	
K3	10	325	
K4	5	100	
K5	5	240	
K6	7	160	
K7	22	460	
K8	0	0	
Total	60	1,465	

Data source: Silat company of Provincial Jihad Organizations (1999)

Besides these, the quantity of production in two lakes in the sub-basin K4 is 350 tons.

3.5.4 Rural Industry

Traditional rural industries in Iran are represented by carpets, which are pieces of woolen handicraft closely related to animal husbandry in villages. Besides carpet weaving, there are gelim weaving as well as traditional hats, shoes and daily necessities among nomads. These farm village industries are household industries, and production depends on the labor of women of the families. In order to promote these traditional rural industries, the Office of handicraft, Provincial Jihad Organization established rural industry cooperative aiming at carpet makers in rural areas. Through these cooperatives, they give support such as guidance for quality control and design, processing and sale of raw materials and improvement of quality and sale of products.

In carpet weaving in villages, one person weaves carpet of about 1 m^2 in a month, and the profit is 400,000 Rials (including labor cost). According to the Office of Handicraft of Chaharmahal va Bakhtiyari Province, quantities of production of carpets and gelim in the province are 250,000 m^2 and 100,000 m^2, respectively.

3.5.5 Marketing system

(1) Agricultural products

The policy to maintain the prices of basic foodstuff such as wheat and barley is adopted by the government, and these products are shipped through village cooperative. Other agricultural products

are sold directly to markets near the village by farmers or shipped to markets through middleman; there are no fixed shipping systems.

(2) Livestock

Livestock is mainly shipped to markets through middleman because the markets are far distant, while farmers sell homemade-dairy products directly in the markets. Livestock of nomads are sold directly to merchants and farmers, in nomad camping places or en route to nomadic migration. There are no fixed distribution systems.

(3) Handicrafts

For carpets representing handicrafts, there are two distribution systems: the Office of Handicraft, the Jihad Organization, and local merchants.

3.6 Natural Disasters related to Watershed Management

3.6.1 Flood and Debris Flow

There is no distinction between flood and debris flow in Iran and debris flow is generally included in "flood". Based on the observation during the site reconnaissance and the gradient of rivers obtained from the topographical map, debris flows are separated from flood as much as possible in the inventory.

Since the Study area is mountainous, debris flows are dominant in the tributaries. On the other hand, flood occurs along the Karoon River, major tributaries and flat plains such as the vicinity of Shahre Kord.

(1) Flood Damage Areas

Flood damage areas are mainly located on the rivers of Sarkhun, Aghabolugh, Jahanbin and Bazoft in Chaharmahal va Bakhtiyari Province, of Marbor, Garmak, Rahimi in Esfahan Province, of Boshar in Kohgiluyeh va Boyerahmad Province, and of Karoon main stream in Khuzestan Province. In particular, the Jahanbin River in Chaharmahal and the Marbor River in Esfahan have many damaged areas, and the latter river basin received more damage.

(2) Flood Damage

The flood group of SED, the Ministry of Jihad, has been engaged in compilation of flood data and flood damage, such as houses, human lives, agriculture land (farmland and garden), livestock, infrastructure (road, canal, bridge, well, ganat), and amount of damage. These data are shown in ANNEX E.

The recent flood occurred in 1997/1998 and the flood group has investigated the flood damage mainly in Chaharmahal Province. The amount of flood damage does not cover all the flood records, and it is difficult to evaluate the degree of flood damage with this amount.

In Khuzestan Province, the lower reaches of the Karoon river basin, a huge flood occurred in 1923, and caused death of around 3,000 people. In addition, floods hit in 1928, 1939 and 1949, and significant damage on human lives and economy had been given to the Province. In the Study area, damage on human lives is reported as five dead and three missing in K5-23, and one dead in K8-13B (Refer to the Inventory - Flood/Debris Flow Damage B).

As for the reconstruction after disaster, the Ministry of Jihad take the responsibility of infrastructures such as bridges and roads, while Housing Foundation of Islamic Revolution consult housing reconstruction depending on the degree of damage.

(3) Time of Occurrence

In the provinces of Kohgiluyeh and Khuzestan, the southwest part of the Study area, flood occurs frequently in November and December, while in Chaharmahal and Esfahan, the snow-melting period of March to May is predominant.

In Ahwaz, the capital of Khuzestan Province, flood is frequent from November to April, and March is most predominant.

(4) Cause of Flood

There are many causes on flood, and it is pointed out that heavy rainfall and snow melting as meteorological condition, and steep rivers (steep longitudinal gradient of rivers) and sedimentation and river bed rise caused by soil erosion as natural condition.

The steep rivers are the Sarkhun, the upper reaches of Bazoft and Kurang, and Sulegan. Sedimentation and soil erosion are remarkable in the Boshar river basin, upstream of Yasuj.

The drain capacity of the Karoon River at Ahwaz is estimated around 12,000 m^3/s, however, the capacity is decreasing because sediment from upper reaches rises the riverbed, which is said to be the main cause of flood.

(5) Flood Discharge

On the Shahid Abbasspur Dam, located in the most downstream of the Study area, the maximum inflow in the reservoir in February 1979 was recorded 4,000 m^3/s. The maximum discharge from the Dam was 565 m^3/s (This flood caused damage to Ahwaz with 80 houses, 22 peoples death, 5,000 ha of

farmland, and 15,000 sheep). In March 1987, the maximum discharge of 770 m^3/s from the Dam was also recorded because of heavy rainfall in the upstream (This flood is recorded in the inventory, but no remarks on flood damage).

3.6.2 Landslide

A lot of landslides are seen in the Study area and they destroy houses, farmland and other infrastructure. Also peoples and the domestic animal are deprived of the life. (see Annex :Disaster Record of Landslide), and some villages have migrated.

There is about 450 landslide record in the Study area according to the landslide data of SED. The features of the landslide in this region are enumerated as follows.

(1) Cause of landslide

The highest percentage of cause of the landslide is "*trouble of trashed mine*" *Erosion by rivers and* stream" is second and "rainfall" is third. Another causes is " destroy of plant cover" and " mineral *and chemical composition of lithology*".

Artificial power like road construction or development of mine is a main cause of landslide. However, the large-scale landslide is very few by these reason and damage is not very large either.

(2) Disaster area

Small-scale landslide with range within 10000 m^2 accounts for 60% or more of generation in relation to the above mentioned reason. Next, the medium range from 10000 to 50000 m^2 is about 30%. Large-scale landslides of more than 50000 m^2 are about 10%.

(3) Kind of disaster

Rangeland and farmland are high damage area of the landslide and damage of the national road and village road are the second. Additionally, there is a lot of damage on water pipeline, gas pipeline and irrigation cannel .

According to the field investigation, the analysis of aerial photograph and the landslide data, the occurrence of the landslide in the project area are described as follows.

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

Therefore, a part of disaster can be prevented by the investigation before construction or area development. However, many area have risks of generation of landslide in view point of geographical and geological features . Control or the prevention of many kind of landslides are possible by present technological level. However, the preventing construction for the Sabo against these landslides needs the enormous capital. Therefore, the study in the future should focus on important areas suitable for the capital investment in consideration disaster prevention by participation of resident. Moreover, it is also important to select Master Plan areas to improve a technological level, and to scrutinize the method of preventing a natural disaster. Various investigations should be applied to the selected area for the improvement of counter-measure in the future. Especially, observation investigation is also important.

3.6.3 *Surface Soil Erosion*

Soil erosion has been already studied in most part of the Study Area by several studies under JIHAD and MOA. However, upper part of K7 river basin and lower part of K8 river basin have not been studied yet. Due to no available study for the said parts of K7 and K8 river basins, preliminary study has been carried out for evaluating soil erosion of the study blank area.

(1) Assessment Methods for Soil Erosion

There are several assessment methods for evaluating soil erosion. Major assessment methods are as follows:

a) Universal Soil Loss Equation (USLE)
b) Erosion Potential Method (EPM)
c) PSIAC Method
d) Discharge-Sediment Rating Method

(2) Erosion Analysis of the Study Blank Area

a) Applied Method for Erosion Assessment

PSIAC method is commonly applied for erosion assessment in Iran, and all mentioned previous studies have applied PSIAC method for assessing soil erosion in the area. However output of this method is not erosion but sediment ; nevertheless no other suitable methods are applicable to study a large river basin. It is, therefore, recommendable to select PSIAC method for studying the blank area. The assessment of PSIAC involves nine (9) factors of which two are essentially concerned with climate and runoff characteristics, one reflects land use, and the remaining six factors introduce measures of geology, soils, topography, ground cover and two erosion development factors on upland erosion and channel erosion. Soil erosion is assessed by the total number (S) of marked scores (R_1, R_2, ...R_9) of 9 factors.

$$S = \sum_{i=1}^{9} R(i)$$

Erosion is assessed by the total marked score (S) as below:

Table 3-6-3-1 Erodibility by Total Marked Score (S) in Five Classification

Erodibility Class	Erodibility	Total Marked Score (S)	Erosion Quantity (Q_s) ($m^3/km^2/yr$)
1	Trace	0 ~ 25	<95
2	Low	25 ~ 50	95 ~ 232
3	Fair	50 ~ 75	232 ~ 568
4	High	75 ~ 100	568 ~ 1390
5	Severe	100<	1390<

(Note) $Q_s=38.77e^{0.0358S}$

b) Classification of topography

Major factors relating to soil erosion such as geology, soil, ground slope, vegetation cover and land use are generally reflecting to the topography. Therefore, erosion has been studied based on topography classified into following 6 categories on the map of 1:50,000.

A: Mountain
B: Hill
C: Terrace
D: Alluvial Flat Plains
E: Alluvial Fan
F: Water

c) Erosion Analysis of the Study Blank Area

Erosion analysis has been carried out for each sub-basin in the study blank area based on effective factors such as surface geology, soil, climate, runoff, topography, ground cover, land use, upland erosion and channel erosion.

(3) General Condition of Erodibility in the Study Area

As shown in following Table, the area of severe erodibility or Level 9 is estimated at 1,113 km^2, that is equivalent to 4.2 % of the total area. Out of 1,113 km^2, the area of 606 km^2 locates in K7 basin, and 262 km^2 and 189 km^2 in K2 and K3 respectively. In K2 basin, 21.4 % of area is classified into severe erodibility. In K2 basin, severe erodibility is largely extended along the Ab Kurang river. Severe erodibility is also observed in K3 and K7 basins as 7.5 % and 6.7 % respectively.

On the other hand, erodibility is generally low in K1 and K4 basins where topography is gentle. In these two gentle topographical basins, such large cities as Share Kord, Farokh Shahr and Boroujen have been developed. Total amount of erosion is estimated at about 10 MCM per year in the Study Area. Out of 10 MCM of erosion, 37 % is produced in K7 Basin and 13 % both in K5 and K8.

Table 3-6-3-2 Erodibility by River Basins in the Study Area

Basins	Level of Erodibility ($m^3/km^2/yr$)											
	Water	1 Trace	2 Trace-Low	3 Low	4 Low-Fair	5 Fair	6 Fair-High	7 High	8 High-Severe	9 Severe	Total	
		<95	<232	95~232	95~568	233~568	232~1390	568~1390	568<	1390<		
		48	116	164	332	400	811	979	979	1390		
Area (km^2)												
K1	0.0	1,923.8	0.0	572.2	0.0	843.2	0.0	561.5	0.0	19.6	3,920.2	
K2	0.0	295.6	0.0	196.4	0.0	149.5	0.0	320.4	0.0	261.9	1,223.7	
K3	1.6	337.9	0.0	1,190.0	0.0	745.3	2.8	42.0	0.8	188.7	2,509.1	
K4	39.0	1,094.3	0.0	1,139.0	0.0	716.5	0.0	201.2	0.0	24.8	3,214.8	
K5	0.0	607.4	0.1	75.7	0.5	312.7	0.5	1,177.8	0.0	0.0	2,174.7	
K6	4.0	413.4	0.0	698.4	0.0	163.1	0.0	195.1	0.0	0.0	1,474.0	
K7	0.0	375.4	0.0	3,510.5	0.0	3,723.5	0.0	805.4	0.0	606.2	9,021.0	
K8	64.9	190.0	103.3	928.7	196.7	1,144.6	281.1	259.5	97.9	11.9	3,278.5	
Total	109.4	5,237.9	103.4	8,310.8	197.2	7,798.2	284.3	3,562.9	98.7	1,113.1	26,816.0	
Area Ratio												
K1	0.0%	49.1%	0.0%	14.6%	0.0%	21.5%	0.0%	14.3%	0.0%	0.5%	100.0%	
K2	0.0%	24.2%	0.0%	16.0%	0.0%	12.2%	0.0%	26.2%	0.0%	21.4%	100.0%	
K3	0.1%	13.5%	0.0%	47.4%	0.0%	29.7%	0.1%	1.7%	0.0%	7.5%	100.0%	
K4	1.2%	34.0%	0.0%	35.4%	0.0%	22.3%	0.0%	6.3%	0.0%	0.8%	100.0%	
K5	0.0%	27.9%	0.0%	3.5%	0.0%	14.4%	0.0%	54.2%	0.0%	0.0%	100.0%	
K6	0.3%	28.0%	0.0%	47.4%	0.0%	11.1%	0.0%	13.2%	0.0%	0.0%	100.0%	
K7	0.0%	4.2%	0.0%	38.9%	0.0%	41.3%	0.0%	8.9%	0.0%	6.7%	100.0%	
K8	2.0%	5.8%	3.2%	28.3%	6.0%	34.9%	8.6%	7.9%	3.0%	0.4%	100.0%	
Total	0.4%	19.5%	0.4%	31.0%	0.7%	29.1%	1.1%	13.3%	0.4%	4.2%	100.0%	
Erosion Amount ($1000m^3/yr$)												
K1		92	0	94	0	337	0	550	0	27	1,100	11%
K2		14	0	32	0	60	0	314	0	364	784	8%
K3		16	0	195	0	298	2	41	1	262	815	8%
K4		53	0	187	0	287	0	197	0	35	759	7%
K5		29	0	12	0	125	0	1,153	0	0	1,319	13%
K6		20	0	115	0	65	0	191	0	0	391	4%
K7		18	0	576	0	1,489	0	789	0	843	3,715	37%
K8		9	12	152	65	458	228	254	96	17	1,291	13%
Total		251	12	1,363	65	3,119	230	3,489	97	1,548	10,174	100%
Erosion Ratio		2%	0%	13%	1%	31%	2%	34%	1%	15%	100%	

(4) Water and Soil Conservation Facilities

Water and soil conservation facilities have been surveyed based on the questionnaire to the concerned JIHAD provincial offices. The provincial offices have own different compiling form for facilities so that it is difficult to compile facilities into an integrated form. Therefore, only constructed years are compiled into inventory by facility categories and sub-basins.

Based on the inventory, situation of conservation facilities has been summarized and reported in following Table 3-6-3-3.

Among 455 sub-basins in the Study Area, 62 sub-basins are so far provided with conservation facilities by JIHAD, that is only 14% of total sub-basins. Conservation facilities can be categorized into three categories.

i) Physical facilities

Check dam, Soil dam, Stone dam, Gabion dam, River dike, Revetment, Contour bund, Terracing, etc.

ii) Biological works

Plantation, Seedling

iii) Rangeland conservation

Fencing works, Rangeland conservation

Table 3-6-3-3 Conservation Facilities in the Study Area

Sub-Basins	K1	K2	K3	K4	K5	K6	K7	K8	Total
Number of Sub-basins	63	21	47	40	41	20	164	59	455
Sub-basins provided with Facilities	18	3	13	7	4	5	10	2	62
	29%	14%	28%	18%	10%	25%	6%	3%	14%
Sub-basins provied with Physical Conservation Facilities	15	3	9	6	3	3	10	2	51
	24%	14%	19%	15%	7%	15%	6%	3%	11%
Check dam	8	3	4	3	1	2	2	1	24
Soil dam w/ comp	2	0	1	0	0	0	0	0	3
Soil dam w/o comp	2	0	1	0	0	2	0	0	5
Stone dam	1	0	1	2	1	0	1	2	8
Gabion dam	1	2	1	2	0	0	0	1	7
River dike	5	0	2	0	0	1	0	0	8
Revetment	0	0	0	1	0	0	0	0	1
Contour Bund (Banquette)	1	1	2	2	1	1	4	0	12
Terracing	0	0	0	0	0	0	4	0	4
Sub-basins provied with Biological works	5	1	7	5	1	4	4	2	29
	8%	5%	15%	13%	2%	20%	2%	3%	6%
Plantation (tree)	-	-	-	-	-	-	1	2	3
Plantation (fruit)	-	-	-	-	-	-	4	0	4
Seedling (grass)	-	-	-	-	-	-	1	2	3
Seedling (spot)	-	-	-	-	-	-	1	2	3
Sub-basins where rangeland is conserved	3	0	3	1	0	1	1	2	11
	5%	0%	6%	3%	0%	5%	1%	3%	2%
Fencing works	3	0	3	1	0	1	0	2	10
Rangeland conservation	0	0	0	0	0	0	1	0	1

(Notes)

1) Above figures are obtained from the Inventory of water and soil conservation facilities.

2) -: not specified.

Among above works, physical facilities have been provided in 51 sub-basins, and biological works in 29 sub-basins and rangeland conservation in 11 sub-basins. It is difficult to evaluate the effects of those facilities so far implemented due to lack of information. It is recommended to prepare an integrated form to grasp important factors such as location map of the project, list of facilities, cost, effects of the project for future monitoring.

3.7 Social Status in Rural Area

3.7.1 Rural Community

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

People's Committee determine the general directions in the village and tribal community, performing an active role in stimulating cooperative activities for the improvement, conservation and restoration of customs, and protection of their predecessors' culture.

3.7.2 Public Organization

Public Organizations close to the villagers comprise Agriculture Services Center (ASC), Jihad Center, and field organizations operating in the province; such as Department of Environment, Ministries of Health and Medical Education, Education, Roads and Transportation, Post and Telegraph and Telephone, Energy, and Cooperatives, Agricultural Ban, and so on.

3.7.3 Farmers Organization

Central Organization of Rural Cooperative, under the Ministry of Agriculture is promoting the formation of rural cooperatives. Of which, most active are the Rural Services Cooperatives, supplying chemical inputs, and purchasing the crop with support price, on behalf of the government. Other organizations are found in Agricultural Cooperative Societies, Production Cooperatives and Moshaa Production Cooperatives.

3.7.4 Public Services

Before the land reform in the 1960's, rural people oppressed by feudal landlords was kept at a distance from the administration and they could not obtained good public services. The last regime was negligent of the public services for rural people owing to give priority over the reorganization of agricultural system than improvement of living conditions and social welfare in rural area. After the Islamic revolution, the government has been carried out various policies aiming to stabilize rural living conditions and to improve social welfare in rural area, and pay attention to improve rural environment.Presently, public services for rural people cover education, health, living, agriculture and livestock and so on.

(1) Educational service

In the study area, related provincial education organizations take the responsibility on primary and secondary educational services, under the control of the Ministry of Education. Primary school (compulsory education: 5 years schooling) is established at village level and it strives for the spread of basic education in rural area. In major villages of the rural district, there is secondary school (3 years schooling) and it contributes to improve rural education. High school (3 years schooling) is established at towns and center of the district. In nomadic residential area, primary school for tribal nomads is established and tribal teacher teaches nomadic children.

According to the statistics 1999, average number of primary school pupil for one teacher is 21.3 in the country. In the related province to the area, it shows: 20 pupils in Chaharmahal va Bakhtiyari, 18 pupils in Kohgiluyeh va Boyerahmad, 20.8 pupils in Esfahan, 17.3 pupils in Fars and 27.5 pupils in Khuzestan. Higher educational institutions such as university and college are established in Shahre Kord, Borujen and Yasuj within the study area.

(2) Health service

Public health service in the area is carried out by related provincial health organizations under the control of the ministry of health and medical education. On the basis of the national health care system, the health network is established throughout country. In rural area, health house is established at village level. Two health technicians in one health house conduct basic health consultation for family, vaccinations and guidance of family planning. Health center is stationed at major village in the rural district. The center carries out medical service for rural people. There are hospitals in towns and center of the district. These hospitals have ambulance service. Central hospital of the province treats for serious diseases and injuries. Establishment criteria of health care facilities are a health house for 500 to 1,500 inhabitants and a health center for more than 2,500 inhabitants.

(3) Agricultural service

Provincial agricultural organizations related to the area take the responsibility on agricultural service for farmers who live in plain area. Besides, the Provincial Jihad Organizations related to the area are carried out agricultural service in the hilly and mountainous area in collaboration with the Provincial Agricultural Organizations. These agricultural services are conducted through the agricultural service center, which is established at the rural district level. Activities of this center are farming assistance including technical support, provision of agricultural foundation, and planning and counseling of training, investigation, and development of markets. In addition, study on land tenure and land holding and establishment of small-scale rural industry are carried out.

On the other hand, village cooperative is established at the rural district level. The cooperatives carry out public service directly to farmers. It includes instruction and supervision for purchasing and distribution of seeds, saplings and domestic animals and breed improvement, and harvesting and selling of farm products, farm credit, and sale of daily necessities.

In order to research and develop regional agriculture, agricultural research and experimental station is established in each province.

(4) Livestock service

Public service for animal husbandry of nomads and farmers is carried out by livestock office of the provincial jihad organization. Its activities are management of animals and animal health (formation of

veterinarian's group, dispatch veterinarian to village and tribal residence area, vaccination and supply of medicine). Directly service to nomads and farmers is conducted through the livestock service station, which is posting at the district level.

(5) Handicraft service

Provincial Jihad Organization supports handicraft making such as carpet, gilim and other woven goods production in rural area. It includes guidance of design and quality control, improvement of production technology, and marketing (provision and processing of law material, purchasing and selling of handicraft). On the other hand, this organization promotes formation of rural industry cooperative among rural people in order to improve quality and technology of handicraft.

3.7.5 Education

As mentioned in the article 3.7.4, after the Islamic revolution, the government promotes the encouragement of education and to improve the literacy rate of the people, as one of the important policies. As a result, adult literacy at the country level improved from 41.8% on the eve of revolution (1979) to 74.5% in 1997. On the other hand, the combined enrolment ratio (first, secondary and tertiary levels) increased from 46% in 1980 to 75% in 1997.

Educational environment in the provinces related to the study area, as well as the country, has been improved remarkably after the revolution. It includes the expansion of educational infrastructure and facilities, and teacher's training.

The enrolment ratio of primary and secondary education by the Human Development Report 1999 is as follows.

Table 3-7-5-1 Enrolment Ratio of Primary and Secondary Education

Unit: %

Province	Primary Education		Secondary Education	
	Total	Female (as % of male)	Total	Female (as % of male)
Country (Iran)	119.1	107.8	76.8	88.8
Chaharmahal va Bakhtiyari	114.7	101.6	76.0	79.9
Kohgiluyeh va Boyerahmad	131.4	115.5	85.0	68.3
Esfahan	115.3	112.0	83.0	95.3
Fars	115.6	105.4	76.2	87.9
Khuzestan	117.4	100.3	70.5	82.4

Source: Human Development Report 1999, Plan and Budget Organization

As mentioned above, the enrolment ratio of primary education in the area is lower than that of the country, except for Kohgiluyeh va Boyerahmad province. The ratio of female to male students increased from 66% in 1976 to 90% in 1996 at primary level in the country. And the significant increase of female student who go on to the secondary education course is presented compared with that of male. The adult literacy of female is also improved similarly. It is assumed that these trends are

similar to the country. Excepting the provinces of Esfahan and Fars, the literacy rate by sex of the related provinces to the study area is lower than that of the country.

Table 3-7-5-2 Adult Literacy

Unit: %

Province	Male	Female
Country (Iran)	79.7	65.9
Chaharmahal va Bakhtiyari	76.2	58.3
Kohgiluyeh va Boyerahmad	74.2	55.9
Esfahan	84.5	74.1
Fars	80.7	68.6
Khuzestan	77.8	60.3

Source: Human Development Report 1999, Plan and Budget Organization

Traditional custom and behavior in rural society produce low literacy rate of female. Since the government strives for eradication of adult illiteracy through literacy movement, this situation is being improved. This movement is carried out by the Literacy Movement Organization.

Regarding the item of education in the inventory, this will be basic data for regional development. Therefore, it is desirable to make an entry of newest accurate numeral value in the form. However, because the data of education could not be obtained in the fieldwork, the education inventory item is filled with the provincial data of the Human Development Report 1999.

3.7.6 Human Development Index (HDI)

Values of the HDI in provinces related to the study area in 1996 are as follows.

Table 3-7-6-1 HDI in Provinces Concerned

Province	Life expectancy at birth (years)	Adult literacy rate (%)	Combined first-second and third level gross enrolment ratio (%)	Adjusted real consumption expenditure per capita (1000 Rials)	Human development index (HDI) value
Country (Iran)	69.2	72.9	75.9	1899	0.790
Chaharmahal va Bakhtiyari	65.9	67.2	75.6	1437	0.682
Kohgiluyeh va Boyerahmad	63.4	61.9	86.7	1160	0.623
Esfahan	70.3	79.5	77.8	1758	0.789
Fars	67.5	74.7	74.6	1909	0.785
Khuzestan	66.9	69.2	72.6	1781	0.746

Source: HDI Report in Iran in 1999

Here, the difference in HDI among provinces related to the study area based on data in 1996 is examined. The rank of Chaharmahal va Bakhtiyari Province, accounting for the most part of the area, is medium (18th place), and Khuzestan Province containing Branch Watershed K8 is similar (10th place). Esfahan Province covering Branch Watershed K4 and a part of K7 is ranked high (3rd place). Fars Province with Branch Watershed K7 is also ranked high (4th place). Khohgiluyeh va Boyerahmad Province with Branch Watershed K7 is ranked low (24th place), because this province is located in the

mountainous region of Zagros Mountains and delay in development is reflected in the value.

3.7.7 Gender Issue

Women of nomadic tribes and in villages in the study area act in the sectors of agriculture, animal husbandry and handicrafts (carpet weaving and others) among economic activities. These activities play an effective role in reduction of production cost and improvement of family income. In addition, the domestic activities, i.e., housekeeping, childcare, are an essential part of women's work.
The cultural manner of thought and social circumstances in rural society is deprived of access to education and training from rural women and girls. The role of rural women and girls who satisfy economic needs and earn family income further worsens this plunder. After the Islamic Revolution, however, improvement of the literacy rate has been seen as a result of the campaign to eradicate illiteracy and improve the school attendance for rural women.

Due to the necessity of self-sufficiency in village, rural women's participation in community exists automatically because they act in a group from the initial stage of farm work. The organization of village women is promoted under guidance of the Provincial Jihad Organizations and the Provincial Agriculture Organizations. In the field of handicrafts, rural industry (women's handicraft) cooperative is organized at village level. Management of this cooperative is carried out by women.

Gender based division of labor is as follows. The male head of a family is farm work in the whole stage, and boys help the father's farm work and graze livestock. Women perform small animal raising, milking and making dairy products, and help men to do farm work such as weeding and harvesting. In addition, they are engaged in handicraft work. Most activities related to capital acquisition and maintenance is the responsibility of men. The head of a family makes decisions regarding his family. The source of wealth controlled by women is few and more related to household consumption.

3.7.8 Religion

In the last regime, religious world has nothing to do with the development. With the dictatorial development under the Shah, it was not based on the needs of the people. Consequently, rural areas were laid outside of development. After the Islamic revolution, the Islamic government has been accelerated the policies which carry two big slogans for reconstruction of the nation i.e. "independent economy" to economical self-reliance and "liberation of the oppressed" to social fairness. These policies encourage rural development such as provision of social and living infrastructure. Executing agency of this development is the Ministry of Jihad-e-Sazandegi. Among the oppressed such as farmers and nomads, in particular, liberation of women is to be promoted, since they used to be the oppressed in social and cultural environment. The leader of the Islamic Revolution of Iran, the late Imam Khomeini, called for women's presence in the appropriate fields, through making them political,

social and economic. This created drastic changes in social and traditional viewpoint and mind-sets. Also it has a strong effect on the improvement of social status of women. As far as the development of the independent economy and the liberation of the oppressed is concerned, the religious world plays an important role of moral support for women.

At village level, the Islamic priest is given advice and consultation on the problems of inhabitants and community. Ministry of Islamic Guidance and Arts and Mass Media conduct social enlightenment and publicity activities for the people.

3.8 Environment

3.8.1 Institutional Framework for Environmental Administration

The principal organization for environmental protection in Iran is the Department of the Environment (DOE). DOE is charged with defining and presenting the national rules, regulations and standards for preservation and enhancement of environmental quality. Its responsibilities include: expert studies into human and industrial pollution, desertification, deforestation, soil erosion, rangeland degradation, improved water resources management, and protection of the biodiversity. Monitoring of air quality, water quality and soil quality is also the responsibility.

DOE head is the Vice President of the Republic. Besides the Headquarters, DOE has the field organizations; Provincial Directorates.

The country's environmental policy and strategies are determined by the Environmental High Council, to which DOE act as a secretariat. The Council chairman is the President of the Republic.

3.8.2 Laws, Regulations and Guidelines

The article 50 of the constitution is the foundation for all environmental related laws and regulations. Also the Islamic penal code addresses the environmental issues and clarifies penalties for persons causing destruction to the environment. Several environmental laws prevail in the country, of which the Law of Environmental Protection and Enhancement(1974), and the Law of Conservation and Utilization of Forest and Range(1975) are related to fields of this Development Study.

Regulation and guidelines prepared by the Department of the Environment(DOE) and ratified by the Parliament are mandatory. In 1994, the Environmental Impact Assessment(EIA) for the petrochemical plants, refineries, power plants, steel mills, industrial complex, airports, and construction of dams and other water structures became mandatory

Iran has joined a number of international environmental treaties such as the Convention on Wetlands of International Importance, Especially Waterfowl Habitats(Ramsar Convention)- 1971.

3.8.3 National Environmental Reserve

Three protected areas, one national nature monument and four wetlands of environmentally importance occur in the Study Area. These sites which include the famous Dena and Sabz Kouh mountains are under the authority of DOE. Plants such as tulip, artichoke and oak, and animals such as wolf, wild pig and bear can be seen in these sites.

Several genetic reserves used for conserving and conducting research on valuable wild plants such as pistachio and elm occur in the Study Area. These reserves are under the authority of Forest and Range Organization.

3.8.4 National park

Only one national park, the Tange Sayad, with an area of 54 km^2 occur in the Study Area. It was declared as a national park by DOE in 1995, and is under the authority of this department. Many animals (wild goat, fox) and birds (partridge, eagle) live in this park.

3.8.5 Cultural Assets

The cultural assets existing in the Study Area include the Atabakan Mosque, built in 13^{th} century, and the Azadeh House, built in 17^{th} century.

4 PCM WORKSHOP

4.1 Objectives of the 1st PCM Workshop

The 1^{st} Project Cycle Management (PCM) workshop for the Study was held on April 16-26, 2000 in the office No.14 of the Watershed Management Deputy, Ministry of Jihad-e-Sazandegi (MOJ), and its tasks were smoothly completed. Participants of the workshop consisted of 17 members from the Ministry, 8 members of the JICA Study Team and 3 members from other related organizations.

4.2 Outline and Outcome of the 1st PCM Workshop

With following the participatory planning method of the PCM method, participants conducted "Participation Analysis", which is to identify the groups likely to be affected by the Study, and to select the "Target Group" among them. The rural residents of Karoon river basin were selected as the

"Target Group" of the Study.

Subsequently, the "Problem Analysis", "Objectives Analysis" and "Project Selection" were conducted. In the normative "Project Selection" of the PCM method, participants of the workshop select a specific project strategy from project components based on the information obtained in the former Objective Analysis process. However, the framework of the JICA Study has already decided to certain extent between MOJ and JICA by signing the Scope of Works and the inception report. Thus the participants could not select a project strategy out of the framework. Then the participants just identified the objectives in the Objective Tree that are covered by the JICA Study.

Table 4-2-1 shows the Project Design Matrix (PDM) of the Study that shows the logical inter-relationship among the components of the study project, such as the objectives, *Activities*, and *Inputs*. The PDM is to be utilized for implementation and evaluation of the study project.

4.3 Other Results of the the 1st PCM Workshop

After completing the above-mentioned participatory planning of the PCM method, the participants discussed on the method to select five sub-basins, for that integrated watershed management master plans shall be prepared in the study. They reached a consensus on the method to select one most prominent sub-basin in the sense of each of the five criteria below:-

- Sub-basin which faces economical under-development and lack of job opportunity.
- Sub-basin which faces actual damage by disasters.
- Sub-basin which faces high population growth.
- Sub-basin which potentially has a risk of disaster.
- Sub-basin which potentially has capacity for development.

Among above five criteria, it will be necessary to reconsider from an economic viewpoint because disasters generally recur in the same area. Problematic areas are considered to be at disadvantage on cost expenditure to disaster. Consequently, the most problematic sub-basin should be reconsidered and avoided in selection if necessary.

The participants also reached a consensus on the groups whose representatives should be invited to the 2nd workshop for designing master plans of 5 pilot sub-basins.

Table 4-2-1 Project Design Matrix (PDM)

Project name: The Study on Watershed Management Plan for Karoon River in the Islamic Republic of Iran | Duration: February 1, 2000 to Oct 31, 2001
Project area: Upper Karoon Basin (Karoon Dam No.1) | Target group: Rural Residents of Karoon Basin | Date: April 25, 2000

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Super Goal - Social and Economic Conditions of rural people in the Karoon basin and other river basins are improved.	1. Human Development Index (HDI) of the residents in the Karoon basin and other river basins increases by the year 2030. 2. Damage by natural disasters in the Karoon basin and other river basin is reduced by the year 2030.		
Overall Goal -Social and Economic Conditions of rural people in the selected 5 sub-basins are improved.	1. Human Development Index (HDI) [1] of the residents in the selected 5 sub-basins increases by the year 2013. 2. Damage by natural disasters in the selected 5 sub-basins is reduced by the year 2008.	1-1. Records of the income of people at the Central Bank of Iran. 1-2. Records of social aspects and population at the Plan and Budget organization (especially the Iranian Statistical Center). 2-1. Records of natural disasters at the Natural Disaster Reduction Committee, the Ministry of Interior. 2-2. Records and reports about flood at the Water Resources Center (TAMAB), the Ministry of Energy.	-Evaluation of the implementation of the master plans is conducted. -The Iranian government calibrate the models for other sub-basins.
Project Purpose Integrated watershed management plans for selected 5 sub-basins are prepared.	-Technical committees of directly related organizations (the Ministry of Jihad-e-Sazandegi, the Planning and Budget Organization, etc.) approve the master plans for 5 sub-basins by October 31, 2001 on feasibility, viability and methodology of the plans.	1. Final report of the study project. 2. The agreements of related organizations on the approvals.	-The master plans are properly implemented.
Outputs 1. Common understanding on the project among the JICA Study Team, Iranian counterpart and related organizations is achieved. 2. Data necessary for inventory are collected. 3. Inventories essential for watershed management planning for all sub-basins of the Karoon basin are prepared. 4. sub-basins for master plans are selected. 5. Necessary programs are integrated for watershed management of each sub-basin.	1. Progress report is submitted periodically. 3. Interim report containing the inventories will be submitted by January, 2001. 4. Interim report including the selected 5 sub-basins for master plans will be submitted by January, 2001. 5. Final report containing master plans will be submitted by 31 October, 2001.	1~5. The reports. 1~5. Project records of the submittal of the reports.	
Activities 1-1. Hold PCM workshop. 1-2. Transfer the PCM method for planning. 1-3. Review the plan of the study project with Iranian counterpart and related organizations. 2-1. Collect available reports. 2-2. Collect remote sensing data. 2-3. Collect physical data. 2-4. Collect present land use data. 2-5. Collect socio-economic data. 2-6. Collect the data related to the natural disaster. 3-1. Divide the Karoon basin into sub-basins. 3-2. Evaluate and analyze all collected data. 3-3. Compile the data into GIS system. 4-1. Define the selection criteria. 4-2. Analyze the collected data. 4-3. Identify the needs and problems of all sub-basins. 4-4. Select 5 sub-basins. 5-1. Hold participatory workshops. 5-2. Conduct participation analysis. 5-3. Identify the issues in the sub-basins. 5-4. Consider countermeasures for each issues. 5-5. Examine the applicability of the counter measures. 5-6. Select the project components. 5-7. Conduct impact assessment. 5-8. Design the master plans for each sub-basins. 5-9. Prepare implementation plans.		Inputs **Iranian side** -4 permanents counterparts. -Temporary counterparts when necessity arises. -Office space with equipment. -Transportation in the field. -Provision of relevant data and information. **Japanese side** -Equipment and devices. -Study team members.	-Protocol of technical assistance between Japan and Iran continues. -Data holders are cooperate with the project. **Precondition** -Rural people cooperate with the study.

[1] Availability of data needed to calculate HDI in the selected sub-basins has not been confirmed.