PHASE II MASTER PLAN STUDY

CHAPTER 7

SOCIO-ECONOMIC FRAME

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7.1 National Frame

7.1.1 Population

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

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

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

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

7.1.2 Economy

Iran's economy has been characterized by its huge dependence on the oil exportation and the fluctuation of oil price in the international market seriously affects its economic performance. As is shown in Table 7-1-1 and Table 7-1-2 the real GDP has enjoyed significant growth of 19.9 % and 17.4 % in 1994 and 1995 mainly due to the rapid growth of oil sector. In 1996, this tendency was somewhat checked notwithstanding the favorable condition of international oil price to 5.8 % but it recovered to 10.2 % in 1997. Not only the oil price but also other international market suffered general stagnant condition and Iran's exchange rate to US$ sharply

decreased from 3,000 Rials/$ to 5,500 Rials/$ in 1998 (it further decreased to 7,900 Rials/$ in 1999) the real GDP experienced negative growth of 4.4 % compared to the previous year.

Due to the steady growth of non-oil sectors such as Manufacturing, Construction and Real Estate, 1999 growth rate managed to recover positive growth rate of 3.2 % in 1999. According to the Central Bank of Iran (Bank Markazi), the real GDP growth in the fiscal year 1999/2000 registered 2.4
% (in factor cost) with the major part contributed by non-oil sectors.

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

(unit : Billion Rials)

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

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

Table 7-1-2 Recent Trend of Share of Economic Activities in GDP at Factor Costs

(unit : %)

	1993	1994	1995	1996	1997	1998	1999
Agriculture	24.0	23.1	22.2	20.3	20.1	22.1	20.9
Mining	0.6	0.5	0.5	0.5	0.6	0.7	0.7
Manufacturing	8.7	14.0	14.3	14.5	16.0	17.5	16.9
Oil	4.1	8.2	16.1	15.2	10.8	6.5	8.4
Water, Electricity and Gas	1.0	1.1	1.3	1.7	1.7	1.8	1.8
Construction	7.4	4.4	3.5	4.3	4.0	3.4	3.4
Trade, Restaurant and Hotel	17.6	17.8	16.0	15.9	16.9	17.8	18.4
Transport, Storage and Communications	7.3	9.0	6.3	7.2	8.1	8.4	8.2
Financial and Monetary Institutions	1.2	1.1	1.0	0.9	0.9	1.0	0.9
Real Estate, Specialized and Professional Service	13.0	11.0	8.5	8.8	9.4	9.5	9.8
Public Services	13.2	8.6	8.7	9.2	9.7	9.5	8.6
Social, Personal and Household Services	2.4	2.2	2.0	2.0	2.0	2.1	2.1
Less : Imputed Bank Service Charge	*0.5*	*1.0*	*0.4*	*0.5*	*0.2*	*0.1*	*0.1*
Gross Domestic Price (at current prices)	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

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

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

7.1.3 Content of Current Development Plan

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

Table 7-1-3 Comparison of Development Plans

unit: %/year

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

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

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

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

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

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

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

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

To implement such policies and programmes and projects thereof, priorities are set forth as follows;

a) To provide the agricultural machinery, and to improve machinery/equipment efficiency.
b) To improve drainage efficiency, and to increase irrigation areas.
c) To manage livestock production in harmony with rangeland capacity , for the benefit of tribal societies.
d) To increase forage production, in order to reduce dependency on imported materials.
e) To support in the creation of agricultural production cooperatives and in the formation of water, soil or natural resources users' associations.
f) To increase agricultural/aquatic production, to attain food security,

(2) Rural Development Policies and Strategies

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

a) 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 favorable exploitation of existing production resources.
- To support in creating small credit –supplier groups, to facilitate presentation to rural villagers as well as to find out new financing sources.
- To reorganize the existing establishments for rural improvement, for creating conditions required.
- To avoid over-centralized institutional set up and duplicate activities of the entities in charge of rural improvement, for obtaining clear roles and duties.
- To reduce incumbency surrounding executive activities in rendering services to the rural villages.
- To accord with standards/criteria in services and for approval of plans for rural improvement.
- To provide visiting works, based on rangeland-livestock balance for social and economic requirement.
- To provide settlement sites for tribes in a voluntary manner.
- To improve the existing management/organizations, for reducing the Governmental incumbency, enhancing the cooperation with effectiveness, and promoting the tribes to become active in works performing in the tribal region of favorable local management-running area, for tribal biosphere.

b) Executive Policies

- To determine duties, roles and areas of organization relating to rural improvement and development, in order to correct, renew and remove similar/duplicate activities as well as to delegate part of executive powers to the Islamic Consultants. Local organizations, or private companies and institutions.
- To fromulate principles to found rural services, to classify presentation services, to provide rural sites-based development/improvement plans, and support in private sector as small credit suppliers, in order to promote rural presentation for economic,

social and cultural activities including the integrated development of agriculture, industry and services sectors, support to the executives.

- To support in humanitarian and private investment to the rural for the provisions of favorable facilities, specifically for employment generation; part of the facility benefits shall be paid towards the deprived areas.
- To provide the visiting and support to the voluntary tribes for the settlement.
- To provide water and soil resources, with a priority of handing over of fertile farmland to rural youths
- To identify comparative advantage and possibility of establishing rural industries (conversion from agriculture or handicrafts), with a priority of employing youths and women.
- To provide industrial areas, by limiting the new site according to legally approved plans.
- To improve and to give assistance to the existing cooperatives for the production promotion.
- To provide educational, technical and vocational services, formally and informally.
- To encourage rural handicrafts and carpet industries, to improve production and business method, and to promote the private sector cooperation.
- To identify less developed areas, for the formulation of development and employment programmes.

7.1.5 Investment in the Current Development Plan

As the budgetary system of Iran is based on the single fiscal year system, budgetary consideration and annual apportionment over the Plan period is not considered. Table 7-1-4 indicates the shares of Current and Development Expenditures of the former Plan period. In total, Development Expenditure had been having around 30% of the total expenditure.

Table 7-1-4 Breakdown of Current Development Expenditure

		1995/96	1996/97	1997/98	1998/99	1999/00	TOTAL
Total Expenditure	(billion Riyals)	41,330.9	56,783.1	65,438.0	70,970.3	95,210.7	329,733.0
	(%)	*(100.0)*	*(100.0)*	*(100.0)*	*(100.0)*	*(100.0)*	*(100.0)*
Current Expenditure	(billion Riyals)	28,448.1	37,571.2	44,966.9	53,545.6	68,009.2	232,541.0
	(%)	*(68.8)*	*(66.2)*	*(68.7)*	*(75.4)*	*(71.4)*	*(70.5)*
Development Expenditure	(billion Riyals)	12,882.8	19,211.9	20,471.1	17,424.7	27,201.5	97,192.0
	(%)	*(31.2)*	*(33.8)*	*(31.3)*	*(24.6)*	*(28.6)*	*(29.5)*

Source : General Budget Laws , Annual Review 1378 (1999/2000), Central Bank of the Islamic Republic of Iran

Table 7-1-5 shows the braekdown of Development Expenditure, allocating 27.1% to "Social Development Sector" and 56.1% to "Economic Development Sector" respectively. Out of fields,

"Agriculture and Natural Resources"(4.0%) and especially "Water Resources"(9.7%) are receiving higher priorities only next to "Oil"(11.8 %) and "Roads and Transport"(10.8%) fields. Together with "Rural Improvement and Development"(5.4%) in the "Social development Sector", nearly 20% of Development Expenditure had been allocated to the Study -concerned fields. At the Current Development Plan much more priority is set to those fields that much higher allocation can be expected during the Plan period. However, as is seen in Table 7-1-4, Development Expenditure fluctuates considerably according to the economic condition of the present years. For example, Development expenditure of 1998/99 fiscal year when the draught started has decreased by 14.9% compared to the former fiscal year's figure. As Iran is facing many issues such as economic stagnation, sharp decrease of exchange rate, violent political and physical changes in the neighboring Afghanistan, and still on-going draught, it will work as considerable adverse factors for steady and smooth expansion of Development Expenditure.

Table 7.1.5 Development Budget during the period of the 2nd Five Year Plan

	Breakdown of Development Budget* (billion Riyals)					Total	
	1995/96	1996/97	1997/98	1998/99	1999/00	(1995/00)	Share(%)
General Affairs	**597.5**	**967.8**	**1,230.5**	**837.1**	**1,164.8**	**4,797.7**	*4.7*
National Defense Affairs	**0.0**	**0.0**	**0.0**	**206.5**	**415.2**	**621.7**	*0.6*
Social Affairs	**3,721.0**	**5,870.4**	**6,156.3**	**5,648.8**	**6,492.7**	**27,889.2**	*27.1*
General Education	806.5	1,002.2	1,089.7	917.5	984.6	4,800.5	*4.7*
Culture and Art	188.5	320.7	389.1	352.2	382.2	1,632.7	*1.6*
Health, Medical Care and Services	428.8	717.9	563.1	496.3	614.3	2,820.4	*2.7*
Social Security and Social Welfare	51.0	56.3	46.2	43.6	50.3	247.4	*0.2*
Physical Education and Youth Services	156.7	270.8	345.4	378.0	449.2	1,600.1	*1.6*
Urban Development	514.6	678.8	892.5	655.6	805.6	3,547.1	*3.5*
Renovation and Dev't of Rural Areas	717.7	1,252.3	1,221.2	1,353.5	973.8	5,518.5	*5.4*
Provision of Housing	272.8	454.0	432.2	292.8	552.0	2,003.8	*1.9*
Environment Protection	31.0	48.3	50.3	36.1	32.7	198.4	*0.2*
Reclamation	112.6	158.9	200.8	189.1	179.4	840.8	*0.8*
Technical and Professional Education	.3	1.1	55.1	51.9	146.0	254.4	*0.2*
Higher Education **	440.5	527.9	443.7	385.2	523.1	2,320.4	*2.3*
Research **	.0	381.2	424.0	497.0	799.4	2,101.6	*2.0*
Economic Affairs	**8,275.3**	**9,703.9**	**11,030.5**	**10,732.3**	**17,994.9**	**57,686.9**	*56.1*
Agriculture and Natural Resources	647.8	801.0	876.5	829.4	975.0	4,129.7	*4.0*
Water Resources	1,494.4	2,019.3	1,842.3	1,427.6	3,482.8	10,266.4	*10.0*
Electricity	1,169.0	1,042.8	1,487.8	2,453.3	3,862.3	10,015.2	*9.7*
Industries	178.3	352.7	167.4	159.1	102.2	959.7	*0.9*
Oil	2,164.3	1,757.7	2,771.1	2,109.8	3,315.3	12,118.2	*11.8*
Gas	552.9	882.4	928.8	791.3	1,737.2	4,892.6	*4.8*
Mines	156.2	160.6	171.7	144.3	178.7	811.5	*0.8*
Commerce	100.9	111.7	98.6	66.0	91.7	468.9	*0.5*
Road and Transportation	1,558.0	2,277.6	2,298.1	2,189.6	2,756.4	11,079.7	*10.8*
Post and Telecommunication	238.7	284.7	376.4	541.8	1,401.8	2,842.9	*2.8*
Tourism	14.8	13.4	11.8	20.0	42.0	102.0	*0.1*
Others	**289.2**	**2,669.8**	**2,053.8**	**0.0**	**6,778.0**	**11,790.6**	*11.5*
TOTAL	**12,882.8**	**19,211.9**	**20,471.1**	**17,424.7**	**32,795.5**	**102,780.1**	*100.0*

Source : General Budget Laws , Annual Review 1378 (1999/2000), Central Bank of the Islamic Republic of Iran

* Figures are based on the 2000/02 Budget Law

** Until 1996/97, these two chapters appeared as "Higher Education and Research" and included only research on Social Affairs. Since 1996/97 research related to all chapters has come under "Research".

7.2 Provincial Frame

7.2.1 Population

(1) Population Trends

Population trends and annual average growth rates of above four (4) Provinces at and between each Census years are shown in Table 7-2-1.

Table 7-2-1 Population Trends by concerned Provinces

Province		Population of Census Years (pp.)				*Annual Average Growth Rate (%/annum)*			
		1976	1986	1991	1996	*1976/86*	*1986/91*	*1991/96*	*1986/96*
Chaharmahal	**Total**	**373,357**	**621,179**	**747,297**	**761,188**	*5.22*	*3.77*	*0.37*	*2.05*
va	Urban	120,272	219,471	277,006	342,905	*6.20*	*4.77*	*4.36*	*4.56*
Bakhtiyari	Rural	252,857	397,899	445,498	417,005	*4.64*	*2.29*	*-1.31*	*0.47*
	Non-Residents	228	3,800	24,793	1,258	-	-	-	-
Esfahan	**Total**	**2,176,694**	**3,294,916**	**3,682,444**	**3,923,255**	*4.23*	*2.25*	*1.27*	*1.76*
	Urban	1,467,335	2,253,169	n.a.	2,914,874	*4.38*	*n.a.*	*n.a.*	*2.61*
	Rural	709,359	1,041,747	n.a.	1,007,087	*3.92*	*n.a.*	*n.a.*	*-0.33*
	Non-Residents	0	0	n.a.	1,294	-	-	-	-
Kohgiluyeh	**Total**	**244,370**	**411,828**	**n.a.**	**544,356**	*5.36*	*n.a.*	*n.a.*	*2.83*
va	Urban	30,867	111,308	n.a.	213,563	*13.69*	*n.a.*	*n.a.*	*6.73*
Boer Ahamad	Rural	213,503	294,788	n.a.	330,793	*3.28*	*n.a.*	*n.a.*	*1.16*
	Non-Residents	0	5,732	n.a.	0	-	-	-	-
Khuzestan	**Total**	**2,187,118**	**2,681,978**	**3,175,852**	**3,746,772**	*2.06*	*3.44*	*3.36*	*3.40*
	Urban	1,275,109	1,485,356	1,930,440	2,397,975	*1.54*	*5.38*	*4.43*	*4.91*
	Rural	901,409	1,161,002	1,225,013	1,312,524	*2.56*	*1.08*	*1.39*	*1.23*
	Non-Residents	10,540	35,020	20,399	36,313	-	-	-	-

Source : Statistical Leaflet/Summary of Provinces

(2) Present and Future Population

Present population of each Provinces is estimated by extrapolating annual average growth rates during 1986/96 by Urban and Rural areas independently, and summing-up both results to the total (thus, the annual average growth rate of the total is counter-calculated). Based on the figure given here and projected average annual growth rates during 2001/ 2010 and during 2010/ 2020 by Urban and Rural areas, Provincial population is provisionally estimated as shown in Table 7-2-2.

Table 7-2-2 Estimated Population by concerned Provinces

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

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

At present (2001), rural population share is estimated to be;

49.9 %: Chaharmahal va Bakhtiyari
23.0 %: Esfahan
54.2 %: Kohgiluyer va Boer Ahamad
31.4 %: Khuzestan

They will decrease to;

35.3 %: Charmahal va Bakhtiyari
14.9 %: Esfahan
34.4 %: Kohgiluyer va Boer Ahamad
20.4 %: Khuzestan

due to rapid urbanization of population especially in Provinces of Chaharmahal, Kohgiluyer and Khuzestan.

7.2.2 Economy

(1) Agriculture

Shares against national total in agricultural major crops and livestock of each Province are shown in Table 7-2-3. Because of the severe draught during 1998 and 1999, production of major crops decreased significantly as are shown in Table 7-2-4. However, Provincial shares in each items can be observed as the draught covered the whole country and has given almost same damages to each Provinces.

Table 7-2-3 Major Crops and Livestocks of Concerned Provinces (1999/2000)

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

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

Table 7-2-4 Changes of Major Crops/Products in recent years

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

Source : Central Bank of Iran, Ministry of Agriculture

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

(2) Provincial Budgets

Table 7-2-4 indicates 1999/2000 budget and the shares of "Jihad Office" and "Agriculture Office" in each concerned Provinces. (Note that these offices are now combined and called "Jihad-e-Sazandegi Office") Other than the difference of budgetary scale of individual Provinces, shares of these two offices are very much different from each others. Considering that the share of Development Expenditure in the National Budget had been around 30% during the former Plan period and around 20% of Development Expenditure had been allocated to the Study related fields, nearly 6% of the National Budget had been allocated to the Study related fields. Comparing this figure, Chaharmahal and Kohgiluye Provinces can be considered as average, while Esfahan Province had been allocating less and Khuzestan Province far more.

This condition, however, may be caused by the difference of development levels of concerned Provinces. In Esfahan Province, such industries as Manufacturing, Commerce and Tourism other than Agriculture are comparatively well developed thus making the budgetary share of Agriculture comparatively low. While in Khuzestan Province, other industries are not much developed and Agricultural allocation is comparatively high as for the basic and major industry of the Province. In fact, actual amount for these two offices in Esfahan Province is more than twice as much as average two Provinces (Chaharmahal and Kohgiluye).

Table 7-2-5 Comparison of Provincial Budget (1999/2000)

Unit : Million IRR

Concerned Province		Chaharmahal	Esfahan	Kohgiluye	Khuzestan
Total Budget		283,275	1,191,309	253,325	435,490
		(100.0)	*(100.0)*	*(100.0)*	*(100.0)*
	Budget for Jihad Office	9,860	22,667	11,663	39,129
		(3.5)	*(1.9)*	*(4.6)*	*(9.0)*
	Budget for Agriculture Office	6,050	14.885	5,861	37,346
		(2.1)	*(1.2)*	*(2.3)*	*(8.6)*
	Subtotal	15,910	37,552	17,524	76,475
		(5.6)	*(3.2)*	*(6.9)*	*(17.6)*

Source : Statistical Books of Provinces

7.3 Master Plan Areas

7.3.1 Provisional Population Forecast

(1) Present Population

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

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

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

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

(2) Past Trends of Population Growth

a) National Trend

National population and its annual average growth rates of the past census years are as follows;

Table7-3-2 Population and Its Growth Rates of Iran

Census Year	Population (pp.)	Annual Average Growth Rates (%/annum)		
1956	18,954,704			
		3.13	(1956/'66)	
1966	25,788,722			
		2.71	(1966/'76)	
1976	33,708,744			
		3.91	(1976/'86)	
1986	49,445,010			
		2.46	(1986/'91)	
1991	55,837,163		*1.96*	(1986/'96)
		1.47	(1991/'96)	
1996	60,055,488			

Source : "Iran Statistical Year Book 1378" (Statistical Center of Iran)

b) Local Population Trend

Following information are obtained from concerned Provincial Statistical leaflets. For reference, Vastegan Area (K4-1-9) and Chaman-Goli Bazoft Area (K5-19a) are included in Chaharmar Province, while Sarbaz Area (K7-0-19-1), Tang Sorkh · Area (K7-48) and Zeras Area (K8-28) are included in Esfahan Province, Kohgiluyeh Province and Khuzestan Province respectively.

Table 7-3-3 *Local Population Trends and Average Annual Growth Rates*

(unit : pp. and %/annum)

Province	Concerned Area (Township)	Population of Census Years					*Av. An. Growth Rates during Census Years*				
		1966	1976	1986	1991	1996	*1966/'76*	*1976/'86*	*1986/'91*	*1991/'96*	*1986/'96*
Chaharmahal	Province Total	198,368	373,357	621,179	747,297	761,168	*6.53*	*5.22*	*3.77*	*0.37*	*2.05*
va	Urban Area	87,552	120,272	219,471	277,006	342,905	*3.23*	*6.20*	*4.77*	*4.36*	*4.56*
Bakhtiyari	Rural Area	110,816	252,857	397,899	445,498	417,005	*8.60*	*4.64*	*2.29*	*-1.31*	*0.47*
	Non Residents	0	228	3,809	24,793	1,258	-	-	-	-	-
Esfahan	Semirom	n.a.	19,080	27,884	n.a.	32,189	*n.a.*	*3.87*	*n.a.*	*n.a.*	*1.45*
Kohgiluyeh	Province Total	n.a.	n.a.	411,838	496,739	544,356	*n.a.*	*n.a.*	*3.82*	*1.85*	*2.83*
va	Boer Ahamad	n.a.	n.a.	145,370	192,906	212,356	*n.a.*	*n.a.*	*5.82*	*1.93*	*3.86*
Boer Ahamad	Kohgiluyeh	n.a.	n.a.	164,301	188,170	206,602	*n.a.*	*n.a.*	*2.75*	*1.89*	*2.32*
	Gachsarah	n.a.	n.a.	102,167	115,663	125,491	*n.a.*	*n.a.*	*2.51*	*1.64*	*2.08*
Khuzestan	Izeh	n.a.	n.a.	n.a.	78,285	90,407	*n.a.*	*n.a.*	*n.a.*	*2.92*	*n.a.*
	Dehdaz District	n.a.	n.a.	n.a.	23,350	26,340	*n.a.*	*n.a.*	*n.a.*	*2.44*	*n.a.*

Source : "Statistical Leaflets" of concerned Provinces

c) Master Plan Area Population Trend

From the Natural Disaster Survey conducted by the Study Team, population of representative villages in each Master Plan Area in periodical Census years and the year of 2001 are obtained as shown below.

Table 7-3-4 Population Trend of Representative Villages in Master Plan Areas

Master Plan Area	No. of Village	Population in Census Years (pp.)					Percentage of Population in 2001
		1966	1976	1986	1996	2001	
Vastegan	4	1,357	1,704	2,520	2,606	2,880	64.6 (77.8)
Chaman-Goli Bazoft	10	1,163	1,576	2,283	2,191	3,297	39.2 (55.8)
Sarbaz	9	883	1,230	1,963	2,303	3,151	29.0 (62.6)
Tang Sorkh	6	825	868	837	724	951	50.8 (82.1)
Zeras	13	1,674	1,341	1,700	1,730	1,703	72.7 (72.7)

Source : "Natural Disaster Survey" (2001)

* Percentage in the parenthesis indicate those of against Villagers

As the given population figure represents only one-third of total population (or, two-thirds of villagers), it may not wise to adapt these trends into each areas. However, it could be said that after suffering very low or negative population growth during 1986 and 1996, each area other than Zeras area is showing rapid increase of population. In case of Zeras area, where its

population growth rate is very low during past 35 years, somewhat delayed population growth is expected.

Table 7-3-5 Population Growth Rates of Representative Villages

Master Plan Area	Average Annual Growth Rate (%/annum)						
	1966/'76	1976/'86	1986/'96	1996/2001	1966/2001	1976/2001	1986/2001
Vastegan	*2.30*	*3.09*	*0.34*	*2.02*	*2.17*	*2.12*	*0.89*
Chaman-Goli Bazoft	*3.09*	*3.78*	*-0.41*	*8.52*	*3.02*	*3.00*	*2.48*
Sarbaz	*3.37*	*4.79*	*1.61*	*6.47*	*3.70*	*3.83*	*3.21*
Tang Sorkh	*0.51*	*-0.36*	*-1.44*	*5.61*	*0.41*	*0.37*	*0.85*
Zeras	*-2.19*	*2.40*	*0.18*	*-0.31*	*0.05*	*0.96*	*0.01*

Source : ditto

(3) Provisional Population Forecast

Forecast of Population Growth Rates during the Project Term, considering the above information and the socio-demographic condition of each Master Plan Areas, following average annual growth rates are tentatively projected. Basic consideration for projecting these figures is that;

① As each Master Plan Areas is situated in the most remote areas from urban facilities and their socio-demographic benefits (such as public health services, family planning services, medical services, etc.), trend of population growth may occur somewhat delayed timing compared with those surrounding areas.

② In case of nomadic population, such time-lag may be further delayed because their life-style is much more severe than villagers.

③ During the Project Term, with the benefits of the Project (such as improvement of public services and access to urban areas, increase of income, improvement in security, etc.), population growth may maintain somewhat higher level compared with those surrounding areas.

④ As such, for the period of 2001 to 2010, annual average growth rates similar to those of "Representative Villages" during 1986 and 2001 are adopted.

⑤ For the period of 2010 to 2020, same rates are applied to Vastegan, Tanghe Sorkh and Zeras areas as there estimated not much opportunities of rapid increase of population in these areas considering "social deficit" of population by the tendency of urbanization of population. However, in case of Bazoft and Sarbaz areas, the former being the focal point of the local development activities and the latter having good chances of better income by apple production, an annual average growth rate of 2.0 % is applied which is very much similar to the national average of 1.96 % during 1986 and 1996.

⑥ As for the difference of annual average growth rate between Villagers and Nomads,

partly because of shortage of information/data and partly because most Nomads are already settled today, it is not taken into account for the estimation of future population.

As the result, following annual average growth rates are applied for each Master Plan Areas.

Table 7-3-6 Projected Population Growth Rates

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

(4) Projected Population of Master Plan Area

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

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

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

7.3.2 Income Level

(1) Present Income Level as the Master Plan Area is defined by sub-basin basis and does not necessarily cope with the administrative and/or statistical boundary, not much information/data is available for defining the trends of income level of the households within the area. However, by utilizing the results of the Inventory Survey conducted at the Phase I Study and the Village Survey in July/August 2001, present income level of households within the Master Plan area can be summarized as shown in Table 7-3-8.

Table 7-3-8 Income Level of Master Plan Areas

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

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

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

Comparing the figures of both Surveys, there is big discrepancy both in individual growth tendency and in component of income sources. Furthermore, figure of Chaman-Goli Bazoft area shows a considerable decrease during 1996 and 2001. On the other hand, figure of Sarbaz area has grown ten (10) times bigger during the same period.

As such, there is not much consistency between the Surveys. Therefore, the present income level of the Master Plan Areas is provisionally estimated as shown in the first column of Table 7-3-9. Those figures are basically taking the results of the Village Survey only correcting the figure of Chaman-Goli Bazoft area to be around three-fourth of Vastegan area considering the fact that both areas are belongong to the same Province (Chaharmahal va Bakhtiyari).

(2) Provisional Forecast of Income Level

Based on the following assumption, income level (of average households) in the target year (2020) of each Master Plan Areas is estimated as shown in Table 7-3-9.

1) Present Income Level is defined as above mentioned
2) Average Annual Growth Rate is adopted the target figure of 6% of the current National Development Plan (the Third 5-year Plan) as an indicator of ideal growth
3) However, considering the performances of former Plans, and taking into account of the nature of income resources which are perfectly dependent on agricultural and livestock production with difficulty to maintain consistent higher growth rates, it is considered around 80 % of the above growth rate (that is, average annual growth rate of 4.8 %) is much more attainable and reasonable.
4) Both results are shown in Table 7-3-9 indicating the Income Level in the target year (2020) of each Master Plan Areas to be between rather actual estimation and ideal estimation.

Table 7-3-9 Projected Income Level by Master Plan Area

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

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

CHAPTER 8

THE PROJECT AREA

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8.1 Natural Condition

8.1.1 Location

The Study area locates in the Southwest of Iran and covers the upper Karoon river basin and belongs to the parts of Chahar Mahal & Bachtiari, Esfahan, Khuzestan and Kohkilooyeh &Boyer Ahmad provinces. The boundary of the Study area locates from E 49°15' to E 52° in longitude and N 30°15' to N 32°45'in latitude. In the Study area, Vastegan, Chaman Goli-Bazoft, Sarbaz, Tang Sorkh and Zeras sub-basin have been selected as master plan areas.

Vastegan locates in the lower Vanak basin and the distance from Share Kord is about 65 km in south-east direction. Its catchment area is 67.0 km^2 and main part of area is alluvial fan spreading toward northeast. Northern boundary of area is Gandman Wetland and this wetland tends to be dried recently. Boroujen, which is the capital of Gandoman district, is the most nearest city and distance to Vastegan is about 25 km to the northeast.

Chaman Goli-Bazoft locates on the right bank of Bazoft river in the middle of Bazoft basin and the distance from Share Kord is about 80 km in west direction. Catchment area is 113.2 km^2 and almost twice times of Vastegan area. Main part of Chaman Goli-Bazoft is hilly and decline from eastern range of mountains to eastern river terrace. Farsan is the nearest township of Bazoft district in the distance of 55 km to the east.

Sarbaz locates on the left bank of Marboreh river and distance to Semiroum is about 55 km in the north, about 30 km to Yasuj in the south. The catchment area is 154.5 km^2 and the largest among 5 Master Plan areas. Main part of Sarbaz is hilly and decline from the west to the east as similar as Chaman Goli-Bazoft. Yasuj is the nearest city nevertheless it is necessary to pass steep range of mountains on the road with poor gravel pavement.

Tang Sorkh locates along Boshar river in the upper Boshar basin and distance from Yasuj is about 30 km in the south-east. Its catchment area is 65.4 km^2 as similar scale as Vastegn. The left bank area of Tang Sorkh is narrow along the Boshar and hilly area. On the other hand, right bank area consits of alluvial fan and mountains with deep valley. Yasuj is the nearest city and it is supposed to be easy to access to Yasuj.

Zeras locates on the right bank of Karoon river in the middle Karoon basin. Distance from Izeh is

about 40 km in the south-east. The catchment area of Zeras is 63.7 km^2 and has mainly steep hillside. Generally speaking, this area is under condition of semi-arid compared to other Master Plan areas. At the downstream of Karoon where is about 15 km downstream of Zeras, Karoon No.3 Dam is now under construction and the area below M.S.L. 850 m will be submerged after completion of Dam. Dehdas is the nearest town.

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

Name of Area	Vastegan	Chaman Goli-Bazoft	Sarbaz	Tang Sorkh	Zeras
Basin Code	K4-1-9	K5-19a	K7-0-19-1	K7-48	K8-28
Area (km^2)	89.9	113.2	154.5	65.4	63.7
Longitude	51° 2'0" - 51°10'0"	49°55'30" - 50°42'30"	51°32'30" - 51°42'0"	51°42'30" - 51°52'30"	50°13'0" - 50°22'0"
Latitude	31°50'00" - 31°43'0"	32°17'25" - 32°7'30"	30°58'0" - 30°47'0"	30°30'00" - 30°22'30"	31°40'0" - 31°33'00"
Plain Name	Boroujen -Sepidasht	Dareh Bazoft Khersan	Kahardan	Yasuj-Sisahkt	Dareh Bazoft Kersan
Main Tributary	Vanak	Bazoft	Marboreh	Marboreh	Karoon
Province	Chahar Mahal & Bakhtiari	Chahar Mahal & Bakhtiari	Esfahan	Kohgiluyeh va Boyerahmad	Khuzestan
District /Township	Gandoman /Boroujen	Bazoft /Farsan	Padena /Semiroum	Central /Yasuj	Dehdaz /Izeh

8.1.2 Topography

The topographical features of five areas, namely Vastegan , Bazoft , Sarbaz , Tang Sorkh and Zeras are described below. Detailed information of each areas such as water course, special geographical features etc. have been described to ANNEX-A(Geological Condition of Each Project Area).

(1) Vastegan

This area has an altitudinal range of 2210 m to 3500 m. The landforms may be categorised into alluvial plains, terraces, fans, hills and mountains.

The alluvial plain is made up of mainly lacustrine and swamp deposits. In the eastern part, it is 3-8 km wide along N-S direction and occurs within 2210-2300 m altitude. Except for a small share of marshland, it is a broad, gently sloping, peneplain suitable for using as agricultural fields. In the vicinity of Vastegan, Gela River flows into the plain from mountainside. This river carries debris from the upper reaches and during floods causing extensive damage to agricultural fields.

The river terraces and fans represent local small-scale features adjoining the mountains in the west. Depositional landforms are filled by earth debris carried by rivers, in the past, from the mountainside. The resulting surface is almost flat with low dip angles.

Hills are seen as small-scale residual features between the alluvial plain and mountainous region in the west. Although the hillocks in the low-altitude areas pose no problems, hills are widespread also within the mountainous region at 2500-2800 m altitude. Those areas are drained by a dense network of streams. Numerous slope failures developed there serve as the source of earth debris that is transported downstream.

The mountainous region to the west exhibits development of steep cliffs, in the eastern sector, generated by faults running across the area and extending along N-S direction. The western sector exhibits gentle slopes, with inclinations of about 30°, facing towards the south. Moreover, the southern part of the mountainous region lying within an elevation of 3000-3500 m is surrounded by ridges, which are accompanied by steep inclination. The mountainous region is characterized by the presence of landforms created by accumulation of detrital deposits resulting from slope failures such as rockfalls. Because of the small scale of such features, they do not pose significant problems.

(2) Bazoft

The target area is a narrow (4-8 km wide along E-W) but elongated (18 km long along N-S) belt. Although the eastern end to the south is in contact with the main river course for about 5 km, other parts represent watersheds of first and/or second order streams.

About 85% of the area is mountainous with altitude ranging between 1500 and 3000 m. The topographical features here are controlled by geological composition and structures. The mountains show almost north-south trends and are connected to the highland (2000-3000 m) towards west. In general, the slopes are steep with abundant exposures of bedrock. In contrast, low (1500-2000 m high) ridges occur in the eastern part. The topography is generally smooth and those grounds are used for grazing.

Small rivers, with a width of 10 m or less, drain the intramontane valleys along NNW-SSE direction being almost parallel to the ridges. Furthermore, the trunk road is also constructed adjoining these rivers. Furthermore, several tributaries flow almost perpendicularly into these rivers from the mountainous region in the western side. The catchments of the tributaries exhibit fan-shaped landforms capable of accumulating a large amount of water. Accordingly, frequent flooding occurs during periods of snow-melting and heavy rainfall.

In the narrow strip adjoining the rivers, there are small-scale fans and multiple levels of terraces and also cliffs. Moreover, landslide topography can be seen in a relatively narrow (10-40 m wide) zone that forms a part of the reworked secondary deposits. Gently sloping areas occupied by fans, detrital deposits or terraces with well-developed surficial cover are used as agricultural fields.

The mountain-slopes in the western side are rich in rock/soil debris, derived from rockfalls etc., most of which flow downstream at times forming land features characteristic of rock avalanche, debris fan and terraces. In the sandstone-dominated eastern slopes, albeit within a narrow zone, there are numerous gully-like landforms, which are the sites of accumulation of detrital/talus deposits. A minor debris flow triggered by such deposits several years ago had caused damage to the houses within the downstream area. Additionally, the detrital deposits are seen to have somewhat wider occurrence at the southernmost part. As preventive measures against the frequent occurrence of debris flows during periods of snow-melting and heavy rainfall, small- scale barriers (sabo dams, that check the loss of sediment due to erosion) are constructed at about ten places.

(3) Sarbaz

This area can be broadly divided into two drainage systems made by major tributaries joining the main river. One is in the northern part and includes the villages of Sarbaz and Noorabad. The other is in the south. The southern tributary joins the main river at about 2.5 km upstream from the confluence of the latter with the northern tributary. Villages of Devergan, Kahangan and Dangaz Loo belong to the latter system

The Sarbaz area has a rectangular shape, with a width of 6-10 km and 20 km length, that stretches from NNW to SSE. High mountains with altitude of 2500～4100m are found in the western end. Towards the east of these mountains, one comes across 2050～2500 m high mountains/hills, river terraces, fans, and alluvial plains.

The easternmost margin of the mountainous region exhibits the influence of large fault: steep slopes (with dips of 50° or more), cliffs and bedrocks outcropping directly at the surface. Towards the east of these mountains, the altitude diminishes; the mountaintops are rather gentle within the range of 2200-2500 m and the hills that continue further east are dissected by numerous streams. The areas immediately close to the main rive are the sites of combined erosion, by both the main river and either of the tributaries. As a result, there are conspicuous residual hillocks that stand out within the low lands.

There are three levels of terraces both along the main river and its major tributaries. Of course, the terraces along the tributaries are narrowly distributed and discontinuous. The terraces are spread over several kilometers near the confluence of the tributaries with the main river.

Fans and alluvial flats occur in small scale along the streams. Presence of debris avalanche and numerous small scale landslides are the marked features of the Sarbaz area.

(4) Tang Sorkh

In this area, the main river flows from SSE to NNW. At Tang Sorkh, it is joined by a major tributary flowing from the east. If the flood plain is also included, the main river valley is 150~500 m wide plain used for farming or as fruit orchards. A major part of the Tang Sorkh area is situated within the watershed of the said tributary at the right bank of the main river. In addition, the area lying between about 3 km upstream from Tang Sorkh and the northern end belonging to the left bank, of the main river, is also included.

The westernmost end of the area at the left bank of the river is represented by 2100-2700 m high ridge that stretches from SE to NW. The top of the ridge stretches over 300 m to 1000 m forming gentle slope or level surface, which is used for grazing. The main slope of the ridge, however, is rather steep with rocky cliffs.

The area between the mountainous region and the main river has abundance of detritus (rock blocks and talus deposits) moving down the slope from the steep cliffs. The lower parts of the slopes along the river course are narrow and rather flat being covered by alluvium. Farther from the level surface is a 100-200 m wide and 300-600-m long belt that has hilly topography with relative height of up to several tens of meters. This belt is affected by river erosion as evidenced by residual landforms. The right bank of the river downstream from Tang Sorkh is almost similar to the left bank in terms of geomorphic features.

A part of the area lies in the right bank of the main river upstream from Tang Sorkh. With a variable width of 1.5~3.5 km, it stretches along the major tributary, mentioned above, that gets gradually farther from the main course. In the easternmost part of the area, the tributary flows from south to north. Taking a 90° turn at the northern end, it continues flowing towards west to join the main river. This tributary was found to have significant flow of water for the whole year. Hence, the water at its lower reaches is used for fish-breeding (in ponds) and also irrigating the fields.

Mountains are widespread within the altitudinal range of 2200-2800 m along this tributary. The top parts are generally gentle and used for grazing. The mountain slopes adjoining the stream, however, are represented by rather high (relative heights exceeding 100 m) scarps or steep slopes.

Throughout the area within the mountain-slopes, the detrital deposits are represented by colluvium, formed out of the bedrock. During snow-melting and heavy rains, these deposits undergo secondary failure generating rock/debris flows. The water canal passing through such deposits in the vicinity of Tang Sorkh village is heavily damaged during such disasters.

(5) Zeras

Karoon, the main river of this area, flows from SE to NE with frequently switching loops of meanders. The area investigated here has a rectangular shape, 3~6 km wide and 14 km long, that stretches almost parallel to the main river course.

About 90 % of the area is mountainous with altitude ranging between 800 and 1700 m. Although slopes with steep inclinations (30~40°) are common, the region seems to have reached a generally stable state. However, large-scale landslide and similar mountain collapse features are conspicuous in the area adjacent to the main river. Also, frequent occurrence of landslides and other types of slope failures, at a smaller scale, can be observed along the tributary. But, most of the area is mountainous and it is made up of clayey rocks with low water-bearing potential. Because of the scarcity of water for drinking as well as irrigation, there are very few settlements. Occasionally, the unconsolidated and narrowly distributed talus deposits or gently sloping faces along the tributary are saturated by water that meets the demand of the residents on temporary basis. During the dry periods, when there is no water, most settlements are temporarily abandoned.

8.1.3 Geology

Information about geological formations distributed in the five Master Plan areas is given in the summary Tables A-1~A5 (see ANNEX A List of Table) and Geological Map (see ANNEX A List of Figure). Details of geological features of each areas such as content of composition of distribution stratum, distribution area etc. are described in ANNEX A (Geological Condition of Each Project Area).

In general, two broad types of faces can be distinguished: (a) unconsolidated sediments, of Quaternary age, comprising the diluvium and younger deposits; and, (b) bedrock of Tertiary or older age.

The unconsolidated deposits comprise river deposits, alluvial deposits that have formed plain areas through accumulation of sediments in lakes, swamps etc., fan deposits that are widely distributed around the confluences of the main river and its tributaries, detrital deposits formed by colluvial material derived from the mountain-slopes, and the terrace deposits developed along the river courses. Additionally, the debris flow deposits and landslide deposits (resulting form large-scale slope failures such as landslides) may be considered as typical facies. There are no volcanic rocks, of Quaternary age, in this area.

In all the Master Plan areas, the unconsolidated sediments show similarities in style of distribution though there are differences in the scale. In contrast, the areal distribution of large-scale debris flow deposits and landslide – related deposits is limited.

The peculiar features of the unconsolidated formations that are directly related to the natural or man-made disasters are summarized below:

:River deposits: evident damage to agricultural fields and households by deposition of recent debris during floods and/or removal of the material by erosion.

:Detrital deposits: loss of slope stability and damage to the infrastructure brought about by the removal of material from the lower parts of cliffs by erosion or artificial human interference (during various construction works). If small-scale disasters are taken into account, such losses occur in all the areas considered.

:Terrace deposits: loss of bearing capacity of the material due to downward erosion by river leading to collapse of roads on terraces or triggering of landslides.

:Debris flow deposits: Tang Sorkh and Sarbaz are known to have suffered from such events in the past. Vulnerability of Sarbaz to debris flows in future is to be considered. Numerous debris flow events took place within the catchment of the Karoon River. Judging from the conditions underlying the selection of the Master Plan areas, debris flows are not prominent in other areas.

:Landslide or collapse deposits:

Small-scale landslides are found scattered in every area. Though Zeras area is the site of occurrence of large-scale landslides, it seems to be almost stable at the moment. In Sarbasz area, there are some active landslides, of medium size, at several places. These slides are causing damage to road and farmlands. No remarkable landslide hazard occurs in other area, as was the case for debris flows.

The nature of the bedrock in each Master Plan areas has been given in the ANNEX A Tables A-1~A-5 and Geological Condition A-1~A-5.

The most widely distributed rock type is limestone. It is hard and occurs variously such as in massive or bedded (slab-like) forms. In order of decreasing importance of distribution, the following rock types may be pointed: marl, sandstone, and conglomerate. Shale, dolomite, and gypsum occur in very small quantities.

In areas of distribution of limestone, steep slopes formed by rock fragments or blocks (of 30 cm to several m linear dimensions) derived from weathered surficial rock are common. In some areas, the material at such sites serves as the source of potential debris flows. In general, this particular material itself was derived in the past, from the source areas situated in higher parts, by either gravity or debris flow. As regards the sites with potential danger of such failures, they belong to Sarbaz and Tang

Sorkh.

Areas made up of marl are distinct according to ease of erosion and generation of numerous landslides. In general, most landslides are small and from the point of view of control works they are manageable. A balance between the land use pattern and the level of danger involved is to be maintained.

Small-scale landslides and talus masses are commonly associated with rocks rich in gypsum, dolomite and shale. Fortunately, such rocks have restricted distribution.

The investigated area has numerous faults that are accompanied by crush zones and tectonic structures characterized by short wave folding under the influence of mountain-building process. The geological structures are controlled by the river courses and the trends of the mountain ranges.

8.1.4 Soil

(1) Soil Survey in the Study Area

Soil survey was carried out in order to grasp soil properties and infiltration rate for establishing development plan and soil and water conservation plan in the study area. Laboratory analysis is also carried out to grasp texture and chemical properties. These results are reported in Annex D.3. Soil maps are presented in Figure 2-1 to 2-5 in DATABASE MAPS.

(2) Soils in the Study Area

Soil classification has been carried out by the field observation, and summarized as shown in Table 8-1-4-1.

a) Vastegan

Vastegan sub-basin can be divided into two clear different basins. One is the upper mountain area and the other is the lower alluvial fan and plain area. Mountain area is geologically formed by gray marl formation and hard limestone formation. Gray marl formation is heavily eroded due to rapid weathering and heavy sediment runs away into the lower plain area. In the mountain area, soils are very scarce and remained at very limited places. Those limited soil cover area is cultivated by apple trees with surface irrigation system. On the other hand, fertile soils are largely extent in the lower plain area and irrigated agriculture is largely conducted using spring water and groundwater. In the plain area, five soil units are observed, namely 1)Hapic Calcisols in plateaus, 2)Calcaric Regosols in gravelly alluvial fans, 3)Calcaric Fluvisols and 4)Calcaric Cambisols in piedmont alluvial plains and 5)Eutric Gleysols in lowlands (FAO-UNESCO 1989). Soil texture is moderate to heavy and permeability is moderate to slow at most area except 2)Calcaric Regosols. Calcaric

Regosols is forming gravelly alluvial fan, and its permeability is rapid to very rapid and gravel and stones are contained in high percentage.

b) Chaman Gholi-Bazoft

Three soil units are observed in Chaman Gholi-Bazoft, namely 1)Vertic Cambisols in hills, 2)Haplic Kastanosems in old alluvial fans and 3)Calcaric Cambisols in plateaus. All soils are heavy to very heavy in texture and slow in subsoil permeability. Soil depth is deep to very deep and soil contains stones and gravel in high percentage. Due to slow permeability and heavy texture, surface runoff easily occurs and soils are easily washed away in steep slope where soils are bare. Sheet and rill erosions are observed in bare hilly slopes and gullies are developing at some places.

c) Sarbaz

Sarbaz sub-basin forms the northern slope of the Dena Mountains and gravelly soils are largely extent at the foot slope of the mountains. Four soils are observed in the area, namely 1)Eutric Leptosols in hills, 2)Calcaric Cambisols in hills and plateaus, 3)Haplic Calcisols in plateaus, and 4)Calcaric Regosols in gravelly alluvial fans. Calcaric Cambisols and Haplic Calcisols are slow in permeability and heavy in texture. Soil depths are shallow in higher location and deep to very deep in lower location. Apple trees are planted and cultivated in lower area since 30 years before and recently in higher area. Eutric Leptosols is marly and medium in permeability and texture, and soil depth is very shallow. This soil is largely extent in the hilly area of Noorabad village, and young apple trees are planted recently where soils are relatively deep and irrigation water is available. Calcaric Regosols is gravelly texture and rapid in permeability.

d) Tang Sorkh

In Tangesorkh, four soils are observed, namely 1)Eutric Leptosols in hills, 2)Calcaric Cambisols in old alluvial fan and plateaus, 3)Calcaric Regosols in gravelly alluvial fans, and 4)Calcaric Fluvisols in river beds. Eutric Leptosols is observed at hilly area where marl is extensively distributed. This soil contains high percentage of stones and soil depth is very shallow. Young apple trees were recently planted in this soil and irrigated by pump irrigation from the Boshar river. Drip irrigation system was introduced for irrigation due to coarse texture. Calcaric Cambisols is one of major soils in this area, which is forming old alluvial fans and plateaus. Texture of this soil is heavy but it contains high percentage of gravel and stone. Most area of this soil is utilized as rangeland and partly as dry farmland. Carcaric Regosols is also one of major soils in this area and it forms gravelly alluvial fans. Most area of this soil is irrigated by gravity system for wheat and partly apple trees. Calcaric Fluvisols is forming lower river bank terrace of the Boshar river.

e) Zeras

Zeras is formed mostly by very steep slope and flat area is very scarce. Red colour soils are extensively covering this area even at very steep slope so that all area is grazed and dry farming is carried out even at very steep slopes up to approximately 50%. Soil texture of slopes is heavy and depth is generally very deep. Although soil contains high percentage of stone and gravel, permeability is slow due to heavy texture. Since permeability is slow and texture is clayey, surface runoff easily occurs and soils are easily eroded where heavily grazed or improperly cultivated. Severe gully erosions are observed in such areas where land is not properly managed.

Table 8-1-4-1 Soil Series and Unit in 5 Master Plan Area

Vastegan

Physiography	Soil Series	Soil Mapping Unit	Area (ha)	Area Ratio (%)	Soil Series Area (ha)	Soil Series Ratio (%)
Plateau	1	1.1	57	2%	183	5%
		1.2	93	3%		
		1.3	33	1%		
Gravelly Alluvial Fan	2	2.1	77	2%	77	2%
	3	3.1	367	10%	367	10%
Piedmont Alluvial Fan	4	4.1	249	7%	418	11%
		4.2	169	5%		
	5	5.1	248	7%	424	12%
		5.2	176	5%		
Low Land	6	6.1	546	15%	2,134	59%
		6.2	1,300	36%		
		6.3	56	2%		
		6.4	232	6%		
Miscellaneous	T		4	0%	45	1%
	RW		41	1%		
Total			3,648	100%	3,648	100%

Chaman Goli Bazift

Physiography	Soil Series	Soil Mapping Unit	Area (ha)	Area Ratio (%)	Soil Series Area (ha)	Soil Series Ratio (%)
Hill	1	1.1				
		1.2				
Old Alluvial Fan	2	2.1	631	26%	1,187	48%
		2.2	556	23%		
Plateau	3	3.1	43	2%	253	10%
		3.2	209	9%		
Association		1.1+1.2	1,015	41%	1,015	41%
Total			2,454	100%	2,454	100%

Sarbaz

Physiography	Soil Series	Soil Mapping Unit	Area (ha)	Area Ratio (%)	Soil Series Area (ha)	Soil Series Ratio (%)
Mountain	1	1.1				
	2	2.1				
Hill	3	3.1	1,235	19%	1,235	19%
	4	4.1			176	3%
		4.2	176	3%		
	5	5.1	104	2%	728	11%
		5.2	371	6%		
		5.3	252	4%		
Plateau	6	6.1	343	5%	343	5%
	7	7.1	416	6%	416	6%
	8	8.1	714	11%	714	11%
G. A. Fan	9	9.1	98	2%	98	2%
Association	1+2	1.1+2.1	1,085	17%	1,085	17%
	4+5	4.1+5.1	1,530	24%	1,530	24%
Miscellaneous	R		134	2%	146	2%
	RW		12	0%		
Total			6,471	100%	6,471	100%

Tang Sorkh

Physiography	Soil Series	Soil Mapping Unit	Area (ha)	Area Ratio (%)	Soil Series Area (ha)	Soil Series Ratio (%)
Plateau		1.1	87	0.07	87	7%
Gravelly Alluvial Fan		2.1	40	3%	268	22%
		2.2	154	13%		
		2.3	73	6%		
Old Alluvial Fan		3.1	120	10%	310	25%
		4.1	190	15%		
River Bed		5.1	29	2%	197	16%
		5.2	168	14%		
Hill		6.1	259	21%	259	21%
Miscellaneous	RW		108	9%	108	9%
Total			1,229	100%	1,229	100%

Zeras

Physiography	Soil Series	Soil Mapping Unit	Area (ha)	Area Ratio (%)	Soil Series Area (ha)	Soil Series Ratio (%)
Old Alluvial Fan	1	1.1	56.61	11%	158.5	30%
		1.2	101.87	19%		
Plateau	2	2.1	68.59	13%	115.9	22%
		2.2	47.3	9%		
		2.3	*			
Plateau & Hill	3	3.1	27.21	5%	259.8	49%
		3.2	24.96	5%		
		3.3	31.29	6%		
		3.4	100.2	19%		
		3.5	76.16	14%		
Total			534.19	100%		

(Note) Soil unit 2.3 is dominant in Plateau, but not enough surveyed.

8.1.5 Meteorology

(1) General Condition of Meteorology

Synoptic station observes every kind of meteorological data of air/soil temperature, humidity, precipitation, wind, sunshine and evaporation. And climatological station observes data of air temperature, humidity and precipitation. There are 5 synoptic stations in/nearby the Study area, 11 climatological stations and 38 rain gauge stations. General characteristics of these stations are shown in Annex C.

Generally rainfall increases according to elevation and it is reported that increase ratio ranges from 0.5 % to 8 % in the Study by MOA. And also it is reported that increase of rainfall is 5 % by 100 m according to the Study in mountain area in Japan which elevation ranges from about 2,000 to 3,000 m. Then ratio of 5 % by 100 m was adopted to estimate rainfall in Master Plan areas. In addition, temperature is assumed to be increase in the ratio of 0.6℃ by 100 m.

a) Vastegan

Borougen station is the most closed synoptic station to Vastegan area and there are 2 climatological stations are found, namely Emam-gheis and Doozak. As for rainfall, there are 4 rainfall gauge stations around area. In these stations, Borougen and Emam-gheis are supposed to be representative meteorological stations in consideration of location and duration of data.

In this study, Emam-gheis are most suitable as representative meteorological station, because the station is not only closed but also locates in same river basin of Vastegan. Then meteorological condition of Vastegan will be studied based on the data of precipitation, air temperature, humidity at Emam-gheis. However, as for conditions of wind, sunshine and evaporation, data of Borougen station will be studied.

Table 8-1-5-1 Meteorological Conditions of Emam-gheis (annual average)

Precipitation (mm)	Maximum Temperature(℃)	Mean Temperature(℃)	Minimum Temperature(℃)	Relative Humidity (%)	Frost Days
596	18.3	10.4	2.6	51	134

Source : Meteorological Data Bank, Ministry of Agriculture

Average elevation of Vastegan is 2,800 m and elevation of Emam-Gheis is 2,300 m. Estimated annual rainfall is about 780 mm and rainfall concentrate from Mehr (October) to Ordivehesht (May). Minimum temperature is estimated to become less than 0℃ from Mehr to Farvardin and whole area is covered with snow in this period. On the other hand,

minimum temperature exceed 0℃ from Ordivehesht (May) and maximum temperature reach about 30℃ in Tir (July). Lowest elevation of Vastegan is about 2,300 m and it is supposed that frozen days are more than 130 days at least according to data at Emam-Gheis. Annual mean humidity is 51 % and ranges from about 40 % in Dey (January) to 80 % in Tir.

b) Chaman Goli-Bazoft

There are Koohrang and Izeh synoptic station near Chaman Goli-Bazoft. Koohrang station locates at north-east site in the distance of 30 km and Izeh station locates at south-west in the distance of 40 km. As for rain gauge station, Goosheh Pol station only locates near Chaman Goli-Bazoft area in the distance of 25 km northward. For the study of rainfall, Goosheh Pol station was selected as representative station for Chaman Goli-Bazoft. As for other climatological conditions, data of Koohrang was studied. Average elevation of area is about 2,300 m. On the other hand, elevations at Goosheh Pol and Koohrang are 1,700 m and 2,700 m. However precipitations at Goosheh Pol and Koohrang are almost same nevertheless the difference of elevation at Koohrang and Goosheh Pol is 500 m. Then it is considred that increase of precipitation would not been done.

Table 8-1-5-2 Meteorological Conditions of Koohrang (annual average)

Precipitation (mm)	Maximum Temperature(℃)	Mean Temperature(℃)	Minimum Temperature(℃)	Relative Humidity (%)	Frost Days
1438 (1474)*	27.5	15.9	1.4	46	132

Source : Meteorological Data Bank, Ministry of Agriculture
* Figure in ( ) shows data of Goosheh Pol

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

c) Sarbaz

Sarbaz area has Yasuj synoptic station and Hanna climatological station nearby within the distance of 30 km. And 3 rainfall gauge stations around area, namely Dehkadeh Shahid, Sisakht and Khak Daneh are found within the distance of about 15 km. In these 3 stations, Dhehkadeh Shahid and Khak Daneh station locates with in the basin of Marboreh river. And from the point of view similarity such as topographical condition and observation period,

Dhekadeh Shahid station is supposed to be suitable for representative rainfall station.

As for climatological conditions, Hanna station will be adopted as representative station for Sarbaz, because Yasuji station locates on the western mountain side of high mountain range, namely Kuh-e-Dinar's, which is the western boundary of Sarbaz. On the other hand, Hanna station locates in eastern side of Kuh-e-Dinar without high mountain range between Hanna and Sarbaz. Then meteorological condition of Sarbaz will be studied based on the data of Dehkadeh Shahid and Hanna station.

Table 8-1-5-3 Meteorological Conditions of Hanna (annual average)

Precipitation (mm)	Maximum Temperature(℃)	Mean Temperature(℃)	Minimum Temperature(℃)	Relative Humidity (%)	Frost Days
326 (522)	18.3	10.6	2.8	53	121

Source : Meteorological Data Bank, Ministry of Agriculture
* Figure in ( ) shows data of Dehkadeh Shahid

Average elevation of Sarbaz is 2,750 m. The elevations of Dekadeh Shahid and Hanna is 2,200 m and 2,300 m. Estimated annual rainfall is about 700 mm and rainfall which exceeds 50 mm concentrates from Azar (December) to Farvardin (April). Minimum temperature is estimated to become less than 0℃ from Mehr (October) to Farvardin (April) and snow approximately falls for these 7 months. As for minimum temperature, it exceeds 0℃ from Ordivehesht (May) and maximum temperature reach about 30℃ in Tir (July). Lowest elevation of Sarbaz is about 2,000 m and minimum temperature in Dey (January) is estimated to be -7 ℃. Then it is supposed snow covers whole area. And it is estimated that frozen days are about more than 120 days at least according to data at Hanna. Annual mean humidity is 50 %.

d) Tang Sorkh

There is only synoptic/climatological stations in Yasuj near Tang Sorkh. Then, in this study, Yasuj synoptic station will be adopted as representative meteorological station for Tang Sorkh.

Table 8-1-5-4 Meteorological Conditions of Yasuj (annual average)

Precipitation (mm)	Maximum Temperature(℃)	Mean Temperature(℃)	Minimum Temperature(℃)	Relative Humidity (%)	Frost Days
885	23.6	15.7	8.7	49	51

Source : Meteorological Data Bank, Ministry of Agriculture

Average elevation of Tang Sorkh is 2,400 m and elevation of Yasuj is 1,800 m. Estimated annual rainfall is about 1,150 mm and rainfall which exceeds 50 mm concentrates from Aban

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

e) Zeras

Izeh synoptic station and Lordegan climatological station are the most closed meteorological stations to Zeras area in 50 km distance respectively. And 2 rainfall gauge stations are available around area, namely Barz and Dehdaz. For study of rainfall, Barz station is recommended as representative rain gauge station for its similar location to Zeras and duration of data. As for other climatological conditions, generally speaking, northern part of the Study area has different characteristics sharing borders with the range of Zard Kuh and it is possible to categorize climatological condition of Zeras into that of Izeh. On the other hand, Lordegan locates almost on the border mentioned above and is considered to belong to another category of climate condition. Then meteorological condition of Zeras will be studied based on the data of Izeh except precipitation.

Table 8-1-5-5 Meteorological Conditions of Izeh (annual average)

Precipitation (mm)	Maximum Temperature(℃)	Mean Temperature(℃)	Minimum Temperature(℃)	Relative Humidity (%)	Frost Days
450 (644)*	27.5	20.7	13.9	44	4

Source : Meteorological Data Bank, Ministry of Agriculture
Figure in ( ) shows data of Barz

Average elevation of Zeras is 1,200 m. The elevations of Barz and Izeh are 880 and 760 m, respectively. Estimated annual rainfall is about 770 mm and rainfall which exceeds 50 mm concentrates from Aban (November) to Farvardin (April). Minimum temperature temperature exceeds 0℃ through the year and maximum temperature reaches about 40℃ in Mordad (August). Frozen days are more than 5 days at least according to data at Izeh. Annual mean humidity is 45 % and ranges from about 65 % in Dey (January) to 20 % in Mordad (August).

(2) Probability and Intensity of Rainfall

Probability of rainfall occurrence has been estimated by graphical method using Weibull plot. As for intensity of rainfall, it is impossible to estimate because hourly rainfall data are not published officially in Iran. However, Department of Water Engineering and Khajeh Nassir-al-Deen Toosi University of Technology analyzed intensity of rainfall in cooperation. Then these results of analysis were adopted

in this study. The probability and intensity of rainfall are summarized as follows.

Table 8-1-5-6 Probability of Annual Rainfall

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

Table 8-1-5-7 Probability of Daily Maximum Rainfall

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

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

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

(3) Evapotranspiration

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

Table 8-1-5-9 Evapotranspiration

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

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

8.1.6 Hydrology

(1) Vastegan

Major tributary in Vastegan is Bijeh Gerd, which originates in western mountain area and flow from the west to the east. After passing Vastegan village, which locates on the top of alluvial fan, it

changes the flow direction and flows into the north-east. On this alluvial plain, surface water often disappear by infiltration in summer season.

Bijeh Gerd has 2 major tributaries, namely Dareh Gol and Baghoon Soo. In summer, surface water which amount is even a little, can be found in Dareh Gol and Baghoon Soo among the tributaries of Bijeh Gerd. And Jihad promotes construction of check dam to conserve watershed in these 2 basins. In north mountain area, which locates on left bank of Bijeh Gerd, some springs make streams. In these area, 7 springs can be identified on map with 1/25,000 scale. Yield of each spring is estimated at about 0.09 m3/s based on discharge measurement.

The nearest discharge gauging station of Vastegan is Godarkabk, which locates at the downstream of Aghaborah in the distance of about 20 km from the Gandoman Wetland. Hydrological condition at Godarkabk is shown as follows. Specific discharge and annual discharge depth are 0.006 m3/s/km2 and 200 mm/year. The areal rainfall at Godarkabk is estimated at about 570 mm and the runoff coefficient comes up to about 35 %.

Table 8-1-6-1 Hydrological Condition of Godarkabk

Catchment Area (km2)	Mean Annual Runoff (m3/s)	Mean Maximum Daily Runoff (m3/s)	Mean Minimum Daily Runoff (m3/s)	Instantaneous Max. Runoff(m3/s)
588	3.8	41.7	0.4	92.2

Aghaborah basin is one sub-basin of Abe Vanak basin and sediment data is available at Tangzardalou in the Abe Vanak basin. Specific amount of sediment is estimated at 30 m3/km2/year based on sediment data at Tangzardalou station. Furthermore, sediment data are available at Solegan which locate at conjunction of Agaborah and Abe Vanak. Specific amount of sediment is estimated at 16 m3/km2/year based on sediment data at Solegan. Then sediment from Vastegan will ranges from 16 to 30 m3/km2/year.

(2) Chaman Goli-Bazoft

Chaman Goli-Bazof basin can be divided into two (2) basins, namely Dareh Tavileh and Gusaleh Bar. Generally speaking, these basins have numerous springs as water sources and each tributary has perennial flow. On the map with scale of 1/25,000, 21 springs in Dareh Tavileh and 28 springs in Gusaleh Bar basin can be identified.

Dareh Tavileh tributary originate in south-east mountain area and flow down to the north east and its water amount is bountiful through the year. Gusaleh Bar tributary originate in east/north-east mountain area and flow into the east. On the toe of alluvial fan, it changes flow direction to the south east and flow in to Bazoft river near Chaman Goli-Bazoft. Specific yield of Gusaleh Bar is supposed to be lesser than that of Dareh Tavileh. Especially surface water of Dareh Kusahid, which is major

sub-tributary of Gusaleh Bar, disappears on the alluvial fan in summer.

The nearest discharge gauging station of Chaman Goli-Bazoft is Ghosheh Pol, which locates at the upstream of Bazoft in the distance of about 20 km from Chaman Goli village. Specific discharge and annual discharge depth at Ghosheh Pol are 0.046 m3/s/km2 and 1,440 mm/year. On the other hand, specific discharge and annual discharge depth at Morghak are 0.030 m3/s/km2 and 960 mm/year. Then it is supposed that there are some errors of discharge measurement or data processing at Goosheh Pol. Sediment data is available at Morghak in the Bazoft basin. Specific amount of sediment is estimated at 23 m3/km2/year.

Table 8-1-6-2 Hydrological Condition of Ghosheh Pol

Catchment Area (km2)	Mean Annual Runoff (m3/s)	Mean Maximum Daily Runoff (m3/s)	Mean Minimum Daily Runoff (m3/s)	Instantaneous Max. Runoff(m3/s)
2355	71.5	696.7	16.3	2284.0

(3) Sarbaz

Sarbaz basin can be divided into two (2) basins, namely Ly Sorkh and Tang Rigan basin. Generally speaking, Sarbaz basin has many springs as similar as Chaman Goli-Bazof. On the map with scale of 1/25,000, 29 springs in Ly Sorkh and 15 springs in Tang Rigan basin can be found. Ly Sorkh tributary originate in southern mountain area and flow down to the north and its water amount is plenty through the year. Tang Rigan tributary originates in south-west mountain area and flow to the north east.

The nearest discharge gauging station of Sarbaz is Dehkadeh Shahid, which locates at the upstream of Dehkadeh Shahid in the distance of about 15 km from Bideh. Specific discharge and annual discharge depth are 0.027 m3/s/km2 and 840 mm/year. The areal rainfall at Dehkadeh Shahid is estimated at about 630 mm and the runoff coefficient exceeds 100 %. On the other hand, the annual discharge depths at Kakdaneh and Kata are 400 mm/year, 300 mm/year, respectively. Then it is supposed that there are some errors of discharge measurement or data processing at Dehkadeh Shahid.

Table 8-1-6-3 Hydrological Condition of Dehkadeh Shahid

Catchment Area (km2)	Mean Annual Runoff (m3/s)	Mean Maximum Daily Runoff (m3/s)	Mean Minimum Daily Runoff (m3/s)	Instantaneous Max. Runoff(m3/s)
200	5.3	65.0	8.5	147.0

Sarbaz is a sub-basin of Marboreh basin and sediment data is available at Khakdaneh in the Marboreh basin. Specific amount of sediment is estimated at 199 m3/km2/year based on sediment data at Khakdaneh station. Furthermore, sediment data are available at Kata. Specific amount of sediment is estimated at 51 m3/km2/year based on sediment data at Kata.

Table 8-1-6-4 Hydrological Condition of Khakdaneh

Catchment Area (km2)	Mean Annual Runoff (m3/s)	Mean Maximum Daily Runoff (m3/s)	Mean Minimum Daily Runoff (m3/s)	Instantaneous Max. Runoff(m3/s)
801	10.2	129.3	4.1	398.0

(4) Tang Sorkh

Tang Sorkh locates at upper basin of Boshar river. Basin is divided into 2 basins such as left and right bank basin. Right bank basin occupies major area of Tang Sorkh and its major tributary is Dareh Sorkh. Dareh Sorkh River has perennial flow and formulate alluvial fan at the mouse to Boshar river. On the other hand, left bank basin consists of small basin, which small tributaries flow down directly into Boshar River. Lengths of tributaries in these small basins, which locate on steep hillside, range from 1 km to 2 km. Then it is supposed that runoff in short term easily occurs in case of rain and water resource is poor.

The nearest discharge gauging station of Tang Sorkh is only Yasuj, which locates at the downstream of Boshar in the distance of about 30 km from the area. The nearest discharge gauging station of Tang Sorkh is Yasuj. Specific discharge and annual discharge depth are 0.018 m3/s/km2 and 580 mm/year. The areal rainfall at Yasuj is estimated at about 870 mm and the runoff coefficient comes up to about 65 %. Sediment data are available at Yasuj. Specific amount of sediment at Yasuj is estimated at 60 m3/km2/year.

Table 8-1-6-5 Hydrological Condition of Yasuj

Catchment Area (km^2)	Mean Annual Runoff (m3/s)	Mean Maximum Daily Runoff (m^3/s)	Mean Minimum Daily Runoff (m^3/s)	Instantaneous Max. Runoff(m^3/s)
803	14.7	129.2	2.3	230.0

(5) Zeras

Zeras locates at middle basin of Karoon river and is divided into many small sub-basins. Main stream in each sub-basin flows into Karoon River directly in rain. Almost all of these streams have no water without rain. And also there is only a few springs in the area. In consideration of these conditions, Zeras has poor water resource. The perennial flow can be found except one tributary which flow through Lir Siya Mozrom and Lir Siya Shapouri village. However, this tributary is little stream and its origin of water source is spring.

The nearest discharge gauging station of Zeras is Barzbakhtiari, which locates at the downstream of Boshar in the distance of about 15 km from the area. Specific discharge and annual discharge depth are 0.013 m3/s/km2 and 400 mm/year. The areal rainfall at Barzbakhtiari is estimated at about 570 mm and the runoff coefficient comes up to about 70 %. Sediment data are available at Barzbakhtiari and specific amount is estimated at 15 m3/km2/year.

Table 8-1-6-6 Hydrological Condition of Barzbakhtiari

Catchment Area (km2)	Mean Annual Runoff (m3/s)	Mean Maximum Daily Runoff (m3/s)	Mean Minimum Daily Runoff (m3/s)	Instantaneous Max. Runoff(m3/s)
8900	112.0	762.9	38.4	1957.0

8.2 Land Use and Vegetation

8.2.1 Land Use

Land use should be carried out the land classification based on natural conditions, such as topography, soil conditions, rainfall, temperature, etc., road to the actual villages and present landuse. And then, site classification which is how to effectively use of land will be done in consideration with socio economy and land improvement techniques. Due to these considerations, the first field survey which was conducted on the year of 2000 was described general land use in the whole area of the Karoon River sub-basin, and inventory for the land use also attached in the interim report. This inventory and other dates were used to make report of the second field survey.

The second field survey on the land use is to make clear present landuse in the master plan area, and land use plan in the future will be considered synthetically together with natural conditions such as topography, geology, soil condition, weather condition and vegetation, and social conditions for villagers.

The most important factor to land use in all of sub-basins related to five areas for master plan became clearly connection with topography of the steep Zagros Mountains. The flow of these proper land use shown as Figure 8.2.1.

Land use in the master plan areas considerably influenced by inclination of topography. Namely, most of their topography separates two parts, one is steep slope area and another one is flat area or hilly districts. There are no buffer zone like gentle slope between steep slope and flat area. Therefore, slope consist of rock zone, forest zone, rangeland and flat area where is farmland, road, villages, and other in order. Mountain area where grow more or less tree is belong to forest area, but rangeland grow a few trees or no trees at all due to categorize land use by the regulation of the department of Forestry and Rangeland, but it was cleared that this regulation not always keep nomadic people by the result of field survey on the present land use.

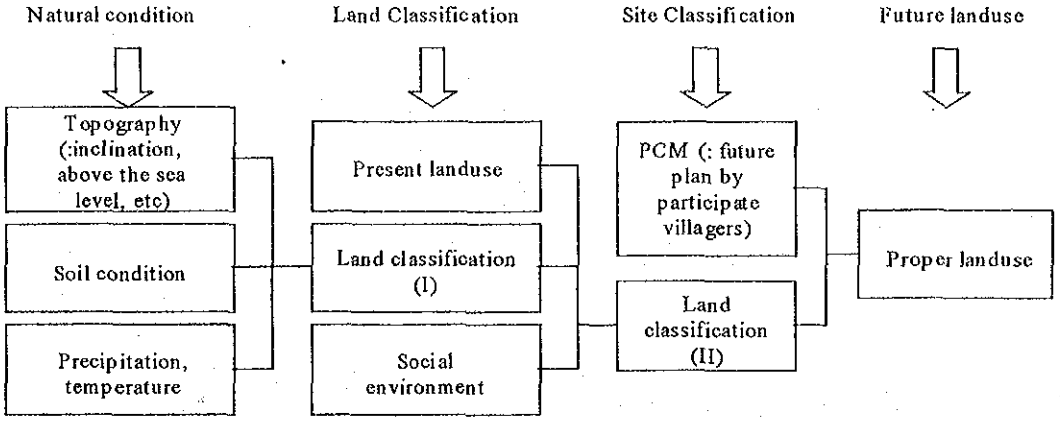

Figure 8-2-1 The Flow of Proper Land use

Land use classification arranged by topography and purpose of land use is as follows;

A. Land use classification by topography

(1) Steep slope area

1. Rocky or Bare land
2. Gentle slope area than that of No.1
   a) High density forest land
   b) Low density forest land
   c) Mountainous grass land

(2) Gentle slope area

1. Rangeland
2. Agro forestry land

(3) Flat area

1. Farm land or agriculture land
2. Uncultivated land
3. Orchard
4. Plantation area

(4) Others

Village, Fish culture, Torrent, Road, etc.

B. Landuse classification by purpose

(1) Forest land

1. Rocky or Bare land

2. Gentle slope area than that of No.1
   a) High density forest land
   b) Low density forest land

(2) Rangeland ... Land inclination slightly gentle or as well as (1)-2
1. Mountainous rangeland
2. Flat rangeland (: uncultivated area)

(3) Agriculture land
1. Agriculture land
2. Fallow land
3. Agro forestry land
4. Orchard or Fruit garden
5. Plantation area

It was the fact that there are so many landuse areas other than above mentioned categories. Accordingly,

Land use category of master plan areas classified by the result of the second field survey which is based on current land use. Final category in the model areas classified as follows, and current land use map in each master plan areas draw and attached with the other papers.

(1) Mountain
1. Rocky Bare rocky land
2. Forest Mountain with natural high density tree/forest

(2) Rangeland
1. Forest rangeland Rangeland with natural low density tree on the gentle slope
2. Rangeland Located at flat or hill (both No.1 and No.2 not separate on the land use map)

(3) Farm land
1. Farming land
2. Orchard Fruit tree farm
   Tree plant Manmade forest

(3) Others
1. Village
2. Waste.....Stone loss

3. River bed
4. Agroforestry.....Tree with farming
5. Fish culture
6. Torrent
7. Road

Tree plantation should be considered to make future land use in each master plan area. These areas of master plan area. These areas of master plan have rangelands with open land in general. Cattle always eat wild grass grow on the ground, so no time to grow, and then, soil erosion easily occurs in the rainy season. This soil erosion will be able to protect by tree plantation.

Most of master plan areas have a small amount of annual rainfall like 600 mm par one year, therefore, all of these areas belong to semi arid by the reason of amount of rain fall. How to keep much moisture content in soil is much important subject for growth and survival rate after plantation. The place where is less than 20 degree of land inclination feasible for forestation, but most rangeland belong to Department of Forest and Rangeland, so more positive support need from government office.

More detail survey is necessary for the selection of tree species to plant, but it is sure that tree species which grow tap root and reach to deep part of soil as soon as possible, also tree species which has strong sprout are effectiveness. Native species such as Quercus brantii, other Quercus spp. And selection of deciduous broad leaves tree which show Annex F-1 in interim report are candidate and recommendable.

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

(1) Vastegan: 89.90 km^2

The most of west side area of the road which pass through the center of the area consist of rock and sandy stone, and they occupy about 45 % of total area. Sand and some size of stone on the slope area show as one of characteristics of the area. The area where is nothing to grow trees or no vegetation has in danger of stone fall and washed away of gravel. The secondary large land use is farmland and rangeland, but almost of east side of flat land are utilizing for farmland. Some rocks which washed away from mountainous area are found a part of torrent, and there are waste of sand and rocks caused by rising river bed, and river bank trees and orchard situated along the irrigation canal, but some of trees withered by lack of water. Wet land where locate north part of land is utilizing as farmland or grazing land at present. There is no function of wet land without wet season.

The advantages of this area occupy huge flat area, and farmers use therefore farmland. One of the characteristics of farmer who live in this area is cultivating their land by rental or their own tractor and

cultivator. This meaning shows most farmers has bigger farmland compare with other local people, however, uncultivated flat area still remain in this area. These lands will soon cultivate to dry or paddy field if canal or water pump operate in the future. Provision of irrigation canal for the promotion of agricultural products is wishes of farmers.

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

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

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

An urgent problem in this area is consolidation of infrastructure such as construction of strong bridge and road connect to villages. These infrastructures are basic facilities for social conditions and countermeasure of disaster can not push without consolidation such as infrastructure preferentially.

Open area with gentle slope in the mountainous area should be protected sand loss with enrichment plantation, and also tree plantation along torrent on rangeland is much important. Due to lack of farm land in this area should be introduced agroforestry system to increase agricultural products.

(3) Sarbaz: 154.5 km^2

River head of this area where locate more or less 3000 m above the sea level can supply sufficient water, but productivity and cultivation area of fruit restrict for lack of canal network because many apple cultivators live in this area. The area of lowland part of present rangeland will be expanded for the cultivation area of apple in the near future. Motivation of this fact is to get much income than other agricultural products, this is why most of farmers are recognizing needlessness of general farmland. In fact, very small area exists in this area at present. Villagers want to refuse nomad come into this area, but it does not succeed because wide rangeland occupy in this area.

New land slide and break down of stone and sand are occurring at some sub basin in the area, so tree plantation for land protection is necessary on the point of view for watershed management.

(4) Tang Sorkh: 65.40 km^2

Amount of 844 mm annual rainfall is much in the five master plan area, therefore, trees grow somewhere in the rocky mountain with quite low density, and the same oak trees also scattered in rangeland, but the places where is thick and fertile soil grow trees with high density. These areas are the widest compare with other master plan area. It shows about 47 % of the area. Sub-basin with flow center of the area toward north is dry up river at the time of field survey but there are piled sand seems to be coursed by soil erosion. It is bigger sub-basin around there, so much water come down only short period at the beginning of spring. Other sub-basin which separate on the way toward east direction has abundant water in the river and fish farm constructed at upper part of the stream and also irrigation canal already constructed both side of the river and water supply to farm. Walnut orchard cultivated for a long time in this area and recently started apple cultivation. For this reason, farmers want to construct water tank for stabilizing supply of water. Farmers want to change sheep and goat breeding to caw breeding for the land conservation. Villagers have interesting to plantation of tree for soil protection.

Villagers are eager to make plantation for establishment of soil protection and soil erosion. Topography of rangeland in Tangsorg show usually very steep, but natural trees grow here and there, because it is more than 600 mm annual rainfall in this area. Valley and along sub-basin can plant trees for protection of soil.

Farmland relatively limited in this area, so many farmers cultivate river bed, but these areas situated with danger by flood. Salix sp. and Populus sp. are better species to plant in this area for preservation and protection of flood.

(5) Zeras: 63.70 km^2

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

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

(unit : k m²)

Area	Item	Rocky	Forest	Range land	Forest + Range Land	Farm land	Orchard	Tree Plant	Village	Waste	River Bed	Forest with Dry farming	Total
K4-1-9	Vastegan	40.39	0.00	11.42	11.42	35.24	0.46	0.69	1.59	0.11	0.00	0.00	89.90
K5-19a	Chaman Goli-Bazoft	74.91	1.27	18.75	20.02	11.17	0.23	0.00	0.32	0.00	0.31	6.24	113.20
K7-0-19-1	Sarbaz	74.13	0.00	53.92	53.92	2.08	20.41	0.18	1.57	0.00	2.21	0.00	154.50
K7-48	Tang Sorkh	22.26	0.00	31.18	31.18	4.58	2.66	0.04	0.26	3.15	1.27	0.00	65.40
K8-28	Zeras	7.21	0.00	33.61	33.61	21.41	0.00	0.00	0.21	0.50	0.76	0.00	63.70
Total		218.90	1.27	148.88	150.15	74.48	23.76	0.91	3.95	3.76	4.55	6.24	486.70

Source: JICA Study Team

8.2.2 Land Capability

Land capability has been analized based on the irrigation suitability as explained below. The results are presented as the Land Capability Map in Figuire 4-6 to 4-10 in DATABASE MAPS.

(1) Evaluation Criteria of Land Capability

There are two different criteria for evaluating land capability in Iran. One is the evaluation from an aspect of topography, and the other is from an aspect of irrigation suitability. Former one is explained in detail in Table D-1-1, Annex-D. In this evaluation method, general information on topography, soil and vegetation are considered and land suitability is evaluated. This evaluation method is rather general and suitable to evaluate all kinds of topographies. On the other hand, the latter one is more detail and concentrated to irrigation suitability.

(2) Land Classification by Irrigation Suitability

The objective of land classification for irrigation is specifying lands suitability form the agricultural and irrigation points of view. This classification has been prepared in accordance with "Manual of Land Classification for Irrigation, Iran Publication No. 205". In this method, land classification factors such as permeability, topsoil texture, topsoil and subsoil stoniness, salinity and sodic, soil depth and kind of limiting layer and also topography like slope gradient, relief, erosion, groundwater table, drainage condition, ponding and flooding hazards are considered. Lands are classified into six (6) classes as below:

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

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

(Source) Soil Institute of Iran

There are no limitations in Class I land, but severe limitations in Class IV land. Class VI land will not be utilized for irrigation farming. Other than Class I land, lands are classified into four subclasses according to their limitations. Limitations on irrigation suitability are explained by following four factors as soil properties, alkalinity, topography and drainability.

Table 8-2-2-2 Limitation Factors on Irrigation

S	Soil property limitation (texture, depth, permeability, infiltration rate, etc.)
A	Soil salinity or alkalinity limitation
T	Topography and erosion limitation
W	Drainage limitation (flooding, ponding, groundwater, etc.)

Details for application of this method are explained in Table D-4-1. Based on Table D-4-1, study area has been evaluated as shown in Table below.

Table 8-2-2-3 Land Classification for Irrigation Purpose

Land Class and Area (ha)	Vastegan	Chaman Goli-Bazoft	Sarbaz	Tang Sorkh	Zeras	Total
Irrigable lands						
I	497	0	0	0	0	497
II	872	253	1,130	29	69	2,353
III	2,157	0	2,255	833	289	5,534
III+IV	0	1,015	0	0	0	1,015
IV	81	1,187	1,859	259	176	3,562
V	0	0	0	0	0	0
Total of Irrigable Land	3,607	2,455	5,244	1,121	534	12,961
None Irrigable Lands						
VI RW(river bed)	41	0	12	108	0	161
VI Mountain & Slope	5,342	8,865	10,194	5,311	5,836	35,548
Total of None Irrigable Land	5,383	8,865	10,206	5,419	5,836	35,709
Total of the Area	8,990	11,320	15,450	6,540	6370	48,670
Ratio to the Irrigable lands						
I	14%	0%	0%	0%	0%	4%
II	24%	10%	22%	3%	13%	18%
III	60%	0%	43%	74%	54%	43%
III+IV	0%	41%	0%	0%	0%	8%
IV	2%	48%	35%	23%	33%	27%
V	0%	0%	0%	0%	0%	0%
Total of Irrigable Land	100%	100%	100%	100%	100%	100%
Ratio to the Total Area						
Irrigable Land	40%	22%	34%	17%	8%	27%
None Irrigable Land	60%	78%	66%	83%	92%	73%
Total of Area	100%	100%	100%	100%	100%	100%

(Note)
1) Details are in Table D-4-2 and Table D-4-3(1)-(5) in Annex D.
2) Land classification maps are described in Figure 4-1 to Figure 4-5 in the Batabase Maps

(3) Land Class in Vastegan

Total irrigable land of Class I to IV is about 3,600 ha equivalent to 40% of total sub-basin area. Ratio of the irrigable land in Vastegan is quite high comparing to other four areas. Most irrigable area is already irrigated presently. Present irrigated area has reached to 2,500 ha that is 70% of total irrigable area. Class I land, no limitation for irrigation, shares 11% of total irrigable land. Class I land locates at the center of the alluvial plain. There is no Class I land in other areas than Vastegan. Class II and III lands, slight and moderate limitation for irrigation, are 24% and 60% respectively. The area of Class I to III land is 98% of total irrigable land. Most of those Class I to III lands are already irrigated by spring water and groundwater presently. Major limitations of Class II and III lands are slow permeability (0.1 to 2 cm/hr), heavy texture (heavy to very heavy) in most area of the plain. Limitations of some lands along the mountain and the floodway are stoniness (35 to 70% of gravel and stone) and rapid permeability (6 to 25cm/hr). Scattered dry farmlands and some rangelands in the western high land is classified into Class III land. Major limitations of those lands are land slope (5% to 13%) and heavy texture. It is, therefore, possible to develop these lands for orchard or for other crops if irrigation water is obtained. Although heavy erosion is caused in the

marl formation, erosion of farmlands is not major problems in this area. Heavy sediment is severe problem along the floodway in the plain.

(4) Land Class in Chaman Goli-Bazoft

Total irrigable land of Class II to IV is about 2,450ha equivalent to 22% of total sub-basin area. Class I land, no limitation for irrigation, is not existing in this area. Present irrigated area is 590ha that is equivalent to 24% of total irrigable area. Other than irrigated area, land is used as rangeland and dry farmland. Class II land is only 10% of total irrigable area, and it locates at the alluvial fans nearby Fariak and Ghale Tabarak villages. Major limitation of Class II land are slow permeability , heavy texture and stoniness. Class III and IV lands share 89% of total irrigable land. Major limitations of these lands are slow permeability, coarse gravels of about 15% to 75%, and overall and trasversal slopes of 2-5% to 35-75%. Some of these lands are used as irrigated farmland where irrigation water can be obtained even in very steep slopes to 40% gradient.

(5) Land Class in Sarbaz

Total irrigable land of Class II to IV is about 5,200ha equivalent to 34% of total sub-basin area. Ratio of the irrigable area is high following to Vastegan. Class I land is not existing also in this area. Present irrigated area is 2,040 ha that is equivalent to 39% of total irrigable area. Irrigated ratio is high following to Tang Sorkh. Apple trees are planted extensively in the irrigated area. Other than irrigated area, land is used as rangeland and partly as dry farmland. Class II land is 22% of total irrigable area. Class II land extends in the flat alluvial plains along the outfow tributaries from the area. All Class II lands are used for irrigated apple orchard. Major limitation of Class II land are slow permeability and heavy or very heavy surface texture. Most of Class III land, 43% of the irrigable land, is located in the gentle slopping high lands moderately elevated from the outflow tributaries. Most area of Class III land, where irrigation water can reach, is also used for apple tree orchard. Major limitations of Class III land are slow permeability, 15-35% of coarse gravel and stones in the topsoil, and overall and transversal slopes to 8% gradient. Class IV land locates mostly at the foots of mountain slopes and the highly elevated lands from the outfow tributaries. Class IV land, 35% of the irrigable land, is mostly used as rangeland for livestock. Major limitations of Class IV land are slow permeability, coarse gravels of about 15% to 35%, weathered Calcareous marl within a depth of 10 to 15cm, overall and trasversal slopes 5-8%, strong micro relief, and moderate surface erosion.

(6) Land Class in Tang Sorkh

Total irrigable land of Class II to IV is about 1,120ha equivalent to 17% of total sub-basin area. Class I land is not existing also in this area. Present irrigated area is 474ha that is equivalent to 42% of total irrigable area. Irrigated ratio is high following to Vastegan. Apple trees have been recently planted along the main river extensively by drip irrigation system. Other than irrigated area, land is

used mostly as dry farmland. Total farmland both of irrigated and dry farming is 724ha equivalent to 65% of total irrigable area. Class II land is only 3% of total irrigable area. Class II land locates only in the narrow river terraces at the both banks along the main river. Right bank Class II land is irrigated and used for wheat and some vegetables. Left bank Class II land has not irrigation system yet even near to the river. Major limitation of Class II land is floods from the main river. Class III land shares largely 74% of the irrigable land. Class III lands are located in the alluvial fan of the main tributary and in the moderately sloping lands between the mountain slope and the river terrace at the both bank of the main river. Most area of Class III lands, where irrigation water can reach, are irrigated and used for wheat and apple tree orchard. Major limitations of Class III land are moderate to slow permeability, heavy soil texture, 35-75% of coarse gravels in the subsoil, 15-35% coarse gravels in the topsoil, 2-5% overall and transversal slopes, and moderate surface erosion. Class IV land locates mostly at the foots of mountain slopes and on the weathered marl hills in the both sides of the main river. This land is used mostly as rangeland and dry farmland. Two large scale drip irrigation systems have been recently completed in this land by MOJA and a farmer group at the left bank of the main river. Class IV land shares 23% of the irrigable land. Major limitations of Class IV land are 35-75% coarse gravels in the subsoil, 15-35% coarse stones in topsoil, very heavy surface soil texture, weathered shale within a depth of 10 to 25cm, 8-12% transversal slope, and surface erosion.

(7) Land Class in Zeras

Total irrigable land of Class II to IV is very limited. It is only about 530ha equivalent to 8% of total sub-basin area. Class I land is not only existing but also no irrigated area in this sub-basin area due to no capable water resources in the area. Class II land is 13% of total irrigable area. Class II land locates only in the small flat plateau at the eastern edge of the area. Major limitations of Class II land are slow permeability, heavy surface soil texture, 3-15% stones in the topsoil, and some gully erosion. Class III land is 54% of the irrigable land. Class III lands are located in the slopes along the edges of Class II land. Major limitations of Class III land are slow permeability, heavy surface soil texture, 15-35% of stones in the topsoil, 75% of coarse gravels in the subsoil, 5-8% overall and transversal slopes, and surface soil erosion. Class IV land locates mostly at the higher slopes than Class III. Major limitations of Class IV land are slow permeability, heavy surface soil texture, more than 75% of coarse gravels in the subsoil, 15-35% coarse gravels in topsoil, 5-8% of overall and 8-12% of transversal slope, and surface erosion. All classes of lands are used for dry farming. Other than Class II to IV lands, whole area of this sub-basin is classified into Class VI land which is none arable. In the Class VI land, dry farming and livestock ranging are heavily carried out by farmers even in the very steep slopes. Limitations of Class VI land are slow permeability, heavy surface soil texture, 3-15% coarse gravels in the topsoil, 40-70% slope, strong micro-relief and severe surface soil erosion.

8.2.3 Vegetation

Intensive field surveys and comprehensive study were done to reveal the present condition of natural vegetation in five Master Plan Areas. In field survey recent topography map, aerial photo and satellite imagery were used. And the Quadrat (plot) method was applied for vegetation investigation. In principle, fresh weight and % of area covered by each plant (grass) were determined in $1m^2$ plot, but in case of existence of shrub and tree, the plot was enlarged to 2 m^2 and 10 m^2, respectively. Data presented in this report are on dry matter basis.

Brief explanation for status of natural vegetation in five master plan areas is given below, and the relating statistics are in summary Table at end of this text. Detail information/data are presented in ANNEX G, and the prepared vegetation maps are shown in a separate volume devoted to Maps and Drawings.

(1) K4-1-9 Vastegan

About 12.7% of this area is under natural vegetation, which is of three types. A large part is comprised of shrub and forbs being distributed on areas with about 2577 m elevation and 38% slope. While grasses, are mostly seen at lower elevation and gentle slope. General slope direction of the area is W-E, inducing no much impact on vegetation status. Astragalus (milkvetch) a thorny shrub, and Bromus (brome) an annual grass each covers 24% of the area. Some other plants such as Phlomis (sage), Euphorbia (spurge), and Gundelia (artichoke) are also components of the vegetation, making it balance. Since it includes shrubs, forbs and grasses. With less amount of rain, shrub and forbs can survive, and with good rain, grasses grow fast offering feed to livestock.

Table 8-2-3-1 Status of Vegetation Types in K4-1-9 Vastegan

Vegetation		Common Name	Area (km^2)	P	CC	Condition	Trend
Code	Type						
AL	Astragalus-Lactuca	Milkvetch-Lettuce	5.83	18.0	300	Moderate	Decreasing
BA	Bromus-Agropyron	Brome-Wheatgrass	3.54	16.0	270	Poor	Decreasing
EL	Eryngium-Lactuca	Eryngo-Lettuce	2.05	22.9	381	Moderate	Constant

Note: P=production (ton/km^2), CC=carrying capacity (AUM/km^2), Source: JICA Study Team, Vegetation Survey, May-July 2001.

(2) K5-19a Chaman Goli-Bazoft

This is a mountainous area most of which (about 66.2%) bears no vegetation. Villages and farmlands are extended on parts with somewhat lower elevation and lesser steep slope. Only 17.7% of the area is under natural vegetation, which occurs in form of forest and wooded pasture. Forest is a vegetation cover where trees are its main component. Division and naming of forest is according to dominant trees. If grazing area possess tree and volume of trees/ha is more than 20 m^3, it is called

wooded pasture. In Bazoft grazing is done in wooded pasture where Quercus (oak) is the main tree, and Amygdalus (wild almond) is scattered. According to pastural plants growing in the area, 3 vegetation types have been identified, which their status is given in Table below. In wooded pasture where trees provide nutrient (litter) and shade, many grasses such as Bromus (brome), Poa (bluegrass), and Cirsium (thistle) grow, contributing in soil conservation and prevention of land degradation. Grasses are mostly in areas with low elevation (1689 m) and gentle slope (18%) facing north. Daphne (mezereon) a bush of no/low pasturage value is widely seen nearby roads and villages.

During field survey it was realized that many of oak trees are old, infected with pathogens (gall) and show no sign of regeneration. This can be considered as a threat to natural vegetation of the area.

Table 8-2-3-2 Status of Vegetation Types in K5-19a Chaman Goli-Bazoft

Vegetation		Common Name	Area (km^2)	P	CC	Condition	Trend
Code	Type						
QC	Quercus-Cirsium	Oak-Thistle	8.88	23.0	383	Moderate	Constant
QB	Quercus-Bromus	Oak-Brome	7.81	8.30	138	Poor	Decreasing
QP	Quercus-Poa	Oak-Bluegrass	2.06	18.30	305	Moderate	Decreasing

Note: P=production (ton/km^2), CC=carrying capacity (AUM/km^2), Source: JICA Study Team, Vegetation Survey, May-July 2001.

A piece of forestland with an area of 1.27 km^2, comprising of Quercus (oak) and Amygdalus (wild almond) occur in this sub basin. Density of forest is not uniform. In localities nearby villages/farmlands most of trees have been cut for various purposes, while remote and inaccessible locations have maintained their trees. The elevation of forestland ranges between 1550 to 1690 meters.

(3) K7-0-19-1 Sarbaz

The vegetation of this sub basin is comprised of 8 types, mainly of shrubs Astragalus (milkvetch) and forbs Gundelia (artichoke), and is distributed in localities with elevation ranges of 2400-2600 m, and slope of 22-39% with S-N direction. Major grasses are Bromus (brome) and Agropyron (wheatgrass) being distributed mostly on areas with slope of 19-23%. In an average, about 49.6 % of land area is covered by vegetation, and the remaining 50.4% is of non-vegetative materials such as rock and bare soil. See ANNEX G for detail. Presence of Daphne (mezereon) in vegetation composition indicates decline in soil fertility of the area.

Table 8-2-3-3 Status of Vegetation Types in K7-0-19-1 Sarbaz

Vegetation		Common Name	Area (km^2)	P	CC	Condition	Trend
Code	Type						
AA	Astragalus-Agropyron	Milkvetch-Wheatgrass	6.32	12.3	200	Poor	Decreasing
AG	Astragalus-Gundelia	Milkvetch-Artichoke	15.58	15.0	250	Poor	Decreasing
AH	Astragalus-Hordeum	Milkvetch-Wildbarley	2.00	21.5	358	Moderate	Constant
AL	Astragalus-Lactuca	Milkvetch-Lettuce	11.09	8.0	133	Poor	Decreasing
DA	Daphne-Astragalus	Mezereon-Milkvetch	4.52	10.5	175	Poor	Decreasing
EG	Eryngium-Gundelia	Eryngo-Artichoke	1.69	18.0	300	Moderate	Constant
GL	Gundelia-Lactuca	Artichoke-Lettuce	8.41	25.1	410	Moderate	Constant
GE	Gundelia-Eryngium	Artichoke-Eryngo	4.31	31.0	516	Moderate	Constant

Note: P=production (ton/km^2), CC=carrying capacity (AUM/km^2), Source: JICA Study Team, Vegetation Survey, May-July 2001.

(4) K7-48 Tang Sorkh

In this sub basin 31.18km^2 (47.7% of total area) is under natural vegetation, being comprised of trees such as Quercus (oak), shrub, forbs and grasses. Trees provide litter (nutrient) and shade, therefore many grasses grow in the area, enriching the natural vegetation, which plays important roles in providing herbage to livestock, maintenance of biological balance, and prevention of soil erosion. In addition to dominant vegetation types mentioned in Table below, some other plants such as Hordeum (wildbarley), Agropyron ((wheatgrass), Stipa (needlegrass), Euphorbia (spurge), Lactuca (lettuce) and phlomis (sage) also grow in this sub basin. Major potion of vegetation is on localities having elevation more than 2200 m and slope more than 40%. Due to occurrence of high % of rock and stone, percentage of vegetation cover is only about 40.

During field survey it was realized that most of shrubs are deformed, and some localities are severely degraded and left as wastelands. These indicate the overexploitation of natural vegetation.

Table 8-2-3-4 Status of Vegetation Types in K7-48 Tang Sorkh

Vegetation		Common Name	Area (km^2)	P	CC	Condition	Trend
Code	Type						
AB	Astragalus-Bromus	Milkvetch-Brome	11.94	31.0	516	Moderate	Constant
AG	Astragalus-Gundelia	Milkvetch-Artichoke	10.77	19.0	316	Moderate	Decreasing
GB	Gundelia-Bromus	Artichoke-Brome	2.61	10.5	175	Poor	Decreasing
QG	Quercus-Gundelia	Oak-Artichoke	5.86	33.8	563	Moderate	Constant

Note: P=production (ton/km^2), CC=carrying capacity (AUM/km^2), Source: JICA Study Team, Vegetation Survey, May-July 2001.

(5) K8-28 Zeras

In this sub basin natural vegetation is comprised of 9 types, which occupies 33.61 km^2 (52.7%) of total area, of which 14.08 km^2 is wooded pasture where Quercus (oak) is the main tree. Vegetation is chiefly distributed on localities with elevation more than 1000 m, and slope more than 40%, being susceptible to water and wind erosion. Presence of high % of bare soil indicates that the natural vegetation is under heavy grazing pressure, getting no opportunity to expand itself in the area. In localities where oak trees provide litter and shade, plants such as Avena (oatgrass), Phalaris (canarygrass), and Agropyron (wheatgrass) grow, which offer herbage to herds and help in soil conservation. Other relevant information and data are tabulated below, as well provided in ANNEX G of this report.

Table 8-2-3-5 Status of Vegetation Types in K8-28 Zeras

Vegetation		Common Name	Area (km^2)	P	CC	Condition	Trend
Code	Type						
AB	Astragalus-Bromus	Milkvetch-Brome	5.29	23.1	385	Moderate	Decreasing
AE	Astragalus-Euphorbia	Milkvetch-Spurge	2.16	11.0	183	Poor	Decreasing
AP	Astragalus-Prangos	Milkvetch-Opoponax	1.48	22.5	375	Moderate	Constant
SH	Stipa-Hordeum	Needlegrass-Wildbarley	4.74	30.5	509	Moderate	Decreasing
EA	Eryngium-Aegilops	Eryngo-Goatgrass	4.31	18.5	308	Moderate	Decreasing
OE	Onopordon-Echinops	Cottonthistle-Globethistle	1.55	14.6	243	Poor	Decreasing
QC	Quercus-Cirsium	Oak-Thistle	8.11	12.6	211	Poor	Decreasing
QH	Quercus-Hordeum	Oak-Wildbarley	4.40	21.3	355	Moderate	Decreasing
QB	Quercus-Bromus	Oak-Brome	1.57	10.7	178	Poor	Decreasing

Note: P=production (ton/km^2), CC=carrying capacity (AUM/km^2), Source: JICA Study Team, Vegetation Survey, May-July 2001.

Table 8-2-3-6 Summary of Vegetation Status in Master Plan Areas

Mater Plan Area	Rangeland Area (km^2)	Overall		Per km^2	
		P	CC	P	CC
K4-1-19 Vastegan	11.42	208.5	3,475	18.2	304
K5-19a Chaman Goli- Bazoft	18.75	306.8	5,113	16.3	272
K7-0-19-1 Sarbaz	53.92	865.7	14,429	16.1	268
K7-48 Tang Sorkh	31.18	604.2	10,069	19.4	323
K8-28 Zeras	33.61	638.9	10,648	19.0	316

Note: P=production (ton/km^2), CC=carrying capacity (AUM/km^2), Source: JICA Study Team, Vegetation Survey, May-July 2001.