10.3.2 River Treatment

Lower reaches of Gusale Bar River bends sharply before entering into Bazoft River. Especially at around 800 m upstream of the confluence, there are two sharp bends and the riverbank erosion is so severe here that the riverbanks are extended into the farmland. The right bank of Bazoft River, just downstream of the confluence with Fariak River, farmland is eroded mainly because of the direction of river course of Bazoft. Countermeasures are planned on these locations as follows;

(1) Lower Reaches of Gusale Bar River

Riverbank erosion is so severe here because of the sharp bend of the river course, energy of the flooded water, and riverbank material being composed of riverbed sediment. Two ground sills and several spur dikes are planned for the bank protection.

Two groundsills are placed just at immediate upstream of the first and the second bend from the bridge on the main road, while spur dikes are arranged at the two bends so as to keep away the water course from both banks and to protect land and farmland adjacent to the river.

(2) Right bank of Bazoft

Bazoft River bends sharply at this location and a narrow valley is located just upstream, therefore, floodwater hits to the right bank of Bazoft and causes erosion. Villagers of Fariak cultivate this bank and gabion type bank protection by people's participation is planned on this section, from the confluence with Fariak River to that of Gusale Bar River. The length of bank protection is around 500 m. The locations of these two river bank profeetion areas are shown in Figure 10-3-1-1 and the structure are illustrated in ANNEX-E.

10.3.3 Landslide Protection and Rock-fall Protection

(1) Landslide Protection

Landslide occurs on the left bank of Gusale BarRiver, the vicinity of Tabarak sofla and Ghale Tabarak, and south of Chemghaleh.

Leaving aside the geological condition, the main cause of these landslides is saturation of surface water fed by rainfall of snow melt, which makes the slope unstable. Therefore, the countermeasures planned here is the drainage system comprised of vertical/horizontal ditch and drop chute. On the other hand, the main cause of landslides along the river is riverbank erosion at the foot of the slope. In such cases, check dams are effective in order to prevent vertical/horizontal erosion of the river course and stabilize the foot of landslide slope.

The vertical and horizontal ditches are aligned in and around the landslide area, and drop chutes are allocated at every 20 m on the vertical ditches. As for the landslides on the Tabarak River, only check dams are allocated because they won't cause direct damage to houses, roads and farmland. The road distance to be protected is around 6 km.

(2) Rock-fall Protection

On the upper and middle reaches of Gusale Bar River, the main road runs along the left bank, where steep slope is formed with Marl and sandstone layers. Rock fall sometimes occur on this slope and causes damage on houses of Kachooz and the main road especially after heavy rain.

Retaining wall type rock fall protection is planned here in order to protect the houses along the road. The space between the road and the slope is not enough to make embankment type protection. The planned rock fall protection is 3 m height with rubble concrete and the length of implementation is around 100 m. Deposit behind the protection, should be removed periodically. Around five houses and 100 m of road distance are to be protected.

The locations of landslide protection and rock-fall protection are shown in Figure 10-3-1-1 and the structures are illustrated in ANNEX-E.

10.3.4 Soil Erosion Protection

In Chaman Goli-Bazoft, present basin-wise erosion rate is estimated at 17.7 t/ha/yr or 1.3 mm/yr, that is the lowest following Sarbaz. The soil loss is concentrated in rangeland and dry farmland as shown in Table 10-3-4-6. Dry farmland soil loss is estimated at 25.3 t/ha/yr or 1.8 mm/yr and rangeland soil loss is at 33.8 t/ha/yr or 2.4 mm/yr that are equivalent to 1.4 and 1.9 times of the basin-wise soil less. The basin-wise soil loss will be reduced to 14.1 t/ha/yr or 1.0 mm/yr in future.

(1) Allowable Soil Loss

As mentioned in Section 8.7.3 and shown in Table 8-7-3-9, problematic land use categories are dry farmland and rangeland from an aspect of soil erosion. There are no problems on soil erosion such as in the irrigated farmland, orchard and tree plantation. There is no particular standard for the allowable soil loss in Iran. As the allowable annual soil loss for the farmland, 10 to 15 t/ha is considered in Japan, and US Department of Agriculture indicates 4.5 to 11.2 t/ha. Taking steepness of topography in the Study Area into consideration, 15 t/ha/yr is considered to be allowable soil loss in the Study Area. In case this standard is applied, dry farmland of about 2,900 ha or 78% of total dry farmland and rangeland of 12,800 ha or 85% of total rangeland are to be protected from soil erosion as shown in Table 10-3-4-1.

Table 10-3-4-1 Areas to be protected from Soil Erosion in the Study Areas

Area	Dry Farmland			Rangeland		
	Total (ha)	Problem (ha)	Ratio (%)	Total (ha)	Problem (ha)	Ratio (%)
Vastegan	63	0	0%	1,142	1,035	91%
Chaman Goli-Bazoft	1,148	798	70%	2,002	1,606	80%
Sarbaz	208	162	78%	5,392	3,668	68%
Tang Sorkh	208	128	62%	3,118	3,118	100%
Zeras	2,141	1,848	86%	3,361	3,361	100%
Total	3,768	2,936	78%	15,015	12,788	85%

(Note) Soil loss of problem area exceeds the allowable level of 15 t/ha/yr.

(2) Protection Measures

For the dry farmland, contour bund method will be selected as the protection measures in the Study Area from the following aspects:

- Contour bund is easy and cheep for construction, and it is suited for the people's participation work.
- It is also easy in maintenance and repaire by people.
- It is already practiced and constructed by stone where stony soils are extended.
- Soil is too shallow for terracing and it is expensive except orchard terracing.
- Local materials such as stone and gravel are able to be fully utilized.

It is recommended to employ vegetative contour bund or contour hedges in the steep slopes over 40% inclination, because structural works are difficult in such steep slopes. Vetiver grass is recommended for this purpose. In case difficulties arise only by contour bund, crop diversification should be considered such as introduction of dry type alfalfa instead of wheat or in fallow land.

For the rangeland, two different measures are undertaken as mentioned in Section 10.2.3. The measures are:

- Seeding for the deteriorated rangelands where the slope is less than 40% from a viewpoint of accessibility.
- Protection for the rangelands with less deterioration and the rangeland where the slope exceeds 40%.

It is difficult to set up the standard of allowable soil loss for the rangeland, because it depends on the improvement effects of protection and seeding. Figure 10-3-4-1 shows the effects of protection and seeding in the rangeland.

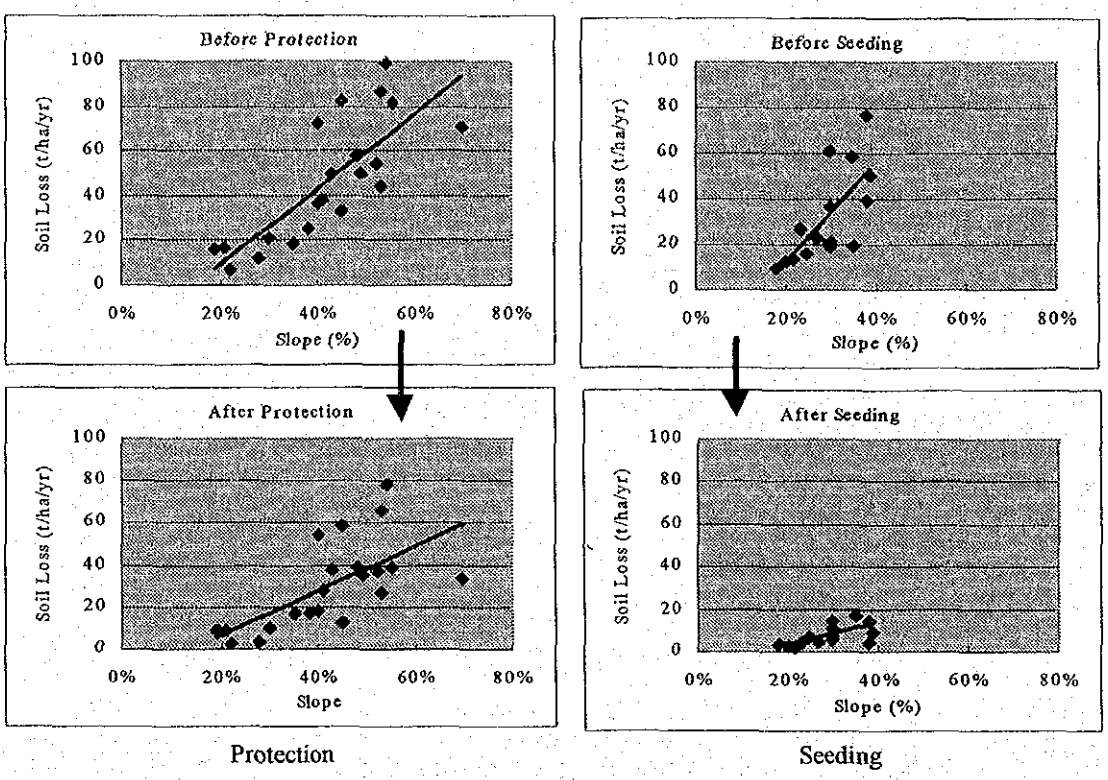


Figure 10-3-4-1 Improvement Effects on Soil Protection in the Rangeland

As shown in Figure 10-3-4-1, the measure by seeding makes drastic effects on soil protection and reduces the soil loss less than 15 t/ha/yr. On the other hand, the effects of protection are rather limited as shown in the Figure, because the restoration by protection is limited within 15% of the rangeland. If the rangeland is severely deteriorated and covered by the large extent of bare soil, vegetation can not be recovered only by protection. Figure 10-3-4-2 shows the correlation of soil loss and bare soil ratio after protection.

As shown in the Figure, large extent of bare soil remains, partly over 40%, and causes a large quantity of soil loss even after protection. If vegetation is restored and bare soil ratio is possibly reduced to zero, soil losses are able to be reduced within 15 t/ha/yr in all rangelands. However, it is necessary to develop the practical measures of seeding in the highly inclined slopes for this purpose. It is strongly recommended to set this subject as one of the most important subjects for the Futher Study as discussed in Paragraph (6) in Section 8.7.3.

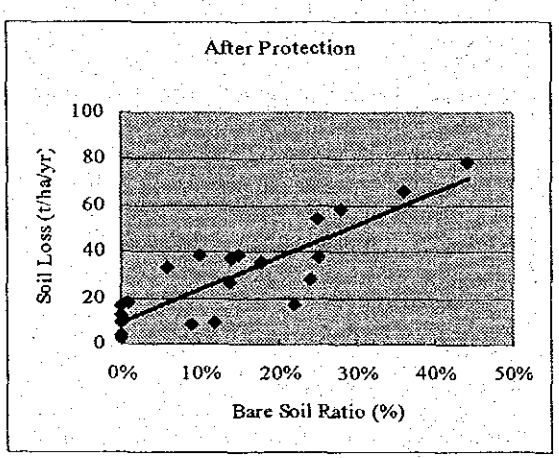


Figure 10-3-4-2 Bare Soil Ratio and Soil Loss after Protection

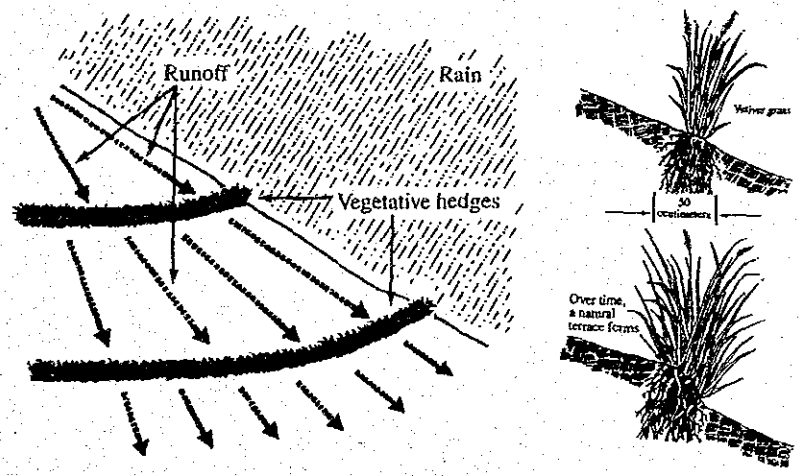
In this Study, it is, therefore, set the standard of effects by vegetation restoration as below:

- Seeding is able to reduce the soil loss within 15 t/ha/yr in all rangelands.
- Protection is able to reduce the soil loss, but the effects are rather limited and depending on the degree of deterioration of rangeland.

(3) Introduction of Vetiver Grass for Soil Protection

Vetiver grass is not common yet in Iran, but it is utilized widely in the world such as in India, Pakistan, China and many countries in Africa. It has the following characteristics on soil and moisture conservation.

1) It grows under wide conditions ranging from 200 mm to 6,000 mm of annual rainfall and at 2,600 meters above sea level.
2) It survives in snow and frost as low as –9°C, and grows on most type of soils.
3) It does not produce viable seeds or practically sterile. It has to be planted vegetatively, meaning that it will not become a weed in the farmland. However, it is not suited for the rangeland because it is generally unpalatable to livestock and its growth is not able to be controlled in the rangeland.
4) It is extremely drought tolerant. The slips for planting have withstood 60 days without rain.
5) In dry areas, it normally takes two to three seasons with constant 'gap-filling' to establish the hedge.
6) Once established, maintenance cost is virtually zero.
7) It is resistant not only to fire but to most pests and diseases.
8) So called vetiver oil can be taken from the roots, which is used as materials for perfume and medicine.
9) The main constraint is not yet common in Iran and lack of nurseries and planting materials.



(Source) Institute of Natural Resources, The southern Africa Vetiver Network

Figure 10-3-4-3 Vegetative Slope Protection in the Steep Slope

It is reported that nursery propagation of Vetiver grass increases the number of slips of about 60 with three harvests per year, giving of 3.75 million slips/ha from a typical nursery planting density of 62,500 slips/ha. It is, therefore, able to produce vetiver grass in low cost. Most cost will be transportation and planting.

(4) Waterway and Gully Protection

Once contour bund is established in the land, rain water runs slower along the contour bund and the time of flood concentration becomes generally longer and the flood peak is reduced. It is safer to the downstream, but runoff discharge concentrates to the outlet from the tail of contour bund. Therefore, the riprap may be needed at the outlet to protect it and to avoid erosion. Due to gravelly soil in the area, the bottom of waterway is generally protected by the deposit of gravel and stone.

On the other hand, gully erosions are observed in the dry farmlands in Chaman Goli-Bazot and Zeras. Such farmlands are necessary to be protected from gully erosion. For protecting land from gully erosion, there are two different ways. One is by check dam and the other is by vegetative way such as vetiver grass to protect the side slope of gullies. Vegetative way is not yet well experienced in Iran. Consequently, check dam has been considered for protecting the farmland from gully erosion in this Study. In case of check dam, the formula of Heede is generally applied for spacing the check dams.

$$Spacing = \frac{HE}{K * \tan\theta * \cos\theta}$$

$Spacing$ = Spacing of check dams (m)

HE = Dam height (m)

K = constant 0.3 for $\tan\theta = 0.2$, 0.5 for more than $\tan\theta = 0.2$

(Source) Soil Erosion and Conservation, RPC Morgan

According to the formula of Heede, spacing of check dam is calculated as shown in Table 10-3-4-2.

Table 10-3-4-2 Check Dam Spacing in Gully

Gully slope		Spacing (m) by Dam Height (HE m)					
(%)	(degree)	0.5	1	1.5	2	2.5	3
5%	2.9	33	67	100	133	167	200
7.5%	4.3	22	45	67	89	111	134
10%	5.7	17	33	50	67	84	100
12.5%	7.1	13	27	40	54	67	81
15%	8.5	11	22	34	45	56	67
17.5%	9.9	10	19	29	39	48	58
20%	11.3	5	10	15	20	25	31
25%	14.0	4	8	12	16	21	25
30%	16.7	3	7	10	14	17	21

(Note) Check dam spacing by the formula of Heede.

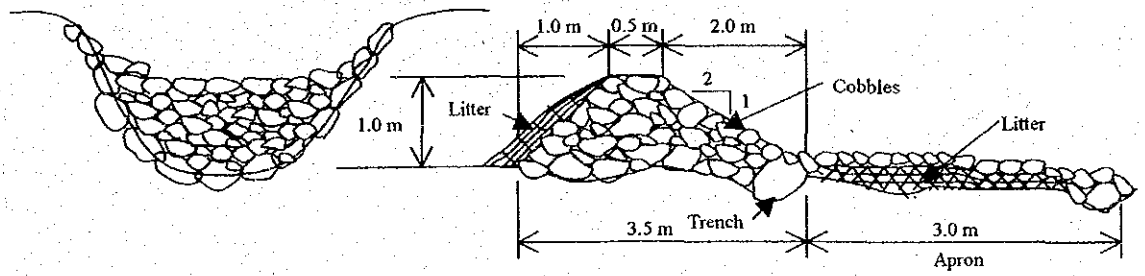
As shown in the table, many check dams are necessary due to short spacing in case of steeper slope

than 20%. It is, therefore, recommended to employ following criteria on construction of check dams taking participation of villagers into consideration.

1) From viewpoint of economic effect and villagers' participation, check dams are considered to be concentrated in the farmland and to the smaller gullies. In this case, villagers are expected to attain the protection work to protect and save the farmland by themselves.

2) On the other hand, large gullies are existing and enlarging at the foot of hills and mountains. Those gullies are also working as the main outlet streams of the area. Some of them may cause serious damages not only to the farmland but also to the villages. Such gullies are difficult for villagers to control. For the large gullies, gabion type of check dam will be employed taking flexibility and safety into account as shown in Figure E-2-16 in Annex E. Those large check dams will be constructed as public works.

3) For the smaller gullies, loose-rock check dam will be employed from the viewpoints of easiness of construction and availability of materials. As a standard, the loose-rock check dam with a height of 1.0 m and a space of 20 m will be considered to the gullies less than 20 % gradient. The loose-rock check dam is as shown in Figure 10-3-4-4.



(Note: referring to "Soil Erosion & Conservation" RPC Morgan, 1993)

Figure 10-3-4-4 Loose-Rock Check Dam for the Small Gullies

In case new gullies are found in farmland, lower height loose-rock check dams like as a height of 0.5 m will be constructed by farmers' themselves. Such new gullies are able to be protected in early stage and not enlarged more.

(5) Plan of Approach to Surface Erosion Protection

It is not right way to approach to establish the surface erosion protection plan only from the severity of present erosion conditions. It is necessary to approach taking the future plans of agriculture and rangeland improvement into account. Agriculture development plan Scenario-1 has been prepared from the aspects of present farming system and future requirement. On the other hand, rangeland

improvement plan has been established in order to increase productivity of grasses for livestock in the various type of rangelands.

For the Scenario-1, soil protection plan was prepared according to the Agriculture Development Plan and the Rangeland Improvement Plan. However, in some farmlands especially with a steeper slope, it is difficult to keep the soil loss within the allowable level only by contour bund. In such case, it is considered to change crops to more protective crops such as dry type alfalfa or tree crops as well as to reduce the fallow land where the farmlands are left without cultivation. On such considerations, Senario-2 has been prepared.

For the rangeland improvement, further improvement plan was not prepared as explained in Paragraph (2) in this Section, because structural measures for the rangeland are not yet proved from the technical and economical aspects. It is recommended to experiment on possibility of seeding measures in the steep rangeland in the Further Study as described in Paragraph (6) in Section 8.7.3.

(6) Prospect of Soil Erosion Protection in Scenario-2 in 5 Master Plan Areas

In order to prospect the results of soil erosion protection plans of 5 Master Plan areas in Scenario-2, important elements of plan have been summarized as shown in Table 10-3-4-3.

Table 10-3-4-3 Prospect of Soil Loss of 5 Master Plan Areas in Scenario-2

Land Use	Area of 5 Master Plan Areas by Soil Loss Amount (ha)								Average Soil Loss (t/ha/yr)	
	Trace	Little	Moderate	Fair	High	Severe	Very Severe	Total		
(t/ha/yr)	(0-5)	(5-10)	(10-15)	(15-20)	(20-30)	(30-50)	(50-)		Present	Future
(mm/yr)	0-0.4	0.4-0.7	0.7-1.1	1.1-1.4	1.4-2.1	2.1-3.6	3.6-		[P]	[F]
Farmland	6,904	505	3,137	0	0	0	0	10,546	12.7	5.1
Irri. Farmland	4,427	0	0	0	0	0	0	4,427	0.5	0.5
Orchard	2,462	23	0	0	0	0	0	2,485	0.8	0.8
Dry Farmland	15	482	3,137	0	0	0	0	3,634	34.1	13.7
Tree Plantation	87	4	0	0	0	0	0	91	0.5	0.5
Rangeland	4,042	3,267	1,431	1,273	303	2,383	2,218	14,917	42.5	21.9
Rock	0	10,360	7,491	0	0	2,184	1,855	21,890	17.7	17.7
Others	911	315	0	0	0	0	0	1,226	10.3	2.0
Total	11,944	14,451	12,059	1,273	303	4,567	4,073	48,670	24.0	15.8
	(Ratio of Area)								15 t/ha<	[F]/[P]
Farmland	65%	5%	30%	0%	0%	0%	0%	100%	0%	40%
Irri. Farmland	100%	0%	0%	0%	0%	0%	0%	100%	0%	100%
Orchard	99%	1%	0%	0%	0%	0%	0%	100%	0%	100%
Dry Farmland	0%	13%	86%	0%	0%	0%	0%	100%	0%	40%
Tree Plantation	96%	4%	0%	0%	0%	0%	0%	100%	0%	100%
Rangeland	27%	22%	10%	9%	2%	16%	15%	100%	41%	52%
Rock	0%	47%	34%	0%	0%	10%	8%	100%	18%	100%
Others	74%	26%	0%	0%	0%	0%	0%	100%	0%	19%
Total	25%	30%	25%	3%	1%	9%	8%	100%	21%	66%

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

The Table shows the total area of 5 Master Plan areas and classification by soil loss rate. As shown in the table, erosion of all dry farmland will decrease below the allowable level of 15 t/ha/yr (1.1

mm/yr) in Scenario-2. It will be reduced to 13.7 t/ha/yr (1.0 mm/yr) that is about 40% of the present soil loss level. On the other hand, erosion of rangeland still remains above the allowable level. Its soil loss rate will be 21.9 t/ha/yr exceeding about 7 t/ha/yr than the allowable level. About 41% or 6,200 ha of rangeland will remain above the allowable level. It is less than a half of present area of 12,800 ha that exceeds the allowable level. The soil loss rate will decrease to 52% of the present level that is 42.5 t/ha/yr.

Other than dry farmland and rangeland, about 18% or 4,039 ha of the rock mountains receives heavy erosion and disposes a lot of sediment. It locates in the upstream basin of Vastegan. It is formed of marly formation and it is difficult to protect the erosion of this formation by the present level of technology.

(7) Benefit of Surface Erosion Protection

Farmland price is about R4,000/m^2 by interview in the Study area. Based on this price, soil value is estimated at R40,000,000/ha for topsoil of 30 cm depth. When a depth of 1 mm could be saved in a year, benefit of surface erosion protection becomes R133,000/ha/yr.

(8) Plan of Surface Soil Erosion Protection in Chaman Goli-Bazoft

Present erosion and proposed erosion protection in Chaman Goli-Bazoft are summarized in Table 10-3-4-6, and its proposed plan is illustrated in Figure 8-2 in Database Map. Erosion rate will be improved from 17.7 t/ha/yr (1.3 mm/yr) at present to 14.1 t/ha/yr (1.0 mm/yr) in future in the sub-basin basis.

1) Surface Erosion Protection of Farmland

- Irrigated Farmland

  The irrigated farmlands are 593 ha in this area, and those are equipped with the furrow irrigation system in the flatter area of around 5% slope and with the small-scale basin irrigation system in the sloping area more than 13% slope. Stone contour bunds are provied by the traditional way in the both irrigation systems. Although some soil loss is observed in the furrow irrigation system, erosion of the irrigated farmland is kept rather small at 1.4 t/ha/yr (0.1 mm/yr) within the allowable level. In Senario-1, the area of irrigated farmland is increased to 640ha by the improvement of irrigation system. Dry farmland of 47 ha, where the irrigation system can be extended easyly, is converted to the irrigated farmland.. Although the selected dry farmland for irrigation belongs to the class IV land for irrigation, it is selected from a viewpoint of locality of irrigation canal system. (see Figure 10-2, Database Map) In Scenario-1, irrigated wheat of 111 ha in the irrigated farmland and dry type wheat of 47 ha in the convented dry farmland are converted to irrigated alfalfa in order to promote milk cow feeding.

- Dry farmland and Forest with Dry Farming

In the dry farmland and the forest with dry farming, where the slopes are more than 13%, erosion rate exceeds the allowable level of 15 t/ha/yr as shown in Table 10-3-4-6. Therefore, three different contour bunds of 30 m, 20 m and 15 m intervals are proposed in Scenario-1 for the lands of 13-20%, 20-30% and 30-40% inclination respectively. However, it is difficult to reduce erosion rate below the allowable level only by the contour bund in some steep lands. Consequently, it is proposed to convert 64 ha of wheat to dry type alfalfa.

For the surface soil erosion protection of farmland, contour bund provision of 25 m interval in average is proposed in 798 ha of the dry farmland and the forest with dry farming as well as crop diversification to alfalfa. Annual erosion rate is reduced form 32.4 t/ha (2.31 mm) to 13.3 t/ha (0.95 mm). Plan of soil erosion protection for farmland is summarized as follows:

Table 10-3-4-4 Surface Erosion Protection for Dry Farmland in Chaman Goli-Bazoft

Area	Type of Farmland	Slope	Facility	Alfalfa Introduction	Soil Loss	
(ha)					Present	Senario-2
798	Dry farmland	13%-40%	Contour Bund	62ha	32.4 t/ha/yr	13.3 t/ha/yr
	Forest with Dry Farming		(25 m interval in average)		2.31 mm/yr	0.95 mm/yr

2) Rangeland Protection

In the rangeland, vegetation improvement plan by protection and seeding was proposed as shown in Table 10-3-4-5.

Table 10-3-4-5 Proposed Rangeland Improvement in Chaman Goli-Bazoft

Rangeland		Area		Bare Soil Ratio		Soil Loss			
Veg.	Slope	Present	Sce.-2	Present	Sce.-2	Present		Scenario-2	
Zone	(%)	(ha)	(ha)	(%)	(%)	(t/ha)	(mm)	(t/ha)	(mm)
Protection									
QB-2	40%	385	385	16%	1%	36.1	2.58	18.1	1.29
QC-1	35%	129	129	3%	0%	18.8	1.34	16.7	1.19
QC-2	40%	343	343	40%	25%	72.2	5.16	54.2	3.87
Ave.	38%	857	857	20%	9%	42.4	3.03	29.7	2.12
Seeding									
QB-1	18%	396	396	16%	0%	8.8	0.63	3.8	0.27
QC-1	35%	248	248	3%	0%	18.8	1.34	16.7	1.19
QC-2	35%	168	168	40%	0%	58.3	4.16	16.7	1.19
QP	30%	206	206	9%	0%	21.1	1.51	14.6	1.04
Ave.	30%	1,018	1,018	17%	0%	26.8	1.91	13.0	0.92
Total	33%	1,875	1,875	18%	4%	33.8	2.41	20.9	1.49

As shown in the table protection is carried out in 857ha and seeding is in 1,018ha, totally in 1,875ha. The annual erosion rate of rangeland is improved from 33.8 t/ha (2.4 mm) to 20.9 t/ha (1.5 mm) in total average. Seeding is able to reduce erosion from 27t/ha to 13 t/ha, that is below the

allowable level, while protection is not able to reduce erosion enough. The erosion decreases from 42t/ha only to 30t/ha by protection. The erosion of QC2 vegetation zone is very high as 54t/ha even after protection. Since bare soil ratio of QC2 remains at 25% even after protection, it is difficult to reduce erosion rate enough. However, erosion rates of almost rangelands except QC2 are able to be reduced below or close to the allowable level.

3) Gully Protection

Dorak village, located on the left bank of Gusale Bar River, has severe gully erosion on the slopes behind the village. The gully causes a lot of damage to the farmland and makes it difficult to continue cultivation.

Gully protection is planned to protect the farmland in laying the loose-rock check dams in the gully. Ten gullies with the average length of 150 m are selected for implementation. The check dams of 75 numbers will be allocated at every 20 m in the gullies. By the provision of those check dams, the farmland of about 30 ha will be protected in the surroundings of Dorak village.

Table 10-3-4-6 Summary of Soil Erosion Protection in Chaman Goli-Bazoft

Development Stage / Land Use	Slope	Crop	Present Conditions: Area (ha)	Conservation: Facility	Conservation: Dist. (m)	Soil Loss: (t/ha)	Soil Loss: (mm)	Area (+) (-)	Senario-1: Area (ha)	Senario-1: Conservation: Facility	Senario-1: Conservation: Dist. (m)	Senario-1: Soil Loss: (t/ha)	Senario-1: Soil Loss: (mm)	Area (+) (-)	Senario-2: Area (ha)	Senario-2: Conservation: Facility	Senario-2: Conservation: Dist. (m)	Senario-2: Soil Loss: (t/ha)	Senario-2: Soil Loss: (mm)
Farmland																			
IFL (Irrigated Farmland)																			
	5%-13%	Wheat	165	Furrow Irri.	50	4.5	0.32	27	192	Furrow Irri.	50	4.1	0.29		192	Furrow Irri.	50	4.1	0.29
		Alfalfa	17					20	37						37				
	13%-20%	Wheat	254	Basin Irri.	2	0.0	0.00	-19	235	Basin Irri.	2	0.0	0.00		235	Basin Irri.	2	0.0	0.00
		Alfalfa	26					19	45						45				
	20%-30%	Wheat	63	Basin Irri.	2	0.0	0.00	-63	0	Basin Irri.	2	0.0	0.00		0	Basin Irri.	2	0.0	0.00
		Alfalfa	6					63	69						69				
	30%-40%	Wheat	56	Basin Irri.	2	0.0	0.00	-56	0	Basin Irri.	2	0.0	0.00		0	Basin Irri.	2	0.0	0.00
		Alfalfa	6					56	62						62				
	Total	Wheat	593			1.4	0.10	47	640			1.5	1.50		640			1.5	1.50
		Wheat	538			1.5	0.11	-111	427			2.2	2.20		427			2.2	2.20
		Alfalfa	55			0.1	0.01	158	213			0.1	0.10		213			0.1	0.10
DFL (Dry Farmland)																			
	5%-13%	Wheat	277	none	100	9.2	0.66	-47	230	none	100	9.2	0.66		230	none	100	9.2	0.66
	13%-20%	Wheat	163	none	100	21.5	1.54		163	Contour bund	30	10.8	0.77		163	Contour bund	30	10.8	0.77
	20%-30%	Wheat	79	none	100	37.8	2.70		79	Contour bund	20	15.9	1.14		79	Contour bund	20	15.9	1.14
	30%-40%	Wheat	5	none	100	53.6	3.83		5	Contour bund	15	20.8	1.49	-2	3	Contour bund	15	13.4	0.96
		D. Alfalfa	0						0					2	2				
	Total		524					-47	477					0	477				
		Wheat	524			17.8	1.27	-47	477			11.0	0.79	-2	475			10.9	0.78
		D. Alfalfa	0					0	0					2	2				
FDF (Forest with Dry Farmland)																			
	5%-13%	Wheat	73	none	100	8.9	0.64		73	none	100	8.9	0.64		73	none	100	8.9	0.64
	13%-20%	Wheat	306	none	100	24.3	1.74		306	Contour bund	30	12.6	0.90		306	Contour bund	30	12.6	0.90
	20%-30%	Wheat	186	none	100	42.0	3.00		186	Contour bund	20	18.0	1.29	-37	149	Contour bund	20	14.8	1.06
		D. Alfalfa	0						0					37	37				
	30%-40%	Wheat	59	none	100	65.9	4.71		59	Contour bund	15	25.5	1.82	-25	34	Contour bund	15	15.8	1.13
		D. Alfalfa	0						0					25	25				
	Total		624						624						624				
		Wheat	624			31.7	2.26		624			15.0	1.07	-62	562			13.1	0.94
		D. Alfalfa	0						0					62	62				
Total of DFL and FDF			1,148			25.3	1.81		1,101			13.2	0.94		1,101			12.2	0.87
	5%-13%		350	none	100	9.1	0.65		303	none	100	9.2	0.66		303	none	100	9.2	0.66
	13%-20%		469	none	100	23.3	1.66		469	Contour l	30	12.0	0.86		469	Contour l	30	12.0	0.86
	20%-30%		265	none	100	40.8	2.91		265	Contour l	20	17.3	1.24		265	Contour l	20	15.1	1.08
	30%-40%		64	none	100	64.9	4.64		64	Contour l	15	25.2	1.80		64	Contour l	15	15.6	1.11
Orchard																			
	20%-30%	Apple	23	Bench Terrace	5	5.2	0.37		23	Bench Terrace	5	5.2	0.37		23	Bench Terrace	5	5.2	0.37
Rangeland																			
	QC-1 35%		377	none	110	18.8	1.34		129	protect	110	16.7	1.19		129	protect	110	16.7	1.19
									248	seeding	110	16.7	1.19		248	seeding	110	16.7	1.19
	QC-2 35%		168	none	110	58.3	4.16		168	seeding	110	16.7	1.19		168	seeding	110	16.7	1.19
	40%		343	none	110	72.2	5.16		343	protect	110	54.2	3.87		343	protect	110	54.2	3.87
	QB-1 18%		396	none	110	8.8	0.63		396	seeding	110	3.8	0.27		396	seeding	110	3.8	0.27
	QB-2 40%		385	none	110	36.1	2.58		385	protect	110	18.1	1.29		385	protect	110	18.1	1.29
	QP 30%		206	none	110	21.1	1.51		206	seeding	110	14.6	1.04		206	seeding	110	14.6	1.04
Total			1,875			33.8	2.41		1875			20.9	1.49		1875			20.9	1.49
QA (Forest)																			
	30%-40%		127	none	110	37.5	2.68		127	protect	110	22.9	1.64		127	protect	110	22.9	1.64
Farmland			1,764			17.0	1.21		1,764			8.9	0.64		1,764			8.2	0.59
Rangeland			1,875			33.8	2.41		1,875			20.9	1.49		1,875			20.9	1.49
Forest			127			37.5	2.68		127			22.9	1.64		127			22.9	1.64
Sub-Total			3,766			26.1	1.86		3,766			15.3	1.09		3,766			15.0	1.07
Village			32			0.0	0.00		32			0.0	0.00		32			0.0	0.00
River Bed			31			0.0	0.00		31			0.0	0.00		31			0.0	0.00
Rock			7,491			13.7	0.98		7491			13.7	0.98		7491			13.7	0.98
Sub-Total			7,554			13.6	0.97		7,554			13.6	0.97		7,554			13.6	0.97
Total			11,320			17.7	1.26		11,320			14.2	1.01		11,320			14.1	1.01
Surface Erosion Protection Project																			
			798			32.4	2.31		798	Contour Bund	25 m	14.8	1.06		798	Contour Bund	25m	13.3	0.95

(Note) 1) Detail analysis are in Table D-5-2-8(2) for Present, in Table D-5-2-9(2) for Scenario-1, in Table D-5-2-10(2) for Scenario-2.

2) 47 ha of dry farmland is conveerted to irrigated farmland by improvement of irrigation system in Scenario-1.

3) Contour bund will be introduced in the Dry Farming Land steeper than 13% slope, and dry type alfalfa of 64 ha will be introduced in Scenario-2.

4) In the Irrigated Farmland steeper than 20% slope, wheat of 110 ha has to be converted to dry type alfalfa in Scenario-2 due to high soil loss.

10.3.5 Rangeland Vegetation Improvement

Improvement of rangeland vegetation is carried out in order to mitigate over grazing and to protect soil from erosion as well as to increase productivity of fodder grasses. In this sub-basin the grazing area is in the form of wooded pasture. If grazing area possess tree and volume of trees/ha is more than 20 m3, it is technically termed as wooded pasture. The grazing areas, particularly located nearby villages, is seriously degraded and produce no sufficient herbage for livestock.

With full consideration of ecological, social and economical conditions, a "low cost" and easily applicable plan has been formulated for this area. Under this plan the parts of rangeland having less than 40% slope, are restored/improved through structural measures, while parts having more than 40% slope, with non-structure measures. Speedy promotion of quantity and quality of rangeland vegetation is desired, because more delay, means more degradation of the area. The initial implementation period, and consequent treatment cycles are set at 10 years.

Implementation of plan will start from localities with poor condition, decreasing trend and lowest herbage production. The experienced local people would perform the works, and animals (donkey) are used for transporting the required materials from village to working areas. Inhabitants of Baghchenar, Dorak, Fariak and Kachooz are expected to cooperate in vegetation improvement works.

In this sub basin total area of rangeland is 1,875 ha, which is treated as follows:

(1) *Parts with Slope less than 40%*

These parts with total area of 1,019 ha are utilized according to the following arrangement:

a) Establishment of Seed Production Plot

In first year a plot of 4 ha is established in rangeland closed to main road and nearby Dorak village. It is fenced and permanently cared by 3 persons with a 24-hour watching schedule of 8 hours each. A mixture (50:50) of seeds of Bromus (brome) and Agropyron (wheatgrass) grasses are sown at a rate of 7 kg/ha (28 kg/plot) to produce sufficient amount of seeds. These grasses are nutritious, very palatable and produce large quantity of herbage. Seeds are sown when soil contains enough moisture and climatic conditions are most favorable (spring/autumn). Shade and litter provided by trees would promote the seed germination and seedling growth.

To reduce the cost, engage the local people in development activities, and overcome the machinery limitation, most of works are done manually. At sowing time, a herd is guided into plot to disturbance the soil. The herd is dismissed, then seeds are sown, and again herd

is moved in, to hide the seeds.

The produced seeds are collected (stored) and used in rangeland improvement works, and herbage is fed to herds and other animals, which are used by the project. The amount of produced seed would be about 280 kg, because 1 seed is expected to produce 10 seeds. And amount of produced herbage is 700 kg, since with seed sowing herbage production of 175 kg/ha is expected.

b) Establishment of Vegetation Improvement Plot

In second year the remaining 1,015 ha (1,019-4 ha) is divided into 10 plots of 101 ha each (1,015/10) and 1 plot is undertaken for vegetation improvement works. The designated plot is protected and cared by 3 persons with a 24- hour working schedule (8 hours each). Seeds of Bromus (brome) and Agropyron (wheatgrass) grasses (collected from seed production plot) are sown at a rate of 2 kg/ha (2*101=202 kg) in this plot to produce palatable herbage for livestock. Shade and Litter provided by trees promote seed germination and seedling growth. Presence of trees and rock would not permit sowing large amount of seeds. In consequent years when a new plot is sown, an old plot is opened to herds and utilized in a sustainable manner. The improvement works on parts with slope less than 40% are completed within 10 years, and the same cycle will be repeated with no time gap to maintain the improved status. However seed-sowing area is 101 ha, whenever rangeland utilization norm (communal/village uses) does not permits, work is done in few scattered pieces, sum being 101 ha.

The 101 ha plot will bring-about an increase of 17.7 tons in its herbage production. With seed sowing works, in an average, an increment of 175 kg/ha in herbage production of rangeland is expected, so 175*101=17,675 kg (17.7 tons/year). At present average production of rangeland is 163 kg/ha, which with project would reach to 338 kg/ha (163+175). Furthermore, in growing season, the established grasses will bring-about an additional 30% in land cover, contributing to soil erosion control and conservation of the area. Present land cover is 45.5%. With project it would be 75.5% (45.5+30).

(2) Parts with Slope more than 40%

The remaining 856 ha with slope more than 40%, is susceptible to erosion and in fact should not be grazed. On the other hand, complete closure of these parts would worsen the feed shortage, and result in high grazing pressure on open areas, making the plan unfeasible/unsustainable. Therefore such parts are utilized under a rotational grazing program. Each year a plot of 86 ha (856/10) is protected by 3 watchmen, with a 24-hour watching schedule (8 hours each). In consequent years upon designation of a new plot, 90% of an old plot is open to herds and utilized in a sustainable manner. While 10% remain closed to ensure the natural dispersion of seeds into area. Entire area will receive improvement measure within 10 years, and the same cycle is repeated with no time gap to

maintain the achievement and ensure continues dispersion of seeds into the area. However protected area is 86 ha, whenever rangeland utilization norm (communal/village uses) dose not permits, the practice is performed in few scattered smaller pieces, sum being 86 ha.

Protection of 86 ha of rangeland will result in an increment of 4.3 tons in its herbage production. With protection in an average, an increment of 75 kg/ha is expected, so 75*86=6,450 kg (6.5 tons/year) of herbage production. Present production is 163 kg/ha, with protection it would reach to 238 kg/ha (163+75). Furthermore, the promoted vegetation will cover an additional 15% of bare soil, contributing in soil erosion control and conservation of the area. With protection present 45.5% land cover, would be 60.5% (45.5+15).

(3) Establishment of Watering Points for Livestock

However Bazoft River of good quality water, and many springs occur in this sub basin, 3 watering points are established in rangeland where no water is readily available to livestock, regardless of slope %. Water supply to animals is important to reduce the mortality rate and increase the livestock production. Establishment of watering point results in less movement of animals, their even distribution in rangeland and thereby contributes in reduction of soil erosion rate and conservation of the area. The watering point is a concreted structure with 7.00 m length, 1.50 m width and 0.30 m depth, in which 600 animal units can drink water in a day. In Iran an adult female goat weighing 40 kg is designated as an animal unit. Average water requirement of an animal unit is 5 liters/day.

With provision of watering facilities totally an increment of 4.3 tons in meat production of livestock (in grazing season=120days) is expected. It has been known that daily water supply to a grazing animal will bring-about an increment of 0.04 ka/day in its weight, of which 50% is in form of meat. About 1,800 animals are directly benefited from these facilities, so 0.04*120*1,800*0.50=4,320 kg (4.3 tons).

10.3.6 Forestland Vegetation Recovery

A piece of forestland with an area of 127 ha, comprising of Quercus (oak) and Amygdalus (wild almond) occur in this sub basin. Density of forest is not uniform. In localities nearby villages and farmlands, most of trees have been removed for various purposes, while remote and inaccessible locations have maintained their trees. About 40 ha of forestland (degraded part) need recovery measures. For this purpose each year 4 ha (40 ha/10 years) of this area is protected, by assigning watchman, with a 24-hour watching schedule (3 persons, 8 hours each). Small pits of 30 cm depth and 5 m interval are made (400 pits/ha) in the area. Three (3) seeds of commercial almond are placed in each pit, added with a layer of about 4.5 cm thick of mixture of soil and litter, which already exist in the field. Precipitation water remaining in empty space of pit, and the litter, provide moisture and

nutrients to seeds, enhancing their germination and growth. Almond seedlings are able to establish themselves quickly and absorbed water from lower layers of soil. The established plots are permanently protected and cared for economical and biological benefits, with cooperation of inhabitants of Ghale Tabarak and Tabarak Sofla villages.

Production of 8.0 tons of almond/plot, and prevention of soil erosion are benefits of this plan. There are 1,600 trees in 1 plot of 4 ha size (400/ha) and each tree is expected to produce 5 kg (in an average) of almond in a year, so 1,600*5=8,000 kg (8 tons/plot/year). Since at present this area has no economical benefit, the project will commercially valuate it through almond production. The established almond trees will contribute in prevention of soil erosion through their root system. The trees are expected to bring-about an additional 20% in land cover of the area. Since presently, in an average only 4% of degraded area bears natural trees, with tree plantation it would reach to 24% (4+20). Considering natural conditions such as occurrence of rocks and shallow soils, 20% additional land cover is satisfactory.

10.3.7 Increase of Irrigated Agriculture

(1) Irrigation Scheme

a) Basic Concept

MOA has the strategy to improve canals for increase of irrigation efficiency and product surplus water for irrigation. Then, this policy is applied in the Master Plan and it is basically planned to improve earth canal with concrete lining. Furthermore, intake and spillway are planned to be improved for prevention from flood damage and steady utilization of water. In addition, proposed check dams should be utilized as intakes to a full extent.

Conveyance efficiency of earth canal is reported to be 75 % on the basis of survey by MOA. On the other hand, conveyance efficiency of concrete lining canal is reported to be 95 %. Then it is possible to reduce conveyance loss up to 20 % and surplus water is estimated at 26.7 % of present discharge.

Table 10-3-7-1 Irrigation Efficiency

Canal type	Conveyance (%)	Application (%)	Total (%)	Increase of efficiency
Earth canal	75	40	30	1.0
Concrete lining canal	95	40	38	1.267

b) Proposed Plan

In Chaman Goli-Bazoft, there are 5 major lines of irrigation canal. Two of these canals in Dareh Tavileh basin have been recently rehabilitated with concrete lining. As for Gusaleh Bar basin, there are three canals and check dams are proposed at the upper stream of intakes

for these canal. Then, it is planned to improve intakes and canals synergistically. After improvement of these canals, surplus water is estimated as follows. By these projects, it is possible to irrigate 47 ha of farmland in case of Alphalfa.

Table 10-3-7-2 Surplus Water and Irrigation Water of Major Crops

Canal	Production of Surplus Water (liters/s)	Water Demand (liters/s/ha)		
		Alfalfa	Vegetable	Apple
Gusaleh Bar left bank canal	40	1.56	1.88	1.64
Gusaaleh Bar right bank canal	23			
Kachooz canal	10			

Source: JICA Study Team and Revised Data of MOA

Major projects of irrigation scheme are summarized as follows. These canals will be maintained by PIC. By these projects, expansion of irrigated agriculture and/or increase of cropping intensity will be expected.

- Improvement of Gusaleh Bar left bank canal (B 0.40 m x H 0.40 m) 2.4 km
- Improvement of Gusaleh Bar right bank canal (B 0.70 m x H 0.45 m) 4.5 km
- Improvement of Kachooz canal (B 0.25 m x H 0.20 m) 1.5 km

(2) Agricultural Scheme

a) Potential of Development

In Charman Goli-Bazoft, approximately half of total farmland is irrigable. Farmland is located in narrow alluvial fan and limited. According to the present land use, irrigated farmland is 593 ha excluding orchard area of 23 ha. On the other hand, according to the village survey, area of irrigated farmland per year is 887 ha and orchard is 95.5 ha. There is a little difference between them. Any way, it can be estimated that all irrigated farmland is fully used. Area of wheat and barley is wider than alfalfa because it seems that irrigation water source is limited. In farmland, wheat, barley, alfalfa and vegetable are planted. It is said that irrigated agriculture has already been developed. However, some irrigation canals are constructed of earth. In such conditions, when the canals are rehabilitated, it is possible to obtain more water for irrigation and more agricultural production. Moreover, it could be expected that agricultural intensity would be increased with the provision of short period growing seed and second cropping method in the irrigated farmland.

b) Development Plan

According to the above irrigation scheme plan, after rehabilitated the canal of Gusaleh Bar left and right banks and Kachooz, production area increment will be reached 46. 79 ha for alfalfa, (38.83 ha for vegetable or 44.51 ha for apple). At present, wheat is planted in these banks and as irrigation water is limited, crops are not planted in summer season. Considering feed shortage of the livestock, yield of crops, marketing conditions of products and village progress

situations, it is recommendable to select alfalfa to be planted firstly for livestock feed, (apple next and vegetable last).

Table 10-3-7-3 Estimated Production Increment by Rehabilitation of Canals (73litres/s)

	In case of Alfalfa	In case of Vegetable	In case of Apple
Gross Water Demand (litre/s/ha)	1.56	1.88	1.64
Increasing Area (ha)	46.79	38.83	44.51
Estimated Yield	8,755 kg/ha	20,000 kg/ha	40,000 kg/ha
Estimated Increasing Production (ton)	409.6	776.6	1,780.4

Note: ① Alfalfa yield: average data in 1995-99 in Study Area from Statistic Section, Ministry of Jihad-Agriculture
② Other yields: site survey by the Study Team

Moreover, by the conservation plan, when it is implemented, crops areas will be slightly varied from the above. Areas of present and future with plans including rehabilitation and conservation plans are as follows:

Table 10-3-7-4 Present and Future Crops Areas

	Present			*Future (with plan)*			
	Land area (ha)	Planting (ha)	Intensity (%)	Land are (ha)	Plantable (ha)	Intensity (%)	Difference (ha)
Irrigated Farmland							
1 Crops							
1) Wheat		537.4			427.4		-110.0
2) Alfalfa		55.6			212.4		+156.79
3) Others		3.0			3.0		
sub-total	593	596.0	100.5	639.8	642.8	100.5	
2. Orchard							
1) Apple		1.8			1.8		
2) Others		21.2			21.2		
sub-total	23.0	23.0	100.0	23.0	23.0	100.0	
Sub-total	616.0	619.0		662.8	665.8		
Dry farmland							
1 Crops							
1) Wheat		1,141.8			1,031.0		-110.79
2) Alfalfa		0.0			64.0		+64
3) Others		6.2			6.2		
sub-total	1,148.0	1,148.0	100.0	1,101.2	1,101.2	100.0	
2. Orchard							
1) Apple		0.0			0.0		
2) Others		0.0			0.0		
sub-total	0.0	0.0		0.0	0.0		
Sub-total	1,148.0	1,148.0	-	1,101.2	1,101.2		
Total	1,764.0	1767.0		1,764.0	1,767.0		
Rangeland	1,875.0			1,875.0			
Others	7,681.0			7,681.0			
Grand total	11,320.0			11,320.0			

Note: Details are referred to Annex "Estimated Crops Areas"
Others in crops line include fallow lands.

According to the village survey, in farmland, wheat & barley are planted in 1,275 ha, alfalfa is in 132 ha and legume, vegetable and others are planted in 10 ha and total 1,417 ha is planted; it is estimated that planting intensity is 100.5% in irrigated farmland considering the 593 ha of irrigated farmland by present land use. When short period grown seeds are selected and cropping patterns are developed, it would be possible to expand more intensity in whole irrigated farmland considering the limited

irrigation water. Such as wheat in winter season + legume (+ vegetable) in summer season would be expected depending on the availability of water. Apple could be planted in same alfalfa farmland, affected little the production of alfalfa.

Ministry of Jihad-Agriculture and related institutes should develop the cropping pattern for intensive agriculture, selection of seed variety, planting technology such as fertilizer application, improved pest management as well as conduct the application examination in the selected area before dissemination of the said cropping pattern and promote the mechanization of agriculture with the provision of low interest loan to the farmers.

10.3.8 Fish Culture Promotion

(1) General

Analyzing the areas' conditions based on the above development potentials and policies, development plans would be designed for changing to cow grazing during the short-, medium-term (5-10 years) as follows. At present, promotion of fish culture is conducted in Ghale Tabarak village under the Provincial Project. The dyke has already been constructed to obtain water through the canal. This plan includes construction of sediment pond to remove sand and impurities and to take good quality water into fish culture. Production volume in a year may be 200t. Application form has already been submitted to the Fishery Organization in the Province and form of fund support has also been submitted. Feature of that project is as follows:

Table 10-3-8-1 Feature of Fish Breeding Center in Tabarak Village

Project Name	Fish Breeding Center of Ghezel Parver Shafid Coleted
Location	Tabarak Village, Bazoft District, Fersan Township
Objectives	Creation of job opportunity, increase of fish meat production
Project cost	Total 3,700,000,000 incle. Land, construction, equipement
Financial source	Provincial credit and loan from bank
Specification	Separation of dam water and transferring by canal Construction of sediment central pool and fish breeding pools Pools on 12,000m2 for production fish , capacity: 200 ton/year

Source: Fishery Organization, Province of Chaharmahal-va-Bakhtiyari

Taking into consideration these conditions such as that fish-breeding center is under construction and production volume would be huge, marketing plan of fish culture products is designed as follows. It is necessary to apply the participatory approach and proper training and education by the government for promoting these development plans. The promotion of these development plans should be required the further feasibility study and detailed design study

(2) Marketing Plan

a) Marketing plan of fish culture products (short-, medium-term)

i) Purpose:

To effectively conduct sale of fish products.

ii) Participants:

Participants will be the group of fish growers.

iii) Remarks of fish products selling:

(a) Cooperative will be established in village as the multi-purpose cooperative. The cooperative will be for multi-purpose cooperative having services of all kind activities for produces and sales of agriculture, livestock, fish culture, forestry, etc. All villagers will be expected to participate,

(b) Group will be established within the cooperative. Groups will be formed based on the produce, members of which would grow same products or have intension to grow same products,

(c) To make up the regulations and general rules, members should be well known,

(d) To make up the rule of general meeting, regular meeting and special meeting and to conduct them,

(e) To conduct election for board of directors. To decide the term of directors,

(f) To conduct the evaluation of productions and sales activities by using the multi-purpose training facilities.

(g) To record and calculate the volume and weight of production and sale in the village, and

(h) To create the marketing route. To establish the marketing channels within the village, to near villages, neighboring cities and large cities,

iv) Structural Measures:

(a) Size of facilities: To establish the distribution facilities for various marketing routes. Approx. 200t/year.

(b) Form of facilities: It should be constructed using the suitable materials for this area and environment and taking into consideration the participatory scheme. Basically, main building material is brick.

(c) Proposed village: Ghale Tabarak; 1 place

(d) Required equipment, materials and facilities:

- Building: made of brick, 50m2;	1 building
- Incidentals: water supply, electricity, latrine	1 set
- Tables: made of wood, 1,800x900x800mm;	2 units
- Chair: made of wood	4 pieces
- Vehicle: Pick-up (for 200t/year production)	2 units
with water tank (steel, 1.2x1.0x0.8m, 4 pieces)	

with oxygen supply facilities (2 units)

- Land: relatively flat land with good access, 100m2

When this marketing plan is established, owner, which will be villagers (164 households of Tabarak villages), will have benefit 409,920,000 Rials (=3,400,000,000-2,990,080,000), which includes fish raising benefit, or 2,499,512 Rials per year per household.

10.3.9 Diversification to Milk Cow

(1) Potential of Development

In Charman Goli-Bazoft, total carrying capacity of livestock at present is 29,227 AUM including carrying capacity of rangeland (1,875ha) of 5,113 AUM, straw from wheat of 17,908 and alfalfa of 6,206 AUM. Therefore, over grazing rate is of 9.5.

Table 10-3-9-1 Estimated Total AUM for Whole Animal (Present)

Straw from wheat		Alfalfa		Range land		Total	Present			Grazing
Area(ha)	AUM	Area(ha)	AUM	Area(ha)	AUM	AUM	(head)	AU	AUM	Rate
1,275	17,908	132	6,206	1,875	5,113	29,227	21,495	23,220	278,640	9.5

Note: Details are referred to Annex "Estimated AUM".

On the other hand, AUM of cow, horse and donkey in villages is 24,112 comparing to 29,227 AUM of wheat straw and alfalfa production. Over grazing rate is pointed at 5.0. Therefore, sheep and goat grazing as well as cow grazing in villages are both severely overgrazing. It is necessary to obtain a lot of feed for proper grazing.

Table 10-3-9-2 Estimated Total AUM for Cow, Horse and Donkey (Present, Village)

Straw from wheat		Alfalfa		-		Total	Present			Grazing
Area(ha)	AUM	Area(ha)	AUM	-	-	AUM	(head)	AU	AUM	Rate
1,275	17,908	132	6,206	-	-	24,112	2,012	10,060	120,720	5.0

Note: Details are referred to Annex "Estimated AUM".

Development potential is very low, even the feed would be obtained by purchasing.

(2) Development Plan

However, it is possible to change to milk cow in future for one of the methods of reducing sheep and goats number. It will stabilize introduction of milk cow and milk processing industry, and make people to reduce number of sheep and goats for mitigating over grazing by means of adding values to products. Total head of 467 could be raised at proper conditions with provision of canal rehabilitation.

Table 10-3-9-3 Estimated Total AUM for Cow (with plan)

Present Total		Additional Alfalfa		Total	Future			Grazing
Area(ha)	AUM	Area(ha)	AUM	AUM	(head)	AU	AUM	Rate
1,407	24,112	46.79	3,899	28,013	467	2,334	28,013	1.0

One the other hand, estimated basic unit of milk cow-raising is as follows:

Table 10-3-9-4 Estimated Basic Unit of Milk Cow-Raising

In case of	Yearly Feed Consumption In case of alfalfa (kg)	Required area; in case of alfalfa	
		Irrigated (ha)	Dry (ha)
In case of cow			
One head	9,000	1.0	13.5
Five heads	45,000	5.1	67.6
In case of cow			
One head	1,800	0.2	2.7
25 heads	45,000	5.1	67.6

Note: Feed consumption includes that for one adult and one young for one head.

Therefore, if farmer keeps five cows, he collects 123.3kg of fresh alfalfa per day for five cows and five calves.

According to the Livestock Office of Provincial Jihad, they promote to diversify into milk cow, varieties of which are Holstein and Semi-local. Milk production estimated by the Livestock Office is as follows:

Table 10-3-9-5 Milk Production by Cow

Variety	Holstein	Semi-local	Local
Weight (kg)	550	470	250
Production (lit/day)	18	12-16	4-5
Duration (d/year)	300	250-270	210-230

Source: Livestock Office, Provincial Jihad, Charhalmahal-va- Bakhtiyari

Therefore, in case of diversifying Local variety to Semi-local variety, milk production would be increased 8-11 litre/day and its duration is enlarged 40 days. Total milk production is increased 2,160-3,170 litre/year or average 2,665 litre/year per head or 266,500 litre/year per 100 head.

Table 10-3-9-6 Estimated Yearly Milk Production

Variety	Holstein	Semi-local	Local
Production (litre/year)	5,400	3,000-4,320	840-1,150
Average (litre/year)	5,400	3,660	995
Per 100 head production (litre/year)	540,000	366,000	99,500
Increment (litre/year)	440,500	266,500	0

When all cows at present are diversified to milk cows, number of which will be reached 1,380 heads in Charman Goli-Bazoft Study Area. In that case, 1,089 households in Chaman Goli-Bazoft area will be benefited 3,677,700 litre or 3,377.135 litre/household which equivalents to 3,377,135 Rials per year per household.

This diversification plan should be promoted step by step with the help of Livestock Office, considering progress of artificial insemination, disease control, registering method, inspection method

for milk cow as well as pasteurization, sterilization, disease control, inspection method for raw milk. Moreover, it is expected milk industry would be established near around to process and distribute the better quality milk.

Ministry of Jihad-Agriculture should promote more aggressively the above, to begin with, promote dissemination of Holstein variety or semi-local variety, artificial insemination, disease control, inspection for livestock growers. It is recommendable that the further feasibility study and detailed design study would be conducted as "Study of Diversification to Milk Cow" for pilot project in considerable areas, not in such narrow area of this Study Area.

(3) Marketing Plan of Milk

a) General

Analyzing the areas' conditions based on the above development potentials and policies, development plans would be designed for changing to cow grazing during the long-term (20 years). Marketing plan should be conducted during the half time of diversification progressed or after diversified. For marketing of milk, it is necessary to apply the participatory approach, establishment of groups & cooperatives and proper training & education by the government for promoting these development plans. The promotion of these development plans should be required the further feasibility study and detailed design study.

① Establishment of groups and cooperatives for milk processing center: long-term

② Collection & distribution center for milk: long-term

b) Establishment of groups and cooperatives for milk processing center (long-term)

i) Purpose:

To change to cow-grazing and to promote the sale of milk-processed products.

ii) Participants:

A group should be established, whose members should grow cows and have intention for development. Group should be set in a cooperative. The cooperative should be formed within each village, whose size should be as same level as Iran's administration.

iii) Remarks for establishment of groups and cooperatives:

Cooperative will be established in each village. The cooperative will be for multi-purpose cooperative having services of all kind activities for produces and sales of agriculture, livestock, fish culture, forestry, etc. All villagers will be expected to participate,

(a) Group will be established within the cooperative. Group will be formed based on the produce, members of which would grow same products or have intension to grow same products,

(b) To make up the regulations and general rules, members should be well known,
(c) To conduct election for board of directors. To decide the term of directors, and
(d) To conduct the evaluation of productions and sales activities by using the multi-purpose training facilities.

iv) Structural Measures:

(e) Size of facilities: To establish the collection and distribution facilities for processed milk products. Approx. 1.0 t/day by approximately 100 heads.
(f) Form of facilities: It should be constructed using the suitable materials for this area and environment and taking into consideration the participatory scheme. Basically, main building material is brick.
(g) Proposed villages: Arteh, Baghchenar, Dorak, Fariak and Tabarak Sofla; 5 places (Each village has more than 100 heads of cow at present, however, it is required to take into consideration the following plan of collection & distribution center for milk.)
(h) Required equipment, materials and facilities for one place:

- Building: made of brick, 100m2;	1 building
- Incidentals: water supply, electricity, latrine	1 set
- Tables: made of wood, 1,800x900x800mm;	2 units
- Chair: made of wood	4 pieces
- Vehicle: Pick-up (for 2t/day milk)	1 unit
with tank (plastic, 50 litre, 40 pieces)	
- Mixing machine: steel, for Kashk	2 units
- Land: relatively flat land with good access, 200m2	

When the milk processing centers are established, one village will have benefit 112,270,000 Rials (511,000,000-398,730,000) or total 5 villages (627 households) will have benefit 561,350,000 Rials or 895,295 Rials per year per household.

c) Collection & distribution center for milk (long-term)

i) Purpose:

To promote sale of milk products.

ii) Participants:

Participants will be villagers who graze cow or have intentions to produce milk products.

iii) Remarks for promotion:

Milk may be deteriorated within two hours. Therefore, milk should be processed immediately. It is necessary to collect and distribute systematically and schematically,

(a) Group will be established within the cooperative. Group will be formed based on the produce, members of which would grow same products or have intension to grow same products,
(b) To make up the regulations and general rules, members should be well known,
(c) To make up the rule of general meeting, regular meeting and special meeting and to conduct them,
(d) To conduct election for board of directors. To decide the term of directors, and
(e) To conduct the evaluation of productions and sales activities by using the multi-purpose training facilities.

iv) Structural Measures:
(a) Size of facilities: To establish the collection and distribution facilities for condensed milk. Approx. 5.0 t/day by 400 heads.
(b) Form of facilities: It should be constructed using the suitable materials for this area and environment and taking into consideration the participatory scheme. Basically, main building material is brick.
(c) Proposed villages: Arteh; 1 place
(d) Required equipment, materials and facilities:

- Building: made of brick, 100m2;	1 building
- Incidentals: water supply, electricity, latrine	1 set
- Tables: made of wood, 1,800x900x800mm;	2 units
- Chair: made of wood	4 pieces
- Vehicle: Pick-up (for 5t/day milk)	2 units
with tank (plastic, 50 litre, 100 pieces)	
- Bulk cooler: stainless, electric operation	1 unit
- Land: relatively flat land with good access, 200m2	

When collection and distribution center for milk is established, 271 household in village will have benefit 394,870,000 Rials (=2,263,000,000-1,868,130,000) or 1,457,085 Rials per year per household.

10.3.10 Rural Water Supply Improvement

(1) Basic Concept

The rural water supply improvement plan is established based on the purpose as follows.

- To provide water supply system to every village in the area,
- To supply enough and hygienic water to villagers,

- To achieve water supply by Level II at least in every village,
- To enhance recognition of water supply service and sanitation.

Here, domestic water demand per capita is applied to be 180 liter/day/person also according to the suggestion by SED.

(2) *Proposed Plan*

Expansion of rural water supply in each village is proposed on the basis of estimated population in 2020. In this expansion, every villager will be supplied water which amount is 180 liter/day/person. Present water demand is 620 m^3/day and water demand in 2020 is estimated at 2,302 m^3/day. Then surplus water demand is 1,682 m^3/day. Water source is supposed to be enough to supply surplus water. Then it is planned to expand distribution tanks and connection pipeline for surplus water supply. Here, capacity of distribution tank is designed to be the volume of supply for 12 hours and 30 % spare.

Table 10-3-10-1 Proposed Water Demand and Distribution

Village	Population in 2001	Water Demand in 2001 (m^3/day)	Population in 2020	Water Demand in 2020 (m^3/day)	Increase of Water Demand (m^3/day)	Proposed capacity of distribution Tank (m^3)
Arteh	600	63	1,299	234	171	111
Bagchhenar	450	47	975	176	128	83
Chemghaleh	2,500	263	5,415	975	712	463
Dorak	600	63	1,299	234	171	111
Fariak	500	53	1,083	195	142	93
Ghale Tabarak	103	11	223	40	29	19
Kachooz	105	11	227	41	30	19
Khiyarkar	42	4	91	16	12	8
Tabarak Olya	358	38	775	140	102	66
Tabarak Sofla	648	68	1,403	253	185	120
Total	5,906	620	12,790	2,302	1,682	1,093

Dimensions of distribution tanks and pipeline are summarized as follows. In addition, Fariak village is under severe condition of water shortage and water supply system should be improved as quickly as possible. It is desirable to execute projects on the two stages aimed to 2010 and 2020. And it is recommended to study in detail design. RWWC will operate and maintain facilities and collect water charges in cooperation with PIC. In addition, PIC will enhance villagers to recognize water charge system and desirable water use for 5 years after completion of construction. By these projects, necessary and clean water will be provided to villagers.

Table 10-3-10-2 Proposed Plan for Water Supply

Village	Distribution Tank	Pipeline
Arteh	B 6.7 m x L 6.7 m x H 3.0 m	PVC Pipe ϕ 75, L=900 m
Baghchenar	B 5.9 m x L 5.9 m x H 3.0 m	PVC Pipe ϕ 75, L=700 m
Chemgaleh	B 13.0 m x L 13.0 m x H 3.0 m	PVC Pipe ϕ 125, L=3,900 m
Dorak	B 6.7 m x L 6.7 m x H 3.0 m	PVC Pipe ϕ 75, L=900 m
Fariak	B 6.2 m x L 6.2 m x H 3.0 m	PVC Pipe ϕ 75, L=800 m
Ghale Tabarak	B 3.1 m x L 3.1 m x H 3.0 m	PVC Pipe ϕ 50, L=200 m
Kachooz	B 3.1 m x L 3.1 m x H 3.0 m	PVC Pipe ϕ 50, L=200 m
Khiyarkar	B 2.2 m x L 2.2 m x H 3.0 m	PVC Pipe ϕ 50, L=100 m
Tabarak Olya	B 5.3 m x L 5.3 m x H 3.0 m	PVC Pipe ϕ 50, L=600 m
Tabarak Sofla	B 5.3 m x L 5.3 m x H 3.0 m	PVC Pipe ϕ 75, L=1,000 m

10.3.11 Rural Road Improvement

(1) Basic Concept

The rural road improvement plan is established based on the purpose described below:

- To improve, rehabilitate and construct rural roads for easy access to other villages and market,
- To keep stability of access especially in winter by provision of pavement, drainage facilities, river crossing and others,
- To strengthen participate group by providing knowledge and skill about maintenance of road and appurtenance facilities.

(2) Proposed Plan

Chaman Goli-Bazoft area has 10 villages. 7 villages of all locate along the highway which is paved by asphalt and well maintained. On the other hand, road from Chemghaleh to Ghale Tabarak is not paved and it becomes difficult to pass in rain and snow. Then it is planed to pave this road with asphalt and improve side drain. Widths of road and pavement are designed to be 4 m and 3 m respectively. In addition, bridge over Dareh Tavileh near Tabarak Sofla is proposed for easy access.

After improvement, road will be maintained by PIC. As for unpaved road including farm road, villagers will have responsibility for construction and maintenance. In addition, it is necessary to transfer technology of road maintenance of road and side drain. Then, PIC should prepare training program. Project components are summarized as follows. By these projects, accessibility to the market will be improved.

- Improvement of road with asphalt pavement 6 km
- Construction of bridge (Tabarak Sofla) 1 no.

- Transfer of technology for maintenance of road and side ditch 5 years
- Construction and maintenance of farm road by farmers 152 km

10.3.12 Establishment of Cooperative

Analyzing the areas' conditions based on the above development potentials and policies, development plans would be designed for handicraft during the short-term (5 years), for fish culture during the short-, medium-term (10 years) and for changing to cow grazing during the medium-(10 years) and long-term (20 years) as follows. It is necessary to apply the participatory approach and proper training and education by the government for promoting these development plans. The promotion of these development plans should be required the further feasibility study and detailed design study.

① Establishment of groups and cooperatives for handicraft: short-term
② Establishment of multi-purpose training center: short-term
③ Training and education plan by government: short-, medium-term
④ Others (for formerly mentioned plans; marketing plan of fish culture products, establishment of groups and cooperatives for milk processing facilities and collection & distribution facilities for milk)

(1) Establishment of groups and cooperatives for handicraft (short-term)

a) Purpose:

To emphasize villagers and promote the sale of produces and processed products made of and from raw materials grown in this area.

b) Participants:

A group should be established, whose members should grow the raw materials and have intention for development. Group should be set in a cooperative. The cooperative should be formed within each village, whose size should be as same level as that of Iran's administration.

c) Remarks for establishment of groups and cooperatives:

i) Cooperative will be established in each village. The cooperative will be for multi-purpose cooperative having services of all kind activities for produces and sales of agriculture, livestock, fish culture, forestry, etc. All villagers will be expected to participate,
ii) Group will be established within the cooperative. Group will be formed based on the produce, members of which would grow same products or have intension to grow same products,
iii) To make up the regulations and general rules, members should be well known,
iv) To conduct election for board of directors. To decide the term of directors, and

v) To conduct the evaluation of productions and sales activities by using the multi-purpose training facilities.

d) Structural measures:

i) Size of group: It will be set that one unit is 100 households in village. Size of group is of 20 members within the said village.

ii) Proposed villages: Fariak; 1 place

iii) Required equipment, materials and facilities for one place (In case of production of gilim and carpet):

- Horizontal weaving machine: 2m x 3m; 5 units
- Vertical weaving machine: 2m x 3m; 5 units
- Building: made of brick, 100m2; 1 building
- Land: relatively flat land with good access, 200m2

However, in case of establishing multi-purpose training facilities, it should be used the said facilities for it.

When handicraft facilities are established, 20 members per each place will be benefieted 25,430,000 Rials (=60,000,000-34,570,000) or 1,271,500 Rials per year per member.

(2) Establishment of multi-purpose training center (short-term)

a) Purpose:

To promote villagers, groups members for production and sales by area's processing and handicraft activities as well as to train and educate them for area's development.

b) Size of facilities:

Participants would be group members, cooperative members and villagers. If all villagers will happen to attend the meetings, a school or other larger place would be selected as venue. The standard size of multi-purpose training facilities should be for 50 persons. Facilities include building and play-yard.

c) Remarks for establishment of multi-purpose training facilities:

i) To be established by villagers' participatory scheme,

ii) To use the raw materials which is produced in this area and/or usually used in this area,

iii) Size of facilities should be taken suitable for size of group and cooperative,

iv) After constructed the facilities, regulation for usage should be made up and users should be well known, and

v) A housekeeper would conduct the activities of operation and maintenance. The housekeeper should be selected by election.

d) Structural measures:

i) Size of facilities: Based on one village 100 households, required multi-purpose facilities to be constructed will be as large for 50 persons. Approx. 50m2.

ii) Form of building: It should be constructed using the suitable materials for this area and environment and taking into consideration the participatory scheme. Basically, main building material is brick.

iii) Proposed villages: Arteh, Baghchenar, Chemghaleh, Dorak, Fariak, Tabarak Olya and Tabarak Sofla; 7 places

iv) Required equipment, materials and facilities for one place:

- Building: made of brick, 100m2;	1 building
- Tables: made of wood, 1,800x1,200x800mm;	10 units
- Chair: made of wood	30 pieces
- Incidentals: water supply, electricity, latrine	1 set
- Land: relatively flat land with good access, 200m2	

(3) Training and education plan by government (short-, medium-term)

a) Purpose:

To instruct, train, educate and transfer the technology to group and cooperative members and villagers for development of areas.

b) Extension service organization:

To improve the organization so as to be able to instruct, train, educate and transfer the technology to group and cooperative members and villagers.

c) Remarks for organization of extension service:

i) To take the participatory scheme. To act with villagers from the beginning of plan formulation,

ii) To improve the township level organization taking into consideration the area's conditions,

iii) To establish each crop group for training and education and to conduct together with section in charge,

iv) To train and educate the members of groups and cooperatives, villagers or villagers in several villages, and

v) To promote the trained group members so that they will train and educate the other members within the groups.

d) Structural measures: None

Each plan is basically independent. However, there would be rooms for reciprocal affection

or common usage. Development plan should be implemented step by step. Suitable development could be led by conducting the monitoring, evaluation and feed back step by step taking into consideration the levels and situations of around development.

10.3.13 Community Enhancement

(1) Purpose

Community enhancement plays a key role to realize sustainable development in the Master Plan Areas. To maintain expected effect of the development project, villager's participation in the development process is quite important. Purposes of the community enhancement are as follows;

a) To promote villager's participation in the projects implementation,
b) To build up villager's mind for mutual aid, and capability against natural disasters,
c) To strengthen villager's living environment.

(2) Organizing Villagers

To realize above purposes, village organization is planned to establish. Relevant government organizations, both in central and local levels, have to facilitate the establishment of the village organization, in cooperation with Village Islamic Councils. Village Islamic Council is positioned in the lowest level of administrative hierarchy in Iran, and is helpful to promote villager's participation. All villagers are naturally member of the village organization. But, the member of the organization should be formed case by case, based on the purpose of the project. Such type of project as profitable and, therefore, villager have to bear a part of project cost, should be organized by those villagers who have a willingness to the development. Followings are procedure for establishment of village organization.

a) Relevant government organization, both in central and local government, establish committee for M/P project which promote implementation of proposed projects and facilitate the establishment of village organization.
a) The government committee holds meeting with representatives of Village Islamic Councils to explain the project purpose, project components, implementation method, etc.
b) Representatives of Village Islamic Council hold small meeting at each villages to explain outline of the project.
c) The government committee facilitates to establish villager's organization based on the villager's willingness to participation in the project.
d) The village organization discusses and establishes organizational structure, rules and regulations of operation, detail plan for participation in the project, etc., under the support by the government committee and Village Islamic Councils.

(3) Remarks of Establishment of Village Organization

a) All villagers are naturally member of the village organization. Number of household in each villages are as follows.

Table 10-3-13-1 Number of village and household in Chaman Goli-Bazoft

No.	Village Name	Household	No.	Village Name	Household
1	Arteh	221	6	Ghale Tabarak	19
2	Baghchenar	120	7	Kachooz	73
3	Chemghaleh	270	8	Khiyarkar	24
4	Dorak	50	9	Tabarak Olya	76
5	Fariak	60	10	Tabarak Sofla	176

Source: Village Survey, August 2001.

b) The member of organization should be formed in accordance with component of the project. It is quite important that those villagers who have a will to participate into the development project organize the village organization.

c) Project Coordination Committee should facilitate establishment of the village organization in cooperation with Village Islamic Council. The council is helpful to promote villager's participation, and to establish rules and regulations of the organization, and to arbitrate villager's conflict if it happens,

d) Participatory approach should be taken into consideration at the beginning of the establishment. It is recommended to hold workshop to pull out villager's frank opinion when plan of operation and monitoring are formulated by villagers themselves,

e) Selected leader will manage and coordinate communal activities, and to communicate with relevant officers from local and/or central government,

f) At the time of establishment of rules and regulation, including account system, general meeting should be held with all members' participation. It is quite important that all villagers participate in the decision making of important issue. Such issue as member's rights, duties, and penal regulation are also the matter of general meeting,

g) All villagers in the organization, including member of Village Islamic Council, should have a vote as an individual right of members. It is important that all members have equal right to participate in their decision-making.

h) Leadership training, organized by rural government officers, should be provided to the leaders of organization, so that they could train and educate the other members within the organization, and

i) Meeting with other near village organizations should be regularly scheduled under the leadership of the rural government officers. Important issue among village organization should be discussed in an open forum.

(4) Facility

Multi-purpose training center, which is proposed in the project for establishment of cooperative, will be available to used for the activities of village organization. The center will be established in those

villages where more than 50 households live in, and 7 villages in the project area meet the condition. Other 3 village organizations should use the multi-purpose training center in the neighboring villages or other communal facilities. Notice board should be established in these 3 villages to provide such information as date and kinds of disaster drills, extension services, etc. to all villagers. In case all villagers will happen to attend the meetings, a school or other larger place located inside or outside of village should be selected as venue.

(5) Activities

Activities of village organization should be planned and implemented through discussion among members in the organization. Followings are basic activities to attain the purpose of community enhancement.

a) Participation in implementation, operation and maintenance of the projects in cooperation with local and/or central government.
b) Participation in monitoring and evaluation of the projects in corporation with relevant government officers,
c) Participation in enlightenment activities against disasters such as flood, debris flow, landslide, rock-fall and soil erosion. Enlightenment activities will be carried out at least once after flood season. According to the Natural Disaster Survey, illegal deforestation is severe in such village as Tabarak sofla and Dorak. As a result, potential of natural disaster has been increased. Protection of forest should be discussed as urgent issue in these villages, this kind of issue should be discussed among the village organizations to build up mutual aid system in the project area.
d) Promotion of health services and nutritional education, environmental education such as fuel consumption.
e) Meeting with other village organizations and relevant government organization to exchange information and experience which obtain through the projects.

Community enhancement will be promoted step by step in the process of project implementation. Relevant government organization, especially in the provincial levers, should assist and facilitate the enhancement of the village organization. There are tree steps in the process of the project implementation to enhance function of the village organization.

First step is at the beginning of the project implementation, and the village organization will be established based on the villager's willingness to participation in the projects. All members belong to the village organization will participate in the decision making process of their organization, and participate in the activities of the organization. Through these activities, a sense of participation will be formulated.

At the time of commencement of the project, plan of operations and detail activities of the villager are already designed by the government. The village organization, therefore, just receive the planned project. It should be noted that some of the members of village organization is dubious about for the result and effect of the project. The government officers have to make close communication with the village organization and build up intimate relations with them.

Second step is at the time of monitoring of the project. In the monitoring activities, villagers grasp the problem faced in the project implementation, and discuss how overcome the problems. The results of the monitoring are put into next activities. The village organization reviews their activities and improves their original plan by themselves. Through these activities, villagers can formulate and enhance a sense of ownership for the development projects.

Third step is at the time of completion of the project. At this time, government organization will hold the workshop for project evaluation under participation by village organization. The result of the project evaluation will be put into the next project activities. The village organization will choice next activity among the master plan projects, or will make new project plan based on their willingness to development. The government organization for project implementation have to support and facilitate villager' selection of next activities.

10.3.14 Increment of Household Income and Job Creation

Increasing household income and job opportunity is one of the most important matters in the villages in the Study Areas. Development plan will include the contents of increasing household income and job creation. These, in case of being fully developed, are shown as income generating activities below:

Table 10-3-14-1 Job Creation and Yearly Income Increment (with plan, fully developed)

Items	Job Creation (number)	Income Increment (Rials)	Increased income per household or person (Rials/H.H or person)
Fish culture (one place, 3 villages)	164 household	409,920,000	2,499,512 per h.h.
	5 operators	32,375,000	6,475,000 per p.
Diversification of Milk Cow			
Milk production (whole villages)	1,089 households	3,677,700,000	3,377,135 per h.h.
Milk processing center (5 villages)	627 households	561,350,000	895,295 per h.h.
	25 operators	161,875,000	6,475,000 per p.
Milk collection & distribution center (one village)	271 households	394,870,000	1,457,085 per h.h.
	7 operators	37,375,000	5,339,286 per p.
Handicraft facilities (4 places)	80 members	101,720,000	1,271,500 per p.
	80 weavers	96,000,000	1,200,000 per p.

Note: Details are referred to ANNEX L Economic and Financial Evaluation, Annual O/M Cost and Value of Output.

10.4 K7-0-19-1 Sarbaz

10.4.1 Construction of Check Dam

(1) Specific Sediment Discharge

In order to estimate sediment discharge of each check dams, the specific sediment discharge used for the planning of Beaedeh Dam at Sarbaz (400 $m^3/km^2/year$) is applied.

(2) North Basin

In North Basin, four medium and small tributaries flow into Marbor River. Among these tributaries, the one located in the utmost north near Sarbaz flows in the basin with gentle slope and a little erosion, whereas the basins of the other three are very devastated with severe erosion and landslides.

This area is categorized as surface erosion type and main check dams with Type C are allocated on these three tributaries in order to prevent vertical/horizontal erosion of the river course and the movement of unstable sediment left on the riverbed, stabilize the foot of slope, and protect farmland in the downstream.

a) T1 Basin

Seven main check dams on the main river course and three on the left tributaries are planned in the T1 Basin, which has the biggest catchment area in North Basin. Four check dams are located in the landslide areas and serve to prevent further slide through prevention of movement of unstable sediment left on the riverbed, and stabilizing the riverbed and foot of slope.

b) T2 Basin

Four main check dams on the main river course and two on the tributaries are planned in the T2 basin, which is located southeast of T1 Basin. Two check dams are located in the landslide areas and serve to prevent further slide through prevention of movement of unstable sediment left on the riverbed, and stabilizing the riverbed and foot of slope.

c) T3 Basin

Three main check dams on the main river course and one on the tributary are planned in the T3 basin, which is located northwest of T1 Basin. Two check dams are located in the landslide areas and serve to prevent further slide through prevention of movement of uns sediment left on the riverbed, and stabilizing the riverbed and foot of slope.

(2) South Basin

South Basin consists of Lee Sorkh River basin, which originates from Dena Mountains. The flood and

debris flow damage in this basin occurs in the lower reaches of Lee Sorkh River, such as Kahangan, Deh Bozorg, Telmohamad, Zabih Abad, Devergan Sofla and Dorahan.

a) Left Bank-TM2

Four villages out of six are located on the left bank of Lee Sorkh River, the area of which borders North Basin and has landslide potential. Four main check dams with Type C and five check dams to be implemented by people's participation are planned in order to prevent the movement of unstable sediment left on the riverbed, and stabilize the riverbed and foot of slope.

b) Middle Reaches

The two basins of right and left tributaries (TM3 and TM4), which join Lee Sorkh River around Dangazloo, also have landslide potential on their upper reaches. Especially, erosion is more severe on the right tributary. Two main check dams with Type C are planned on each tributary in order to prevent the movement of unstable sediment left on the riverbed, and stabilize the riverbed and foot of slope.

In addition, six check dams to be implemented by people's participation are allocated on the right tributary.

c) Upper Reaches

Upper reaches of Lee Sorkh River, upstream of Dangazloo, there are no villages except Nomad camps. Because of high-rocky mountain area, devastation is very limited. However,

Four main check dams are planned mainly at just downstream of the confluences of tributaries in order to prevent the movement of unstable sediment left on the riverbed, stabilize the riverbed and foot of slope, and preserve downstream area. In addition, one check dam to be implemented by people's participation is allocated on one of the left tributaries.

d) Main River Course

On the upper reaches of Lee Sorkh River, the valley of the main river course is filled with debris consisted of big boulders, which were derived from the huge rockslide on the slope of the Dena Mountains around 30 years ago.

On the most upper reaches of the main river course, a small pond was formed at the time of the slide and remains stable since then. The size of this pond is 10 m in depth, 10 m width in average, and around 20 m in length. Stored water infiltrates through surrounding debris, and the pond has very limited catchment, therefore, there is no danger of collapse.

In the debris-filled valley, rather smaller materials had been washed down and only big ones had been left in the riverbed. Judging from the size of boulders, there is no possibility of sudden movement.

Two main check dams are planned in order to prevent the movement of unstable sediment left on the riverbed, stabilize the riverbed and foot of slope, and preserve downstream area. One is located just the downstream of the debris-filled valley, and another is on the upstream of Dangazloo. Type C and Type B is adopted respectively in consideration of the river condition.

(3) Outline of Check Dams

The dimension of main check dams are listed in Table 10-4-1-1 and their location is also shown in Fig. 10.4.1-1 The total number of check dams by type is summarized as follows;

Main check dam (Type B)	1 No.
Main check dam (Type C)	33 Nos.
Check dam (Type D)	12 Nos.

(4) Estimation of Sediment Discharge and Sediment Capacity of Check Dams

Sediment discharge and sediment capacity of main check dams are worked out and summarized in Table 10-4-1-1.

(5) Effect of Check Dams

The check dams planned here are mainly considering storing capacity for debris, securing farmland on the lower reaches, and preventing devastation in the northern basin, while preventing devastation and securing farmland are considered in the southern basin.

Based on Table 10-4-1-1, the total vacant volume (storing capacity for debris) of main check dams is around 136,500m³, and that of 12-check dams by people's participation 36,000m³ (3,000m³ per each) and totally become 172,500m³. On the other hand, annual sediment discharge is estimated around 46,000 m³. Thus, the total vacant volume is equivalent to about 4-years of sediment discharge (In northern basin: 7-years, and in southern basin 3-years).

Table 10-4-1-1 Dimension of Main Check Dams in Sarbaz

River: Site No.	ITEM											Remarks
	C.A. (km^2)	ΣC.A. (km^2)	/ (m)	Q (m^3/sec)	Dam Type	C.EL (m)	H (m)	W (m)	L (m)	h (m)	Q_a (m^3/sec)	
TM:												
1001	15.98	24.93	6,950	102.6	C	2398.5	6.0	18.0	52.0	2.5	140.0	
1002	11.74	49.27	10,990	163.5	B	2221.0	8.0	22.0	62.0	2.5	168.0	
1201	1.50	1.50	2,580	5.4	C	2236.5	3.5	14.0	50.0	0.5	9.0	
1211	6.74	6.74	4,370	24.4	C	2296.0	3.0	13.0	28.0	1.0	24.4	
1221	1.46	1.46	3,310	5.3	C	2271.0	3.5	9.0	46.0	0.5	5.9	
1241	2.78	2.78	3,700	10.1	C	2196.3	3.2	8.0	38.0	0.7	10.9	
1301	3.88	3.88	3,350	14.1	C	2241.0	5.5	14.0	42.0	1.0	26.2	
1302	1.70	5.58	4,150	20.2	C	2211.5	7.0	32.0	66.0	0.5	20.3	
1401	20.26	20.26	7,150	70.1	C	2397.0	4.5	13.0	28.0	2.0	73.1	
1402	5.04	25.30	10,600	87.5	C	2226.5	2.5	17.0	51.0	2.0	93.1	
1511	7.12	7.12	6,200	35.5	C	2287.5	3.0	12.0	34.0	1.5	42.9	
1601	5.48	5.48	5,310	27.4	C	2388.5	5.5	10.0	26.0	1.5	36.4	
1701	7.28	7.28	6,180	30.0	C	2433.5	4.0	16.0	38.0	1.0	30.0	
1801	1.67	1.67	2,840	6.9	C	2484.5	4.5	11.0	45.0	0.5	7.1	
T1:												
101	1.10	1.10	2,720	8.5	C	2479.0	5.0	13.0	30.0	0.5	8.5	
102	2.79	3.89	3,650	29.9	C	2386.0	5.5	10.0	29.0	1.5	36.4	
103	1.99	5.88	4,420	45.2	C	2314.0	4.0	13.0	32.0	1.5	46.2	
104	3.99	10.75	5,050	82.7	C	2259.0	5.5	15.0	26.0	2.0	83.1	
105	0.84	11.99	5,750	92.2	C	2218.5	5.0	13.0	30.0	2.5	105.0	
106	0.77	12.76	6,800	92.3	C	2169.0	5.0	13.0	33.0	2.5	105.0	
107	0.95	14.06	7,940	96.6	C	2124.5	3.5	35.0	65.0	1.5	117.7	
111	0.35	0.35	1,260	2.0	C	2195.5	3.0	10.0	27.0	0.5	6.5	
121	0.40	0.40	1,020	2.2	C	2334.5	5.0	11.0	30.0	0.5	7.1	
141	0.88	0.88	1,430	6.8	C	2421.0	6.0	10.0	32.0	0.5	6.8	
T2:												
201	0.93	0.93	1,620	2.6	C	2255.0	5.5	7.0	28.0	0.5	4.6	
202	1.25	2.71	2,570	7.6	C	2162.5	6.5	6.0	31.0	1.0	12.0	
203	0.53	3.24	3,440	9.1	C	2117.5	6.5	9.0	27.0	1.0	17.4	
204	0.89	4.58	3,790	12.9	C	2106.5	6.5	10.0	45.0	1.0	19.1	
211	0.45	0.45	1,540	1.3	C	2154.5	7.5	7.0	27.0	0.5	4.6	
221	0.53	0.53	1,060	1.5	C	2297.0	5.0	6.0	33.0	0.5	4.0	
T3:												
301	0.69	0.69	2,200	1.9	C	2194.0	5.0	13.0	38.0	0.5	8.4	
302	0.73	1.42	3,170	4.0	C	2135.5	5.5	14.0	48.0	0.5	9.0	
303	0.86	3.66	3,840	10.3	C	2088.5	5.0	8.0	26.0	1.0	15.6	
311	1.38	1.38	2,720	3.9	C	2161.0	5.0	13.0	44.0	0.5	8.4	

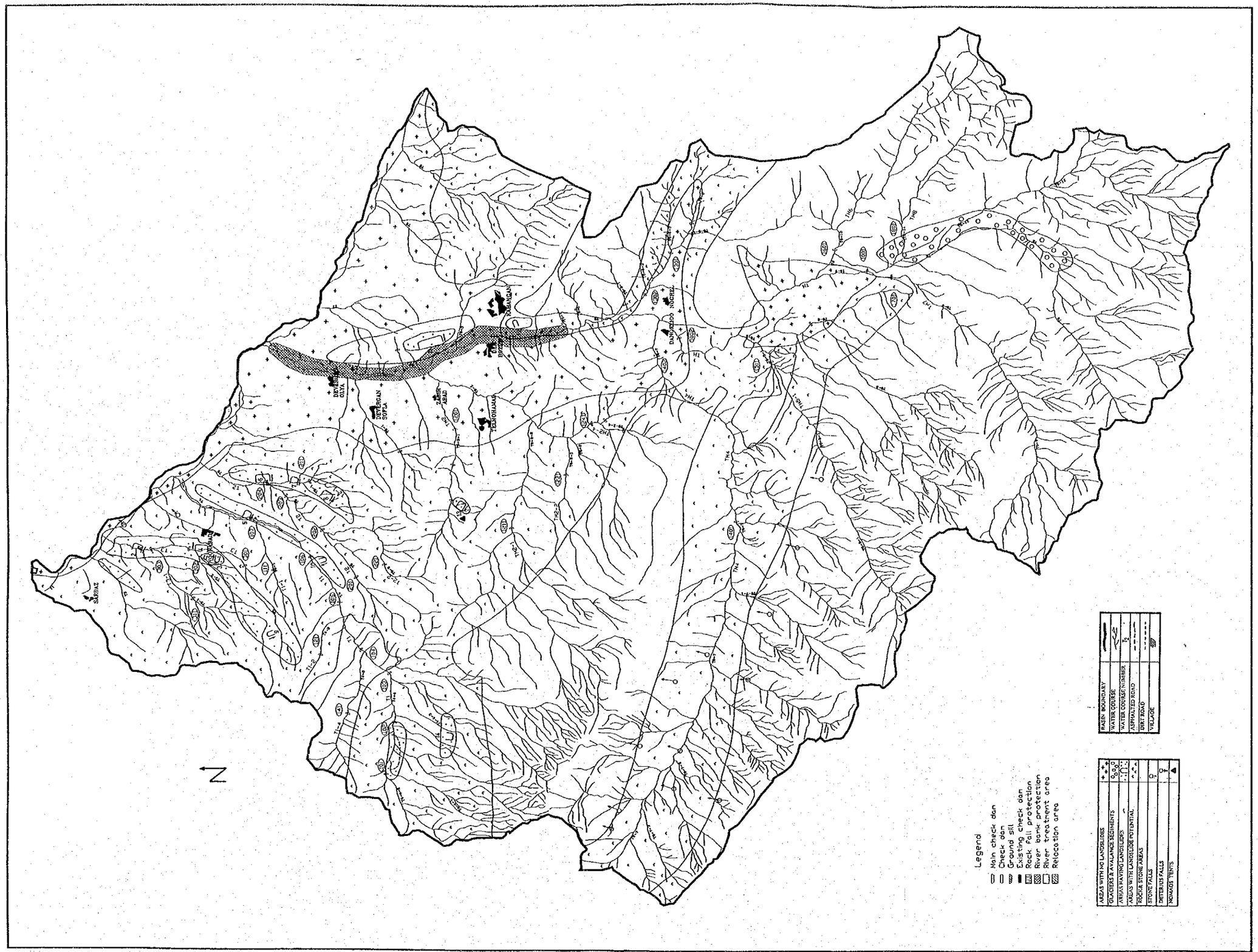


Figure 10-4-1-1 Location Map of Disaster Prevention Facility : Sarbaz