

10.4.2 River Treatment

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

Revetment and spur dikes are partially installed on some sections of the banks, downstream of Lee Sorkh River, however, these are not enough to cover most of the river banks. Thus, gabion type bank protection by people's participation is planned for 1.5 km upstream from Kahangan Bridge and 4 km downstream from the Bridge.

The location of river treatment is shown in Figure 10-4-1-1 and the structure is illustrated in ANNEX-E.

10.4.3 Landslide Protection

In North Basin, landslide occurs Sarbaz and the catchments of T1, T2 and T3 tributaries in and around Noorabad, while in South Basin it occurs on the small hills, each of which are located south and north of Kahangan, and on the catchments of one of left tributaries (TM2).

The countermeasures planned are the same as that of Bazoft. One landslide area is located on the small hill, north of Kahanganm, and there is one dirt irrigation canal on the middle of the landslide slope. Lining of this canal is necessary in order to reduce the landslide movement.

The farmland and road sections to be protected with such countermeasures are estimated to be 58 ha and 1.1 km respectively.

The locations of landslide protection are shown in Figure 10-4-1-1 and the structure is illustrated in ANNEX-E.

10.4.4 Soil Erosion Protection

Present erosion and proposed erosion protection in Sarbaz are summarized in Table 10-4-4-3 and its proposed plan is illustrated in Figure 8-3 in Database Map. As shown in Table 10-4-4-3, present annual soil loss of Sarbaz is 14.6 t/ha (1.0 mm) in the sub-basin basis, that is the lowest among five Master Plan areas due to large extent of orchard as well as relatively low rainfall erodibility and gentle slope. The annual erosion rates of dry farmland and rangeland are 32.8 t/ha and 26.8 t/ha that are equivalent to 2.2 and 1.8 times of the basin-wise soil loss. From the viewpoint of occupation of area, erosion of rangeland is dominant in the area. The annual erosion rate will be improved to 6.8 t/ha

(0.5 mm) in future by soil erosion protection.

(1) Plan of Surface Erosion Protection for Farmland

Due to large extent of orchard, soils are enough protected already so that no measures are necessary for soil protection except dry farmland. Erosion of dry farmland is exceeding the allowable level due to high ratio of fallow land. The fallow land occupies 80% of farmland. In Scenario-1, by the improvement of irrigation system, 11 ha of fallow land where the Khangon-Devergan Canal System runs nearby and 56 ha of the rangeland (vegetation zone AL) where the Noorabad-Sarbaz Canal System runs nearby are converted to the orchard (see Figure 10-3 in Database Map). Converted dry farmland belongs to Class II land for irrigation, but rangeland belongs to Class IV land because only Class IV land is available in the said canal system. Based on the Agricultural Plan, 20 m interval contour bund has been proposed in the dry farmland over 13% inclination in Scenario-1. However, it is difficult to keep erosion within the allowable level due to high ratio of fallow land. Consequently, it is proposed to convert fallow land of 15 ha to dry type alfalfa in Scenario-2. Annual erosion rate of dry farmland of 162 ha is reduced from 41.1 t/ha (2.94 mm) to 14.8 t/ha (1.06 mm). The effects of contour bund provision are summarized as follow.

Table 10-4-4-1 Surface Erosion Protection for Dry Farmland in Sarbaz

Area (ha)	Type of Farmland	Slope	Facility	Alfalfa Introduction	Soil Loss	
					Present	Scenario-2
162	Dry farmland	13%-30%	Contour Bund (20 m interval)	15ha	41.1 t/ha/yr 2.94 mm/yr	14.8 t/ha/yr 1.06 mm/yr

(2) Erosion Improvement in Rangeland

Rangeland improvement is carried out for 1,641 ha by protection and for 3,695 ha by seeding, totally for 5,336 ha as shown in Table 10-4-4-2. Annual erosion rate of rangeland will be improved from 26.8 t/ha (1.91 mm) to 5.6 t/ha (0.4 mm), that is enough lower than the allowable rate of 15 t/ha. There is no severe problem in the rangelands both for protection and seeding.

Table 10-4-4-2 Proposed Rangeland Improvement in Sarbaz

Rangeland Veg. Zone	Slope (%)	Area		Bare Soil Ratio		Soil Loss			
		Present (ha)	Sc.-2 (ha)	Present (%)	Sc.-2 (%)	Present		Scenario-2	
						(t/ha)	(mm)	(t/ha)	(mm)
Protection.									
AH	19%	200	200	27%	12%	16.2	1.16	9.4	0.67
EG	21%	169	169	24%	9%	17.2	1.23	8.6	0.61
GE	28%	431	431	13%	0%	12.1	0.86	4.0	0.29
GL	22%	841	841	11%	0%	7.0	0.50	2.6	0.19
Ave.	23%	1,641	1,641	19%	5%	13.1	0.94	6.2	0.44
Seeding									
AA	27%	632	632	20%	0%	22.5	1.61	4.8	0.34
AG	39%	1,558	1,558	34%	0%	49.8	3.56	9.0	0.64
AL	23%	1,109	1,053	38%	0%	26.6	1.90	4.3	0.31
DA	22%	452	452	27%	0%	13.4	0.96	2.2	0.16
Ave.	28%	3,751	3,695	30%	0%	28.1	2.01	5.1	0.36
Total	25%	5,392	5,336	24%	3%	26.8	1.91	5.6	0.40

(3) Gully Protection

There are no severe gullies in this area, so that no plans are established.

Table 10-4-4-3 Summary of Soil Erosion Protection in Sarbaz

Development Stage	Present Condition						Scenario-1						Scenario-2								
	Land Use		Area (ha)	Conservation		Soil Loss		Area (ha) (+)	Area (ha) (-)	Conservation		Soil Loss		Area (ha) (+)	Area (ha) (-)	Conservation		Soil Loss			
	slope	Crop		Facility	Slope L (m)	(t/ha)	(mm)			Facility	Slope L (m)	(t/ha)	(mm)			Facility	Slope L (m)	(t/ha)	(mm)		
Farmland																					
DFL (Dry Farmland)																					
1	- 5%		26	none	100	2.3	0.16	15	none	100	2.1	0.15	15	none	100	2.1	0.15	15	none	100	
		Wheat	5			1.0	0.07	5			1.0	0.07	5			1.0	0.07	5			
		Fallow	21			2.6	0.19	-11	10		2.6	0.19	10			2.6	0.19	10			
		D. Alfalfa	0					0					0					0			
2	5%-13%		20	none	100	5.4	0.39	20	none	100	5.4	0.39	20	none	100	5.4	0.39	20	none	100	
		Wheat	4			2.0	0.14	4			2.0	0.14	4			2.0	0.14	4			
		Fallow	16			6.2	0.44	16			6.2	0.44	16			6.2	0.44	16			
		D. Alfalfa	0					0					0					0			
3	13%-20%		122	none	100	32.6	2.33	122			14.6	1.04	122			14.6	1.04	122			
		Wheat	23			12.5	0.89	23	Contour bund	20	5.6	0.40	23	Contour bund	20	5.6	0.40	23	Contour bund	20	
		Fallow	99			37.3	2.66	99			16.7	1.19	99			16.7	1.19	99			
		D. Alfalfa	0					0					0					0			
4	20%-30%		40	none	100	67.0	4.79	40			25.5	1.82	40			25.5	1.82	40			
		Wheat	8			28.8	2.06	8	Contour bund	20	12.9	0.92	8	Contour bund	20	12.9	0.92	8	Contour bund	20	
		Fallow	32			76.5	5.46	32			28.7	2.05	32			28.7	2.05	32			
		D. Alfalfa	0					0					0					0			
Total			208		100	32.8	2.34	-11	197		60	14.9	1.06	197		60	12.8	0.91	197		
		Wheat	40			13.3	0.95	40			6.1	0.44	40			6.1	0.44	40			
		Fallow	168			37.4	2.67	-11	157		17.2	1.23	-15	142		15.9	1.14	-15	142		
		D. Alfalfa	0					0					15	15		1.3	0.09	15	15		
Orchard																					
1	- 5%	Apple	373	Irr. Ditch	5	0.1	0.01	+11	384	Irr. Ditch	5	0.1	0.01	384	Irr. Ditch	5	0.1	0.01	384	Irr. Ditch	5
2	5%-13%	Apple	678	Irr. Ditch	5	0.3	0.02	+56	734	Irr. Ditch	5	0.3	0.02	734	Irr. Ditch	5	0.3	0.02	734	Irr. Ditch	5
3	13%-20%	Apple	990	Irr. Ditch	5	1.2	0.09		990	Irr. Ditch	5	1.2	0.09	990	Irr. Ditch	5	1.2	0.09	990	Irr. Ditch	5
Total			2,041			0.7	0.05		2,108			0.7	0.05	2,108			0.7	0.05	2,108		
Rangeland																					
AA	27%		632	none	100	22.5	1.61	632	Seeding	100	4.8	0.34	632	Seeding	100	4.8	0.34	632	Seeding	100	
AG	39%		1,558	none	80	49.8	3.56	1,558	Seeding	80	9.0	0.64	1,558	Seeding	80	9.0	0.64	1,558	Seeding	80	
AH	19%		200	none	110	16.2	1.16	200	Protection	110	9.4	0.67	200	Protection	110	9.4	0.67	200	Protection	110	
AL	23%		1,109	none	120	26.6	1.90	-56	1,053	Seeding	120	4.3	0.31	1,053	Seeding	120	4.3	0.31	1,053	Seeding	120
DA	22%		452	none	80	13.4	0.96	452	Seeding	80	2.2	0.16	452	Seeding	80	2.2	0.16	452	Seeding	80	
EG	21%		169	none	100	17.2	1.23	169	Protection	100	8.6	0.61	169	Protection	100	8.6	0.61	169	Protection	100	
GL	22%		841	none	50	7.0	0.50	841	Protection	50	2.6	0.19	841	Protection	50	2.6	0.19	841	Protection	50	
GE	28%		431	none	50	12.1	0.86	431	Protection	50	4.0	0.29	431	Protection	50	4.0	0.29	431	Protection	50	
Total			5,392		86	26.8	1.91	5,336		86	5.6	0.40	5,336		86	5.6	0.40	5,336		86	
Tree Plantation																					
Tree	17%		18	Irr. Ditch	5	1.0	0.07	18	Irr. Ditch	5	1.0	0.07	18	Irr. Ditch	5	1.0	0.07	18	Irr. Ditch	5	
Total			18			1.0	0.07	18			1.0	0.07	18			1.0	0.07	18			
Farmland			2,249			3.7	0.26	56	2,305		1.9	0.14	2,305			1.7	0.12	2,305			
Rangeland			5,392			26.8	1.91	-56	5,336		5.6	0.40	5,336			5.6	0.40	5,336			
Tree Plantation			18			1.0	0.07	18			1.0	0.07	18			1.0	0.07	18			
Sub-Total			7,659			20.0	1.43	7,659			4.5	0.32	7,659			4.4	0.31	7,659			
Village			157			0.0	0.00	157			0.0	0.00	157			0.0	0.00	157			
River Bed			221			0.0	0.00	221			0.0	0.00	221			0.0	0.00	221			
Rock			7,413			9.7	0.69	7,413			9.7	0.69	7,413			9.7	0.69	7,413			
Sub-Total			7,791			9.2	0.66	7,791			9.2	0.66	7,791			9.2	0.66	7,791			
Total			15,450			14.6	1.04	15,450			6.9	0.49	15,450			6.8	0.49	15,450			

Soil Erosion Protection Project

162	41.1	2.94	162	Contour Bund	20m	17.3	1.24	162	Contour Bund	20m	14.8	1.06
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(Note)

- 1) Detail analysis are in Table D-5-2-7(3) for Unit Soil Loss, in Table D-5-2-8(3) for Present, in Table D-5-2-9(3) for Scenario-1, in Table D-5-2-10(3) for Scenario-2.
- 2) Dry farmland of 11 ha and Rangeland of 56 ha is converted to Orchard 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 15 ha will be introduced in fallow land in Scenario-2.

10.4.5 Rangeland Vegetation Improvement (seedling, water point)

Improvement of rangeland vegetation is carried out in order to mitigate over grazing and to protect soil from erosion. In this sub basin total area of rangeland is 5,392 ha, of which 1,080 ha is under authority

of Department of the Environment and treated according to their regulation/arrangement. 56.5 ha will be converted to orchard through a separate plan undertaken by this project. Thus these areas (total about 1,136 ha) are excluded from the rangeland vegetation improvement plan. On the other hand, results of field investigation on present condition of rangeland reveal that only 2,528 ha, mainly nearby villages and roads required recovery through seed sowing works. While as benefits of suitable soil and favorable climatic condition the remaining parts have moderate condition and constant trend, which are improved through protection and rotational utilization program.

With attention to above mentioned facts, and considering the ecological, social and economical conditions of the area, a "low cost" plan for improvement of rangeland has been prepared. To ensure quick restoration/improvement of vegetation, period for initial implementation, and the consequent treatment cycles is set at 10 years.

Implementation of plan will start from localities having lowest production. Field works are entrusted to experienced local people, and donkeys do transport of required materials from village to field. Considering natural distribution of rangeland, in vegetation improvement works cooperation of all villages, particularly that of Deh Bozorg, Dangazloo, Devergan Sofla, Kahangan, Noghel and Telmohamad is required.

Total area of rangeland to be improved by this plan is 4,256 ha (5,392-1,136 ha). Of these 2,528 ha would be through seed sowing works, and 1,728 ha through protection and rotational utilization program.

(1) Seed Sowing Works

a) Establishment of Seed Production Plot

In first year a plot of 4 ha is established in rangeland closed to road and nearby Kahangan village, in a suitable soil. Plot is fenced and permanently cared by 3 persons with a 24-hour working schedule of 8 hours each. Seeds of Bromus (brome) and Agropyron (wheatgrass) grasses are mixed at a 50:50 ratio and sown in the plot at a rate of 7 kg/ha (28 kg/plot) for seed production purpose. The seed are sown in spring/autumn when climatic condition is suitable for germination and growth. To reduce the cost, and overcome the natural physical obstacle most of works are done manually. At sowing time, a herd of local livestock is guided into plot to cause disturbance of soil. The herd is dismissed, then seeds are sown, and again herd is moved in, to hide the seeds.

The produced seeds are collected and used in rangeland improvement works, and herbage is fed to herds and other animals, which are used by the project.

The produced seed is 280 kg, from 1 seed, 10 seeds is expected ($28 \times 10 = 280$). And the

produced herbage would be about 700 kg. With seed sowing, herbage production of 175 kg/ha is expected, so $4 \times 175 = 700$ kg.

b) Establishment of Vegetation Improvement Plot

In second year the remaining 2,524 ha (2,528-4 ha) is divided into 10 plots and 1 plot of 252 ha (2,524 ha/10 years) is taken for vegetation improvement works. The plot is sown with grass seeds (1kg/ha) collected from seed production plot, protected and cared 24-hour by 3 persons, 8 hours each. Presence of large % of rock, bush, shrub and forbs, does not permits sowing large amount of seed. In consequent years upon designation of a new plot, an old plot is opened to herds and utilized in a sustainable manner. Entire area will receive this treatment within 10 years, and the same cycle is repeated with no time gap to sustain the improved situation. However seed-sowing area is 252 ha, whenever rangeland utilization norm (communal/village uses) does not permits, the work is done in few scattered smaller pieces, sum being 252 ha.

The 252 ha plot would bring-about an increase of 44.1 tons of herbage in production of rangeland. With seed sowing works, in an average, an increment of 175 kg/ha is expected, so $252 \times 175 = 44,100$ kg (44.1 tons/year). At present average production of rangeland is 161 kg/ha, which with project would reach to 336 kg/ha (161+175). Moreover, in growing season the established grasses will cover an additional 30% of bare soil, which contributes in prevention of soil erosion and conservation of the area. Present land cover is 49.6%. With project it would be 79.6% (49.6+30).

(2) Protection and Rotational Utilization Program

The 1,728 ha with no seed-sowing requirement is divided into 10 plots of 173 ha size and each year 1 plot is protected, by assigning watchman, with a 24-hour watching schedule (3 persons, 8 hours each). Upon establishment of a new plot, 90% of an old plot is open to herds, and 10% remain closed to ensure the natural dispersion of seeds into the area. This protection and rotational utilization of plots will be practiced with no time gap to obtain more feed for livestock and ensure regular dispersion of seeds into area, which will bring-about gradual increment in rangeland production. However protected area is 173 ha, whenever rangeland utilization norm (communal/village uses) does not permits, the practice is performed in few scattered smaller pieces, sum being 173 ha.

Protection of 173 ha of rangeland will bring-about an increment of 13.0 tons in its herbage production. With protection in an average, an increment of 75 kg/ha is expected, so $173 \times 75 = 12,975$ kg (about 13.0 tons/year). In an average, presently rangeland produces 161 kg/ha. With project it is 236 kg/ha (161+75). Furthermore the improved vegetation would cover an additional 15% of bare soil, contributing to prevention of soil erosion and conservation of the environment. Present land cover is

49.6%, with protection it will reach to 64.6% (49.6+15).

(3) Establishment of Watering Points for Livestock

However Morbor River and many springs of good quality water occur in this sub basin, to reduce the movement/trampling of animals and have their even distribution in rangeland, 4 watering points are established in localities being far from river/springs. The watering point is a concreted structure of 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 of 40 kg weight is designated as one animal unit. Average water requirement of an animal unit is 5 liters/day.

Establishment of these facilities will bring-about an increment of 5.8 tons in meat production of livestock. It has been known that daily water supply to a grazing animal will promote its weight by 0.04 kg/day, of which 50% in form of meat. About 2,400 animals are directly benefited from the water point facilities, so $0.04 \times 120 \times 2,400 \times 0.5 = 5,760$ kg (about 5.8 tons).

10.4.6 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 10-4-6-1 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

Source: Ministry of Agriculture

b) Proposed Plan

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 %. In Sarbaz, there are 7 major irrigation canals. In these canals, Dangazloo-Kahangan, Kahanghan-Devergan, Dangazloo and Noorabad-Sarbaz canal are proposed to be rehabilitated with concrete lining. After rehabilitation of these canals, surplus water is estimated as follows. By these projects, it is possible to irrigate 145 ha of farmland in case of Alfalfa.

Table 10-4-6-2 Surplus Water and Irrigation Water of Major Crops

Canal	Production of Surplus Water (liters/s)	Water Demand (liters/s/ha)		
		Alfalfa	Vegetable	Apple
Dangazloo-Kahangan canal	94	1.68	1.93	1.77
Kahanghan-Devergan canal	20			
Dangazloo canal	30			
Noorabad-Sarbaz canal	100			

Source: JICA Study Team and Revised Data of MOA

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

- Improvement of Dangazloo-Kahangan canal (B 0.85 m x H 0.50 m) 3.0 km
- Improvement of Kahangan-Devergan Olya canal (B 0.30 m x H 0.25 m) 1.9 km
- Improvement of Dangazloo canal (B 0.50 m x H 0.35 m) 2.3 km
- Improvement of Noorabad-Sarbaz canal (B 0.50 m x H 0.35 m) 11.0 km

(2) Agricultural Scheme

a) Potential of Development

In Sarbaz, almost all farmland are irrigable. Farmland is located in narrow fan and low hills. According to the land use at present, total farmland is 2,249 ha including orchard land, dry farmland and fallow land, and almost all farmland is irrigable, canals have been constructed. On the other hand, according to the village survey, total farmland is 4,307.5 ha, it is found that 653 ha of irrigated farmland shown in the village survey is planted in apple trees areas. Apple is fully planted in irrigated farmland. It is said that irrigated agriculture has already been developed in the Area and 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.

b) Development Plan

According to the above irrigation scheme plan, after rehabilitated the canals of Dangazloo-Kahangan, and Dangazloo, production area increment will be reached 73.81 ha for alfalfa, (or 70.06 ha for apple or 64.25 ha for vegetable). These canal are supplying water to apple trees areas at present. Apple and alfalfa are planted in these irrigation areas, but as

irrigation water is limited, alternate irrigation is applied or limitation of irrigation water occurs in summer season. Considering the marketing conditions of apple products, village progress situations and feed shortage for livestock, it is recommendable to select alfalfa planting in apple trees areas, (vegetable next).

Table 10-4-6-3 Estimated Production Increment by Rehabilitation of Canals (124 lit/s)
(Dangazloo-Kahangan and Dangazloo canals)

	In case of Alfalfa	In case of Vegetable	In case of Apple
Gross Water Demand (litre/s/ha)	1.68	1.93	1.77
Increasing Area (ha)	73.81	64.25	70.06
Estimated Yield	5,865 kg/ha	20,000 kg/ha	40,000 kg/ha
Estimated Increasing Production (ton)	503	1,492	3,254

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

And, Kahangan-Devergan canal rehabilitation could be supplied water for 11.30 ha for apple (or 11.90 ha for alfalfa or 10.36 ha for vegetable) in present dry farmland.

Table 10-4-6-4 Estimated Production Increment by Rehabilitation of Canal (20 lit/s)
(Khanghan-Devergan canal)

	In case of Alfalfa	In case of Vegetable	In case of Apple
Gross Water Demand (litre/s/ha)	1.68	1.93	1.77
Increasing Area (ha)	11.90	10.36	11.30
Estimated Yield	5,865 kg/ha	20,000 kg/ha	40,000 kg/ha
Estimated Increasing Production (ton)	503	1,492	3,254

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

On the other hand, rehabilitation of Noorabad-Srabaz canal could be supplied water to newly developed area from village rangeland. Considering the intentions of farmers and marketing conditions of products, it is recommendable to select apple.

Table 10-4-6-5 Estimated Production Increment by Rehabilitation of Canal (100 lit/s)
(Noorabad-Srabaz canal)

	In case of Alfalfa	In case of Vegetable	In case of Apple
Gross Water Demand (litre/s/ha)	1.68	1.93	1.77
Increasing Area (ha)	59.52	51.81	56.50
Estimated Yield	5,865 kg/ha	20,000 kg/ha	40,000 kg/ha
Estimated Increasing Production (ton)	349	1,036	2,260

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 10-4-6-6 Present and Future Crops Areas

	Present			Future (with plan)			Difference (ha)
	Land area (ha)	Planting (ha)	Intensity (%)	Land are (ha)	Plantable (ha)	Intensity (%)	
Irrigated Farmland							
1 Crops							
1) Wheat		228.5			228.5		+73.81
2) Alfalfa		420.7			494.5		
3) Others		3.8			3.8		
sub-total	0.0	653.0	32.2	0.0	726.8	34.7	
2. Orchard							
1) Apple		2,029.5			2,097.3		+67.8
2) Others		11.5			11.5		
sub-total	2,041.0	2,041.0	100.0	2,108.8	2108.8	100.0	
Sub-total	2,041.0	2,694.0	132.0	2,108.8	2,835.6	134.5	
Dry farmland							
1 Crops							
1) Wheat		208.0			166.7		-41.3
2) Alfalfa		0.0			30.0		+30
3) Others		0.0			0.0		
sub-total	208.0	208.0	100.0	196.7	196.7	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	208.0	208.0		196.7	196.7		
Total	2,249.0	2,902.0		2,305.5	3,032.3		
Rangeland	5,392.0			5,335.5			-56.5
Others	7,809.0			7,809.0			
Grand total	15,450.0			15,450.0			

Note: Details are referred to Annex "Estimated Crops Areas"

Others in crops line include fallow lands.

Irrigated crops are and will be planted in apple tree area.

According to the cropping pattern, in irrigation farmland, some legume and vegetables could be planted after wheat harvested. It would be possible to expand more intensity in whole irrigated farmland considering the limitation of irrigation water and development of cropping pattern such as wheat in winter season + legume (+ vegetable) in summer season or apple + alfalfa (+ vegetable or + legume) planting. Alfalfa could be planted in same apple orchard, affected little the production yield 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.

10.4.7 Collecting and Grading Center of Apple

Analyzing the areas' conditions based on the above development potentials and policies, development plans would be designed for apple collecting and grading during the short-term (5 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 apple collecting & grading center (short-term)

a) Purpose:

To emphasize villagers and promote apple sale by means of establishment of collection, grading, packing and distribution facilities.

b) Participants:

A group should be established, whose members grow apple 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) Establishment of apple collecting and grading facilities (short-term)

- i) Size of group: It will be set that one unit is 100 households in village. A group should be established one in each village. Members should have the intention to development. As the apple land area is approximately 3ha on the average, while yield will be 40t/ha, production will be 12,000t/year. Size of facilities should be designed 2,400 t/year, one-fifth of total production for the first stage.
- ii) Proposed villages: Deh Bozorg, Kahangan and Telmohamd; 3 places
- iii) Required equipment, materials and facilities for one place:

- Building: made of brick, 200m ² ;	1 building
- Tables: made of wood, 1,800x1,200x800mm;	20 units
- Chair: made of wood	100 pieces
- Incidentals: water supply, electricity, latrine	1 set

- Water tank for cleaning: steel, 1x1x1mm; 10 pieces
- Drying table: steel, with fan 10 units
- Roller conveyor: width 400mm; 10 units
- Land: relatively flat land with good access, 300m2

When apple collecting and grading center is established, 100 households in one place will have benefit 875,530,000 Rials (=3,110,400,000-2,234,870,000), or 2,626,590,000 Rials for 3 places, or 87,553,000 Rials per year per household.

10.4.8 Diversification to Milk Cow

(1) Potential of Development

In Sarbaz, total carrying capacity of livestock at present is 31,952 AUM including carrying capacity of rangeland (5,292 ha) of 14,429 AUM, straw from wheat of 2,256 AUM and alfalfa of 15,264 AUM. Therefore, over grazing rate is of 10.5.

Table 10-4-8-1 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
215	2,455	107	3,271	5,264	14,429	31,949	53,678	27,920	335,040	10.5

Note: Details are referred to Annex "Estimated AUM"

On the other hand, AUM of cow, horse and donkey in villages is 8,520 AUM comparing to 5,726 AUM of wheat straw and alfalfa production in village. Over grazing rate is pointed at 1.5. Therefore, sheep and goat grazing are more severely affected the village than the cow, horse and donkey grazing. It is necessary to obtain a lot of feed for proper grazing.

Table 10-4-8-2 Estimated Total AUM for Cow, Horse and Donkey (Present, Village)

Straw from wheat		Alfalfa		Range land		Total	Present			Grazing
Area(ha)	AUM	Area(ha)	AUM	Area(ha)	AUM	AUM	(head)	AU	AUM	Rate
215	2,455	107	3,271	-	-	5,726	142	710	8,520	1.5

Note: Details are referred to Annex "Estimated AUM"

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

(2) Development Plan of Diversification

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 95 could be raised only feed grown in the area at proper conditions. If canal rehabilitation for agricultural development would be conducted and alfalfa would be selected for

additional planting, (though, first selection is apple, second is alfalfa), total head of 215 could be raised.

Table 10-4-8-3 Estimated Total AUM for Cow (with plan)

Present Total		Additional Alfalfa		Total AUM	Future			Grazing Rate
Area(ha)	AUM	Area(ha)	AUM		(head)	AU	AUM	
322	5,726	-	-	5,726	95	477	5,726	1.0
322	5,726	85.71	7,146	12,872	215	1,072	12,872	1.0

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

Table 10-4-8-4 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 10-4-8-5 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 or 266,500 litre/year per 100 heads.

Table 10-4-8-6 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
In case of 100 head (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 cow, number of which will be reached 1,219 heads in the Sarbaz Study Area. In that case, 1,705 households in Sarbaz area will be benefited 3,248,635 litre

or 1,905.358 litre/household which equivalent to 1,905,358 Rials per year per household.

This diversification plan should be promoted step by step with the help of Livestock Office, taking into consideration 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 medium-(10 years) and 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: medium-, long-term
- ② Collection & distribution center for milk: long-term

b) Establishment of groups and cooperatives for milk processing center (medium-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:

- (a) 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,
- (b) 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,
 - (c) To make up the regulations and general rules, members should be well known,
 - (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 processed milk products. Approx. 1.0 t/day by approximately 100 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: Deh Bozorg, Kahangan, Sarbaz and Telmohamad; 4 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.)
- (d) 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 4 villages (1,338 households) will have benefit 449,080,000 Rials or 335,635 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. 5t/day by approximately 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: Sarbaz; 1 place (This village has 250 heads at present, therefore, it is required to collect milk from nearby villages, taking into the above plan of milk processing center.)
- (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, 300 households in village will have benefit 394,870,000 Rials (=2,263,000,000-1,868,130,000) or 1,316,233 Rials per year per household.

10.4.9 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 533 m³/day and water demand in 2020 is estimated at 3,170 m³/day. Then surplus water demand is 2,637 m³/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 10-4-9-1 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)
Deh Bozorg	400	42	1,400	252	210	136
Dangazloo	350	37	1,225	221	183	119
Dorahan	300	32	1,050	189	157	102
Devergan Olya	100	11	350	63	52	34
Develgan Sofla	120	13	420	76	63	41
Kahangan	1,700	180	5,952	1,071	891	579
Noghel	300	32	1,050	189	157	102
Noorabad	550	58	1,926	347	288	187
Sarbaz	700	74	2,451	441	367	239
Telmohamad	500	53	1,750	315	262	170
Zabih Abad	10	1	35	6	5	3
Total	5,030	533	17,610	3,170	2,637	1,712

Dimensions of distribution tanks and pipeline are summarized as follows. 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 10-4-9-2 Proposed Plan for Water Supply

Village	Distribution Tank	Pipeline
Deh Bozorg	B 7.3 m x L 7.3 m x H 3.0 m	PVC pipe ϕ 75, L=1,300 m
Dangazloo	B 6.9 m x L 6.9 m x H 3.0 m	PVC pipe ϕ 75, L=1,200 m
Dorahan	B 6.4 m x L 6.4 m x H 3.0 m	PVC pipe ϕ 75, L=1,000 m
Devergan Olya	B 4.0 m x L 4.0 m x H 3.0 m	PVC pipe ϕ 50, L=300 m
Develgan Sofla	B 4.3 m x L 4.3 m x H 3.0 m	PVC pipe ϕ 50, L=400 m
Kahangan	B 14.5 m x L 14.5 m x H 3.0 m	PVC pipe ϕ 140, L=5,700 m
Noghel	B 6.4 m x L 6.4 m x H 3.0 m	PVC pipe ϕ 75, L=1,000 m
Noorabad	B 8.5 m x L 8.5 m x H 3.0 m	PVC pipe ϕ 90, L=1,800 m
Sarbaz	B 9.5 m x L 9.5 m x H 3.0 m	PVC pipe ϕ 90, L=2,300 m
Telmohamad	B 8.1 m x L 8.1 m x H 3.0 m	PVC pipe ϕ 75, L=1,700 m
Zabih Abad	B 1.7 m x L 1.7 m x H 3.0 m	PVC pipe ϕ 50, L=50 m

10.4.10 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

Asphalt road from Bideh connects 8 villages, which are Dorahan, Devergan Sofla, Devergan Olya, Deh Bozorg, Telmohammad, Khangan, Dangazloo and Noghel village. On the other hand, road without pavement links connects these villages, Sarbaz and Noolabad. Furthermore, there is the unpaved road from Noolabad to Yasuj. These unpaved roads are bumpy and prevent villagers in Noolabad and Sarbaz from easy access to other areas. Then it is necessary to improve the road with asphalt pavement from Sarbaz to Dangazloo via Noolabad. Widths of road and pavement are designed to be 4 m and 3 m respectively.

After improvement, asphalt and gravel paved road should be maintained by government. As for unpaved road including farm road, villagers should 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 from Sarbaz to Dangazloo via Noolabad | 20 km |
| - Transfer of technology for maintenance of road and side ditch | 5 years |
| - Construction and maintenance of farm road by farmers | 300 km |

10.4.11 Establishment of Cooperative

Analyzing the areas' conditions based on the above development potentials and policies, development plans would be designed for handicraft and apple collecting & grading during the short-term (5 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; establishment of apple collecting & grading center, establishment of groups and cooperatives for milk processing center and collection & distribution center 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: Sarbaz; 1 place
- iii) Required equipment, materials and facilities (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, 20members per each place will be benefited 25,430,000 Rials (60,000,000-37,570,000) 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: Deh Bozorg, Dangazloo, Dorahan, Kahangan, Noorabad, Sarbaz, and Temohamad; 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.

10.4.12 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.
- b) The government committee holds meeting with representatives of Village Islamic Councils to explain the project purpose, project components, implementation method, etc.
- c) Representatives of Village Islamic Council hold small meeting at each villages to explain outline of the project.
- d) The government committee facilitates to establish villager's organization based on the villager's willingness to participation in the project.
- e) 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 10-4-12-1 Number of village and household in Sarbaz

No.	Village Name	Household	No.	Village Name	Household
1	Deh Bozorg	250	7	Noghel	43
2	Dangazloo	155	8	Noorabad	60
3	Dorahan	50	9	Sarbaz	300
4	Devergan Olya	24	10	Telmohamad	480
5	Devergan Sofla	34	11	Zabih Abad	1
6	Kahangan	308	—	—	—

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 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 landslide, and soil erosion. Enlightenment activities will be carried out at least once after flood season.
- 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.

10.4.13 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 10-4-13-1 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)
Apple collecting & grading center (3 places)	300 households 102 workers	2,626,590,000 255,000,000	87,553,000 per h.h. 2,500,000 per p.
Diversification of Milk Cow			
Milk production (whole villages)	1,705 households	3,248,635,000	1,905,358 per h.h.
Milk processing center (4 villages)	1,338 households 20 operators	449,080,000 129,500,000	335,635 per h.h. 6,475,000 per p.
Milk collection & distribution center (one village)	300 households 7 operators	394,870,000 37,375,000	1,316,233 per h.h. 5,339,286 per p.
Handicraft facilities (one place)	20 members 20 weavers	25,430,000 24,000,000	1,271,500 per p. 1,200,000 per p.

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

10.5 K7-48 Tang Sorkh

10.5.1 Construction of Check Dam

(1) Specific Sediment Discharge

Based on the topography, geological condition and riverbed condition, the specific sediment discharge for the right tributary of Tang Sorkh River and T3, T5 and T6 tributaries, where sediment production is larger than that of the other tributary, is applied $350 \text{ m}^3/\text{km}^2/\text{year}$, while the rest of the tributary is adopted $100 \text{ m}^3/\text{km}^2/\text{year}$.

(2) Tang Sorkh River Basin

a) Right Tributary

The right tributary of Tang Sorkh River is severely devastated and feed a lot of debris to the main river. Five main check dams with Type C and two check dams to be implemented by people's participation are planned in order to prevent the movement of unstable sediment, and stabilize the riverbed and foot of slope.

b) Main River Course

Sar Tang Sorkh located on the right bank of Tang Sorkh River has flood, but the damage is very limited. In addition, sediment in the riverbed is very little. Thus, two check dams to be implemented by people's participation are planned on the tributaries from the stone fall area.

On the left bank, three major tributaries join the main river course near Sar Tang Sorkh and fishpond. One main check dam is allocated on each tributary in order to prevent the movement of unstable sediment, and stabilize the riverbed and foot of slope.

A narrow gorge is formed at the confluence with the left tributary. Another main check dam with Type B is located here in order to protect farmland in the lower reaches and stabilize the water for existing irrigation system on both banks through intake facility attached to the dam. This dam should be implemented after the completion of the check dams on the right tributary.

(3) Right Bank of Boshar River

a) North Basin

A few tributaries flow into Boshar River on its right bank, north of Tang Sorkh River. One main check dam with Type C and one check dams to be implemented by people's participation are planned in order to prevent the movement of unstable sediment, and stabilize the riverbed and foot of slope.

b) South Basin

South of Tang Sorkh River, a few tributaries also flow into Boshar River on its right bank. Erosion is very severe in the area and seven main check dam with Type C are planned on this basin in order to prevent movement of unstable sediment, and stabilize the riverbed and foot of slope, and protect further erosion and farmland in the lower reaches.

(4) Left Bank of Boshar River

Several tributaries join into Boshar River from the left bank. Two of them, which flow through Allah Abad and Cheshmeh Chenar, cause damage on these villages by flood and debris flow. One main check dam with Type C is planned on each tributary in order to prevent the movement of unstable sediment, and stabilize the riverbed and foot of slope.

One tributary located north of Cheshmeh Chenar has the largest catchment among the tributaries on the left bank and farmland in the lower reaches near Boshar River. The catchment area of this tributary is rocky and less devastated. Thus, one main check dam with Type C is allocated on this tributary in order to prevent the movement of unstable sediment and protect farmland in the lower reaches.

In addition, one check dam to be implemented by people's participation is planned in order to prevent further erosion.

(5) Outline of Check Dams

The dimension of main check dams are listed in Table 10-5-1-1 and their location is also shown in Fig. 10.5.1.1. The total number of check dams by type is summarized as follows;

Main check dam (Type B).....	1 No.
Main check dam (Type C).....	19 Nos.
Check dam (Type D)	6 Nos.

(6) 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 10-5-1-1.

(7) 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 of the basin.

Based on Table 10-5-1-1, the total vacant volume (storing capacity for debris) of main check dams is around 55,700m³, and that of 6-check dams by people's participation 18,000m³ (3,000m³ per each) and

totally become 73,700m³. On the other hand, annual sediment discharge is estimated around 6,300 m³. Thus, the total vacant volume is equivalent to about 12-years of sediment discharge.

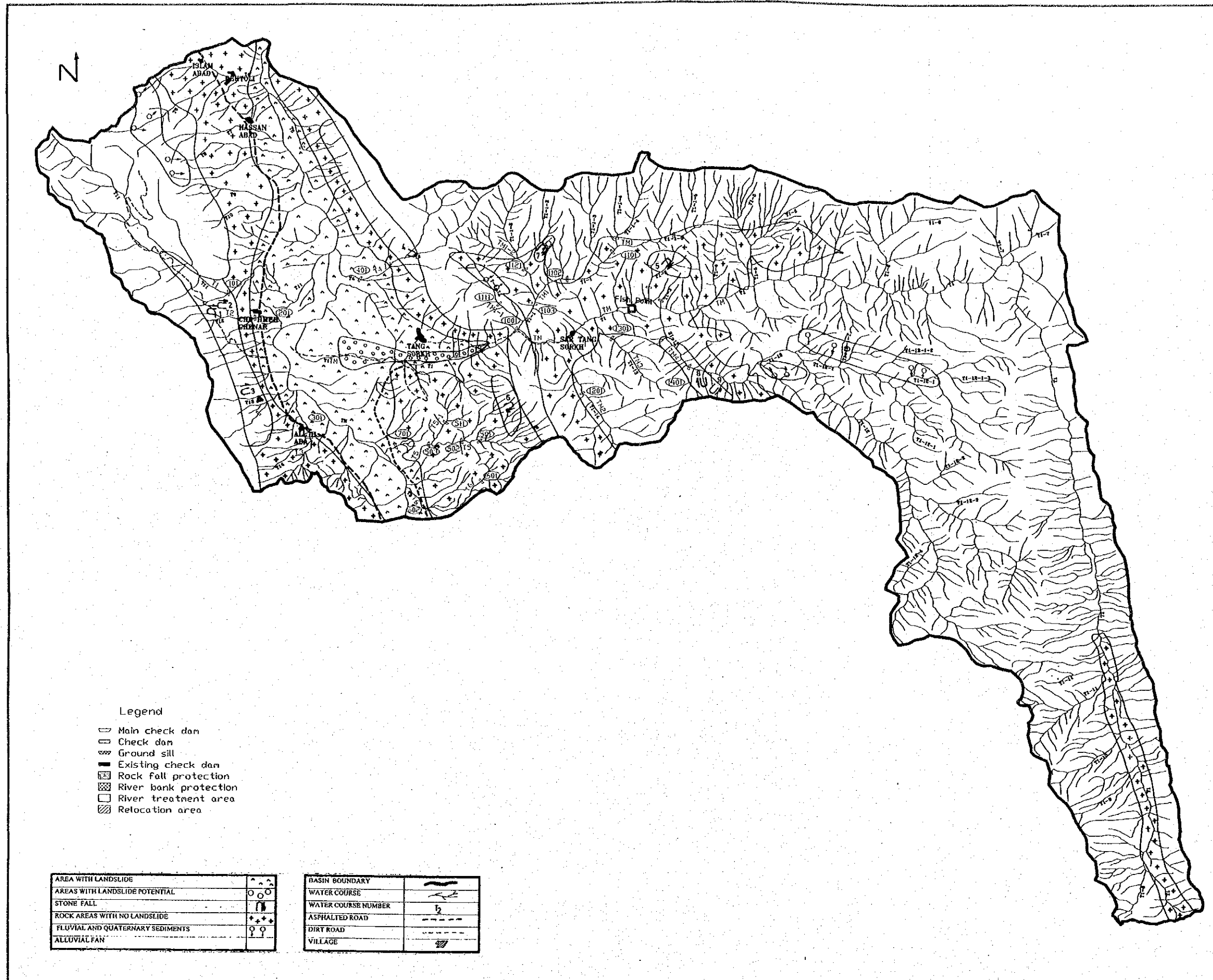


Figure 10-5-1-1 Location Map of Disaster Prevention Facility : Tang sorkh

10.5.2 Soil Erosion Protection

Present erosion and proposed erosion protection in Tang Sorkh are summarized in Table 10-5-2-3, and its proposed plan is illustrated in Figure 8-4 in Database Map. As shown in Table 10-5-2-3, present annual erosion rate of this sub-basin is 29 t/ha (2.1 mm/yr), that is the highest following Zeras. The annual erosion rates of dry farmland and rangeland are 18.1 t/ha and 48 t/ha respectively. The rate of rangeland is 1.7 times of it of the basin-wise so that the erosion of rangeland is dominant in this sub-basin. The basin-wise erosion will be improved to 16 t/ha/yr (1.1 mm/yr) in future.

(1) Plan of Surface Erosion Protection for Farmland

As shown in Table 10-5-2-3, present annual erosion rate of the irrigated farmland is 1.6 t/ha (0.11 mm), that is enough lower than the allowable level of 15 t/ha. On the other hand, erosion rate of dry farmland of 20-30% inclination is extremely high at 41 t/ha (3.0 mm), that is largely exceeding the allowable level. Since this dry farmland locates at the foot of mountain slope in the right bank of Boshar river, where the high erosive soil (Soil series 2.3) is covering the land, as well as high rainfall erodibility, heavy erosion is caused in this land. In Scenario-1, irrigation improvement will bear extra irrigation water, and it will enable to irrigate 76 ha additionally. Dry farmlands of 76 ha, where the irrigation canal runs closely, are converted to the irrigated farmland, and those farmlands are proposed to be cultivated with alfalfa by the Agricultural Plan. As shown in Scenario-1 in Table 10-5-2-3, erosion rate of those farmlands will be reduced below the allowable level by introduction of basin irrigation system.

Although erosion rate of dry farmland of slope 5-13% is 16.2 t/ha, exceeding slightly the allowable level, but it is not so serious. Therefore, soil protection will be concentrated to the dry farmland with a slope of 20-30% inclination. In this dry farmland, annual erosion rate can be reduced from 41.4 t/ha (2.96 mm) to 15.5 t/ha (1.11 mm), almost close to the allowable level, by provision of 20 m interval contour bund as below:

Table 10-5-2-1 Surface Erosion Protection for Dry Farmland in Tang Sorkh

Area (ha)	Type of Farmland	Slope	Facility	Alfalfa Introduction	Soil Loss	
					Present	Scenario-2
44	Dry farmland	20%-30%	Contour Bund (20 m interval)	none	41.4 t/ha/yr 2.96 mm/yr	15.5 t/ha/yr 1.11 mm/yr

(2) Erosion Improvement in Rangeland

As shown in Table 10-5-2-2 rangeland improvement is carried out for 2,262 ha by protection and for 856 ha by seeding, totally for 3,118 ha. The annual erosion rate of rangeland will be reduced from 48.4 t/ha (3.46 mm) to 24.7 t/ha (1.76 mm) by protection and seeding. Although the vegetation zone GB

is proposed to be protected by the Rangeland Improvement Plan, its improvement measure should be by seeding in Scenario-2 taking its location and the high ratio of bare soil into consideration. Since It locates at just upper part of the important farmland of this area as shown in Figure 8-4 in Database Map, its improvement measure should be taken by seeding from the viewpoints of its importance and inclination slower than 40%. It is able to reduce erosion to 14.2t/ha by seeding. In the rangelands with seeding, erosion rate decreases to 9.8 t/ha (0.70 mm) enough lower than the allowable level. On the other hand, erosion rate of rangelands by protection decreases only to 26.9 t/ha (1.92 mm), that is still higher than the allowable level. It is due to the high erosion rate of AG-1 even after protection because of severe deterioration of this rangeland. Other than AG-1, it is possible to reduce erosion rate lower than the allowable level.

Table 10-5-2-2 Proposed Rangeland Improvement in Tang Sorkh

Rangeland		Area		Bare Soil Ratio		Soil Loss			
Veg. Zone	Slope (%)	Present (ha)	Sc.-2 (ha)	Present (%)	Sc.-2 (%)	Present		Scenario-2	
						(t/ha)	(mm)	(t/ha)	(mm)
Protection									
AB-1	45%	794	794	8%	0%	33.1	2.36	12.4	0.89
AG-1	45%	907	907	43%	28%	81.9	5.85	58.5	4.18
QG-1	30%	561	561	10%	0%	21.3	1.52	9.7	0.69
Ave.	40%	2,262	2,262	20%	9%	45.4	3.24	26.9	1.92
Seeding									
AB-2	30%	400	400	8%	0%	19.0	1.36	7.1	0.51
AG-2	30%	170	170	43%	0%	60.6	4.33	10.8	0.77
GB	38%	261	261	41%	0%	76.7	5.48	14.2	1.01
QG-2	25%	25	25	10%	0%	15.9	1.14	7.2	0.51
Ave.	31%	856	856	26%	7%	43.1	3.08	9.8	0.70
Total	35%	3,118	3,118	23%	8%	48.4	3.46	24.7	1.76

(3) Improvement of Waste Land

The erosive marl hills defined as the wasteland (AR) are locating at both banks of the Boshar river. Present annual erosion rate of the wasteland is estimated at 40 t/ha/y (2.86 mm). The marl hills can be developed by fruit tree plantation with drip irrigation, because the hills are relatively gentle in slope and close to the Boshar river that can be water source for the hills. There is a plan to develop those hills by MOJA in future. When it is developed by fruit tree plantation, annual erosion rate will be reduced to 7.7 t/ha (0.55 mm).

(4) Gully Protection

In this area, there is no severe gully erosion, so that no plans are made for gully protection.

Table 10-5-2-3 Summary of Soil Erosion Protection in Tang Sorkh

Development Stage			Present				Scenario-1				Scenario-2								
Land Use	Slope	Crop	Area (ha)	Conservation		Annual Soil Loss		Area (ha)	Conservation		Annual Soil Loss		Area (ha)	Conservation		Annual Soil Loss			
				Facility	Slope L (m)	(t/ha)	(mm)		Facility	Slope L (m)	(t/ha)	(mm)		Facility	Slope L (m)	(t/ha)	(mm)		
Farmland																			
IFL (Irrigated Farmland)																			
1	5%-13%	Wheat	145	Furrow Iri.	50	2.7	0.19	44	189	Furrow Iri.	50	2.8	0.20	189	Furrow Iri.	50	2.8	0.20	
		Alfalfa	97			3.9	0.28					127	3.9				0.28	127	3.9
2	13%-20%	Wheat	81	Basin Iri.	2	0.0	0.00	32	113	Basin Iri.	2	0.0	0.00	113	Basin Iri.	2	0.0	0.00	
		Alfalfa	54			0.0	0.00					40	0.0				0.00	40	0.0
3	20%-30%	Wheat	24	Basin Iri.	2	0.0	0.00	-16	24	Basin Iri.	2	0.0	0.00	24	Basin Iri.	2	0.0	0.00	
		Alfalfa	16			0.0	0.00					0	0.0				0.00	0	0.0
Total		Wheat	250			1.6	0.11	76	326			1.6	0.11	326			1.6	0.11	
		Alfalfa	167			2.3	0.16	0	167			3.0	0.21	167			3.0	0.21	
			83			0.2	0.01	76	159			0.2	0.01	159			0.2	0.01	
DFL (Dry Farmland)																			
1	5%-13%	Wheat	80	none	225	7.2	0.51	-44	36	none	225	6.0	0.43	36	none	225	6.0	0.43	
		fallow	80			7.2	0.51					-44	36				6.0	0.43	-44
2	13%-20%	Wheat	84	none	100	16.2	1.16	-32	52	none	100	15.6	1.11	52	none	100	15.6	1.11	
		fallow	84			16.2	1.16					-32	52				15.6	1.11	-32
3	20%-30%	Wheat	44	none	100	41.4	2.96	44	44	Contour bund	20	15.5	1.11	44	Contour bund	20	15.5	1.11	
		fallow	44			41.4	2.96					44	15.5				1.11	44	15.5
Total		Wheat	208			18.1	1.29	-76	132			13.0	0.93	132			13.0	0.93	
		fallow	208			18.1	1.29	-76	132			13.0	0.93	132			13.0	0.93	
			0			0	0	0	0			0	0	0			0	0	
Orchard																			
13-20%			266	Orchard Terrace	5	1.6	0.11		266	Orchard Terrace	5	1.6	0.11		266	Orchard Terrace	5	1.6	0.11
Rangeland																			
AB-1	45%		794	none	100	33.1	2.36		794	Protection	100	12.4	0.89		794	Protection	100	12.4	0.89
AB-2	30%		400	none	120	19.0	1.36		400	Seeding	120	7.1	0.51		400	Seeding	120	7.1	0.51
AG-1	45%		907	none	50	81.9	5.85		907	Protection	50	58.5	4.18		907	Protection	50	58.5	4.18
AG-2	30%		170	none	100	60.6	4.33		170	Seeding	100	10.8	0.77		170	Seeding	100	10.8	0.77
GB	38%		261	none	80	76.7	5.48		261	Protection	80	51.1	3.65		261	Seeding	80	14.2	1.01
QG-1	30%		561	none	80	21.3	1.52		561	Protection	80	9.7	0.69		561	Protection	80	9.7	0.69
QG-2	25%		25	none	100	15.9	1.14		25	Seeding	100	7.2	0.51		25	Seeding	100	7.2	0.51
Total			3,118		90	48.4	3.46		3,118		90	27.8	1.99		3,118		90	24.7	1.76
Tree Plantation																			
Tree - 30%			4	Iri, Ditch	5	6.5	0.46		4	Iri, Ditch	5	6.5	0.46		4	Iri, Ditch	5	6.5	0.46
Waste Land																			
AR 40%			315	none	80	40.0	2.86		315	none	80	40.0	2.86		315	Orchard Terrace	5	7.7	0.55
Summary																			
Farmland			724			6.3	0.45		724			3.7	0.26		724			3.7	0.26
Rangeland			3,118			48.4	3.46		3,118			27.8	1.99		3,118			24.7	1.76
Tree Plantation			4			6.5	0.46		4			6.5	0.46		4			6.5	0.46
Waste Land			315			40.0	2.86		315			40.0	2.86		315			7.7	0.55
Sub-Total			4,161			40.4	2.89		4,161			24.5	1.75		4,161			19.7	1.41
Village			26			0.0	0.00		26			0.0	0.00		26			0.0	0.00
River Bed			127			0.0	0.00		127			0.0	0.00		127			0.0	0.00
Rock			2,226			9.7	0.69		2,226			9.7	0.69		2,226			9.7	0.69
Sub-Total			2,379			9.1	0.65		2,379			9.1	0.65		2,379			9.1	0.65
Total			6,540			79.0	2.07		6,540			18.9	1.35		6,540			15.8	1.13
Soil Erosion Protection Project																			
			44	none		41.4	2.96		44	Contour bund	20 m	15.5	1.11		44	Contour bund	20 m	15.5	1.11

(Note)

- 1) Detail analysis are in Table D-5-2-8(4) for Present, in Table D-5-2-9(4) for Scenario-1, in Table D-5-2-10(4) for Scenario-2.
- 2) Dry farmland of 76 ha is converted to irrigated farmland by irrigation system improvement in Scenario-1.
- 3) Waste land is irrigated by Agricultural Improvement Project by MOJA, and erosion is reduced to 7.7 t/ha/yr by apple tree plantation in Scenario-2.

10.5.3 Rangeland Vegetation Improvement

Improvement of rangeland vegetation is carried out in order to mitigate over grazing and to protect soil from erosion. The rangeland with a total area of 3,118 ha, is in a moderate status and possesses many

Quercus (oak) trees, which produce large amount of litter, contributing to growth of pastoral vegetation. About 600 ha of rangeland, and a piece of abandoned rangeland (wasteland) of 160 ha area (totally 760 ha) are undertaken for structural measures. And the remaining 2,358 ha are improved through non-structure measures. According to principles of this plan, structural measures are only applied to localities with slope less than 40%. At slope more than 40% applying such measures is not reasonable. Easy applicability, propagativity, and speedy restoration/improvement of vegetation are also among principles of this plan. Period for initial implementation, and the consequent treatment cycles is set at 10 years.

The vegetation improvement works will start from localities where vegetation has poor condition, decreasing trend and lowest production. Field works are entrusted to experienced local people, and donkeys do transport of required materials from village to field. In vegetation improvement works, cooperation of Hassan Abad, Islam Abad, Sar Tang and Tang Sorkh villages is required.

(1) Parts with Slope less than 40%

a) Establishment of Seed Production Plot

In first year a plot of 4 ha is established in abandoned rangeland closed to road and nearby Tang Sorkh village, where soil moisture content is somewhat high due to occurrence of Boshar River. The plot is fenced and permanently cared by 3 persons with a 24-hour watching schedule. A mixture of seeds (50:50) 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. Bromus and Agropyron are very palatable and produce large amount of herbage. The seed are sown in spring/autumn, when climatic condition is suitable for germination and growth. To reduce the cost, most of works are done manually. At sowing time, a herd of local livestock is guided into plot to cause disturbance of 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) for further use in rangeland, and herbage is fed to herds and other animals, which are used by the project. The produced seed is about 280 kg, since 1 seed is expected to produce 10 seeds ($28 \text{ kg} \times 10 = 280 \text{ kg/plot}$). And the produced herbage would be about 700 kg, since with seed-sowing herbage production of 175 kg/ha is obtained ($175 \times 4 = 700 \text{ kg/plot}$).

b) Establishment of Vegetation Improvement Plot

In second year the remaining 756 ha ($760 - 4$ ha) is divided into 10 plots of 76 ha size (756 ha/10 years) and 1 plot is undertaken for improvement works. This plot is sown with Bromus (brome) and Agropyron (wheatgrass) seed (collected from seed production plot) at a rate of 2 kg/ha. It is protected and cared by 3 persons with a 24-hour working schedule (8

hours each). In consequent years, upon designation of a new plot, an old plot is opened to herds and utilized in a sustainable manner. Entire area will receive this treatment within 10 years, and the same cycle is repeated with no time gap to sustain the improved situation. However seed-sowing area is 76 ha, whenever rangeland utilization norm (communal/village uses) does not permit, the work is done in few scattered smaller pieces, sum being 76 ha.

In second year the remaining 756 ha (760-4 ha) is divided into 10 plots of 76 ha size (756 ha/10 years) and 1 plot is undertaken for improvement works. This plot is sown with Bromus (brome) and Agropyron (wheatgrass) seed (collected from seed production plot) at a rate of 2 kg/ha. It is protected and cared by 3 persons with a 24-hour working schedule (8 hours each). In consequent years, upon designation of a new plot, an old plot is opened to herds and utilized in a sustainable manner. Entire area will receive this treatment within 10 years, and the same cycle is repeated with no time gap to sustain the improved situation. However seed-sowing area is 76 ha, whenever rangeland utilization norm (communal/village uses) does not permit, the work is done in few scattered smaller pieces, sum being 76 ha.

(2) Parts with Slope more than 40%

The 2,358 ha with slope more than 40% is divided into 10 plots of 236 ha size (2,358 ha/10 years) and utilized under a rotational grazing program. For this purpose each year one plot is protected, by assigning watchman, with a 24-hour watching schedule. In consequent years, upon designation of a new plot, 90% of an old plot is opened to herd, and 10% remain closed to ensure the natural dispersion of seeds into area. Since most part of rangeland bear natural trees, which provide shade and supply nutrients to pastoral vegetation through litter, with one-year protection high amount of herbage production is expected. This program is applied with no time gap to increase the herbage production of rangeland and ensure regular natural dispersion of seeds into area. However protected area is 236 ha, whenever rangeland utilization norm (communal/ village uses) does not permit, the practice is performed in few scattered smaller pieces, sum being 236 ha.

Protection of 236 ha of rangeland will bring-about an increment of 17.7 tons in its production. With protection in an average, an increment of 75 kg/ha is expected, so $236 \times 75 = 17,700$ kg (17.7 tons/year). Present average production is 194 kg/ha, with project it is 269 kg/ha (194+75). Moreover, the improved vegetation will cover an additional 15% of bare soil, contributing to prevention of soil erosion and conservation of the environment. With project present 39.7% land cover is promoted to 54.7% (39.7+15).

(3) Establishment of Watering Points for Livestock

However Boshar River and some springs of good quality water occur in this sub basin, to reduce the movement/trampling of animals and have their even distribution, 2 watering points are established in

rangeland, regardless of slope %. These points are in localities being far from river and springs. The watering point is a concreted structure of 7.00 m length, 1.50 m width and 0.30 m depth, in which 600 animal units can drink water in a day. Average water requirement of an animal unit is 5 liters/day.

With provision of watering points an increase of 2.9 tons in meat production of livestock (in grazing season=120 days) is expected. Because it has been known that daily supply of water to a grazing animal will bring-about an increment of 0.04 kg/day in its weight (kg/year) in its weight, 50% of which is meat. About 1,200 animals are directly benefited from these facilities, so $0.04 \times 120 \times 1,200 \times 0.5 = 2,880$ kg (about 2.9 tons/year).

10.5.4 Forestland Vegetation Recovery

There is a piece of land nearby Tang Sorkh village, occupied by *Quercus* (oak) and *Amygdalus* (wild almond) with potential for improvement. This area of 25 ha will be divided into 10 plots of 2.5 ha (25 ha/10 years). Each year one plot is protected, by assigning watchman, with a 24-hour watching schedule. Small pits of about 30 cm depth and 5 m interval are made (400 pits/ha) in the area. Three (3) commercial almond seeds are placed in each pit, added with a layer (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 absorb water from lower layers of soil.

Production of 5.0 tons of almond/plot, and prevention of soil erosion are benefits of this plan. There are 1,000 trees in a plot of 2.5 ha size (400 trees/ha) and in an average each tree produce 5 kg of almond in a year, so $1,000 \times 5 = 5,000$ kg (5 tons/year). Since at present this area has no economical benefit, the project will commercial value it through almond production. The established almond trees will contribute in prevention of soil erosion through their root system, since they would bring-about an additional 20% in land cover of the area. At present about 7% of the areas possess natural trees, while with project it is 27% (7+20), being 4 times higher than present condition. Trees play important roles in maintenance of biological balance and conservation of the environment.

10.5.5 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 10-5-5-1 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

Source: Ministry of Agriculture

b) Proposed Plan

There are 2 major canals in Tang Sorkh River basin. Intakes of these canal are without diversion dam and the upper streams of canals are not lining. However, check dam is planned at conjunction of Tangsork River and its tributary near Tang Sorkh village. Then it is expected that steady intake of water will be actualized. And also lower streams of canals at this check dam are lined with concrete. Then, surplus water by this integration of intakes is estimated as follows

Table 10-5-5-2 Surplus Water and Irrigation Water Demand of Major Crops

Canal	Production of Surplus Water (liters/s)	Water Demand (liters/s/ha)		
		Alfalfa	Vegetable	Apple
Tang Sorkh left bank canal	32	1.56	1.88	1.64
Tang Sorkh right bank canal	87			

Source: JICA Study Team and Revised Data of MOA

(2) Agricultural Scheme

a) Potential of Development

In Tang Sorkh, approximately half of farmland is irrigable. Farmland is located in narrow fan and low hills. According to the present land use, total farmland is 724 ha including orchard land and almost irrigable area is irrigated, canals have been constructed. In irrigated crop farmland, wheat, barley, alfalfa, legume are planted. It is said that irrigated agriculture has already been developed and some irrigation canals are constructed of earth. In such condition, when the canals are rehabilitated, it is possible to obtain more water for irrigation and more agricultural production.

b) Development Plan

According to the above irrigation scheme plan, after rehabilitated the canal of Tang Sorkh,

production area increment will be reached 76.28 ha for alfalfa, (or 63.30 ha for vegetable or 72.56 ha for apple). At present, wheat is planted in these irrigation areas, but as irrigation water is limited, dry farmland is there. Considering the feed shortage of livestock in these areas, it is recommendable to increase livestock feed such as alfalfa.

Table 10-5-5-3 Estimated Production Increment by Rehabilitation of Canals (119 lit/s)

	In case of Alfalfa	In case of Vegetable	In case of Apple
Gross Water Demand (litre/s/ha)	1.68	1.93	1.77
Increasing Area (ha)	76.28	63.30	72.56
Estimated Yield	8,429 kg/ha	20,000 kg/ha	40,000 kg/ha
Estimated Increasing Production (ton)	503	1,492	3,254

Note: (1) Alfalfa yield: average data (Township based) in 1995-99 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 10-5-5-4 Present and Future Crops Areas

	Present			Future (with plan)			Difference (ha)
	Land area (ha)	Planting (ha)	Intensity (%)	Land are (ha)	Plantable (ha)	Intensity (%)	
Irrigated Farmland							
1 Crops							
1) Wheat		166.9			166.9		
2) Alfalfa		83.1			159.4		+76.28
3) Others		0.0			0.0		
sub-total	250.0	250.0	100.0	326.3	326.3	100.0	
2. Orchard							
1) Apple		188.8			188.8		
2) Others		67.2			66.5		
sub-total	256.0	256.0	100.0	256.0	0.7	100.0	
Sub-total	506.0	506.0		582.3	256.0		
Dry farmland							
1 Crops							
1) Wheat		173.4			90.7		-76.28
2) Alfalfa		0.0			0.0		
3) Others		34.6			41.0		
sub-total	208.0	208.0	100.0	131.7	131.7	100.0	
2. Orchard							
1) Apple		0.0			0.0		
2) Others		10.0			10.0		
sub-total	10.0	10.0	100.0	10.0	10.0	100.0	
Sub-total	218.0	218.0		141.7	141.7		
Total	724.0	724.0		724.0	724.0		
Rangeland	3,118.0			3,118.0			
Others	2,698.0			2,698.0			
Grand total	6,540.0			6,540.0			

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

According to the cropping pattern, in irrigation farmland, some legume and vegetables could be planted after wheat harvested. At present, all irrigable farmland are irrigated and intensity is 100%. However, it could not be found such crops were planted. After created the farm practice and cropping

pattern, it would be possible to expand more than 100% of intensity in whole irrigated farmland considering the limitation of irrigation water; development of cropping pattern such as wheat in winter season + legume (+ vegetable) in summer season or apple + alfalfa (+ vegetable or + legume) planting. Moreover, Alfalfa could be planted in same apple orchard, affected little the production yield 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.

10.5.6 Collecting and Grading Center of Vegetable and Apple

Analyzing the areas' conditions based on the above development potentials and policies, development plans would be designed for crop diversification during the short-(5 years) and medium-term (10 years) and for fruit marketing during the medium-(10 years) and long-term (20 years) as follows. 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 horticultural crops collecting and grading center: short-, medium-term
- ② Establishment of apple collecting and grading center: medium-, long-term

(1) Establishment of horticultural crops collecting and grading center (short-term)

a) Purpose:

To emphasize villagers and promote the cooperate sale of horticultural crops by means of conducting the collection, grading, packing and distribution.

b) Participants:

A group should be established, whose members should grow horticultural crops 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. A group should be established one in each village. Members should have the intention to development. When group's member would be 20, using approx. 0.25ha of each land, while yield is 20t/ha, total production would be 100t/season or approx 3 t/day. Crops with higher demands should be selected. 3-5 kinds of crops should be chosen for first stage.
 - ii) **Proposed villages:** Tang Sorkh; 1 place
 - iii) **Required equipment, materials and facilities:**
 - 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
 - Basket: plastic; 50 pieces
 - Water tank: steel, 1x1x1m; 5 units
 - Vehicle: pick-up truck; 2 units
 - Land: relatively flat land with good access, 200m²

When horticultural crops collecting and grading center is established, 100 households in one place will have benefit 3,750,000 Rials (=381,600,000-377,850,000), or 37,500 Rials per year per household.

(2) **Establishment of apple collecting & grading center (medium-, long-term)**

a) **Purpose:**

To emphasize villagers and promote apple sale by means of establishment of collection, grading, packing and distribution facilities.

b) **Participants:**

A group should be established, whose members grow apple 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.

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. A group should be established one in each village. Members should have the intention to development. As the apple land area is approximately 1ha in average of 20 families, while yield will be 40t/ha, production will be 800t/year.
- ii) Proposed villages: Tang Sorkh; 1 place
- iii) Required equipment, materials and facilities:

- Building: made of brick, 100m ² ;	1 building
- Tables: made of wood, 1,800x1,200x800mm;	10 units
- Chair: made of wood	30 pieces
- Incidentals: water supply, electricity, latrine	1 set
- Basket: plastic	100 pieces
- Water tank for cleaning: steel, 1x1x1mm;	5 pieces
- Drying table: steel, with fan	5 units
- Roller conveyor: width 400mm;	5 units
- Vehicle: pick-up truck;	1 unit
- Land: relatively flat land with good access, 200m ²	

When apple collecting and grading center is established, 100 households in one place will have benefit 204,130,000 Rials (=940,800,000-736,670,000), or 2,041,300 Rials per year per household.

10.5.7 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 73 m³/day and water demand in 2020 is estimated at 338 m³/day. Then surplus water demand is 274 m³/day. Then it is proposed to improve distribution tank and pipeline. Here, capacity of distribution tank is designed to be the volume of supply for 12 hours and 30 % spare. In addition, Hassan Abad, Mehrab Abad and Islam Abad village depend on old facilities and villagers complain the shortage of drinking water. Therefore it is urgent to improve water supply systems in these villages.

Table 10-5-7-1 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)
Allah Abad	67	6	127	23	17	11
Cheshmeh Chenar	30	3	57	10	8	5
Hassan Abad	90	8	171	31	23	15
Islam Abad	49	4	93	17	12	8
Mehrab Abad	42	4	80	14	11	7
Sar Tang Sorkh	80	7	152	27	20	13
Tang Sorkh	800	73	1,520	274	201	131
Total	1,158	105	2,200	396	291	190

Dimensions of distribution tank and pipeline are summarized as follows. 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 charge in cooperation with PIC. In addition, PIC will enhance villagers to recognize water charge system and desirable water use. By these projects, necessary and clean water will be provided to the villagers.

Table 10-5-7-2 Proposed Plan for Water Supply

Village	Distribution Tank	Pipeline
Allah Abad	B 2.5 m x L 2.5 m x H 3.0 m	PVC pipe ϕ 50, L=100 m
Cheshmeh Chenar	B 1.9 m x L 1.9 m x H 3.0 m	PVC pipe ϕ 50, L=50 m
Hassan Abad	B 2.8 m x L 2.8 m x H 3.0 m	PVC pipe ϕ 50, L=100 m
Islam Abad	B 2.2 m x L 2.2 m x H 3.0 m	PVC pipe ϕ 50, L=100 m
Mehrab Abad	B 2.1 m x L 2.1 m x H 3.0 m	PVC pipe ϕ 50, L=100 m
Sar Tang Sorkh	B 2.7 m x L 2.7 m x H 3.0 m	PVC pipe ϕ 50, L=100 m
Tang Sorkh	B 7.2 m x L 7.2 m x H 3.0 m	PVC pipe ϕ 75, L=1,000 m