10.2 K4-1-9 Vastegan

10.2.1 Construction of Check Dam

(1) Specific Sediment Discharge

In order to estimate sediment discharge of each check dams on Gela River basin, the specific sediment discharge used for the planning of Beaedeh Dam at Sarbaz (400 m^3/km^2/year) is applied as topography, geological condition and annual rainfall are very similar to that of Vastegan. While the valley on the steep cliff, 100 m^3/km^2/year is adopted.

(2) Southern Part of Western Upland

This area is categorized as surface erosion type and erosion is very severe here. Therefore, main check dams are allocated to the key points of the upland basin in consideration of the existing check dams, design flood discharge, terrain of the dam sites and tributaries. Thirteen main check dams are planned mainly at just downstream of the confluences of tributaries in order to mitigate the riverbed gradient, prevent vertical/horizontal erosion of the river course, stabilize the foot of slope, prevent the movement of unstable sediment left on the riverbed, prevent devastation of riverbed and river banks and reduce the sediment to be carried downstream.

On the other hand, ten check dams are allocated between main check dams in order to supplement their function. The implementation is to be entrusted to people's participation.

Type C is applied for main check dams and Type D is for check dams.

(3) Narrow Gorge

Three main check dams are planned at the narrow gorge on the Steep Cliff, where all the tributaries on the Western Upland join and flow down into the Eastern Lowland. The main purposes of these dams are to dissipate flood flow energy and to store the sediment. In addition, recharge for groundwater is expected through the impoundment of partial floodwater. Thus the implementation of these dams should be carried out after the completion of check dams in the upper reaches.

In view of the river condition, Type A is applied for three dams.

(4) Steep Cliff Area around Nasir abad

Five main check dams are planned on the valleys at the Steep Cliff Area around Nasir abad. Behind Nasir abad, two check dams are allocated in order to prevent the debris flow hit to the village directly. North of Nasir abad, also two check dams are allocated for the protection of farmland and a farm road

in the downstream area. The last one is sited at the south of Nasir abad so as to decrease the direct damage on the spring, which is the source of irrigation canal and fishpond, farmland and a fishpond.

Type C is applied for main check dams.

(5) Steep Cliff Area around Vastegan

One check dam with Type C is planned on one of the valley at the Steep Cliff Area around Vastegan for the protection of farmland in the downstream area.

(6) Outline of Check Dams

The dimension of main check dams are listed in Table 10-2-1-1 and their location is also shown in Fig. 10.2.1-1. The total number of check dams by type is summarized as follows;

Main check dam (Type A) ..... 3 Nos.
Main check dam (Type C) ..... 19 Nos.
Check dam (Type D) ..... 10 Nos.

(7) 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 10-2-1-1-1.

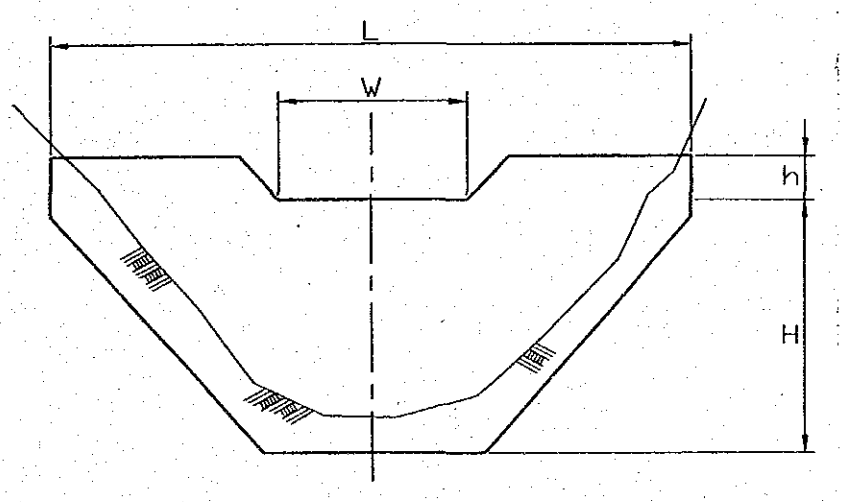
(8) Effect of Check Dams

As aforementioned, check dams, one of the major disaster prevention facilities, have functions of not only storing capacity for debris but also are expected to mitigate the riverbed gradient, prevent vertical/horizontal erosion of the river course, stabilize the foot of slope, prevent the movement of unstable sediment left on the riverbed, prevent devastation of riverbed and river banks and reduce the sediment to be carried downstream. However, storing capacity for debris is the only clear index of effect.

Based on Table 10-2-1-1, the total vacant volume (storing capacity for debris) of main check dams is around 110,000m^3, that of existing check dams 120,000m^3, and that of 10-check dams by people's participation 30,000m^3 (3,000m^3 per each) and totally become 260,000m^3. On the other hand, annual sediment discharge is estimated around 15,000m^3. Thus, the total vacant volume is equivalent to about 17-years of sediment discharge.

Table 10-2-1-1 Dimension of Main Check Dams in Vastegan

River: Site No.	ITEM											Remarks
	C.A. (km^2)	ΣC.A. (km^2)	/ (m)	Q (m^3/sec)	Dam Type	C.EL (m)	H (m)	W (m)	L (m)	h (m)	Q_a (m^3/sec)	
TM:												
101	3.30	3.30	4,480	18.7	C	2671.5	4.0	10.0	48.0	1.0	19.1	
102	2.96	6.26	5,200	35.5	C	2636.0	3.5	10.0	54.0	1.5	36.4	
103	2.58	8.84	6,170	50.1	C	2585.0	5.5	11.0	34.5	2.0	63.1	
104	7.47	33.45	8,540	139.5	A	2357.0	8.0	15.0	51.0	3.0	160.1	
105	0.36	33.81	9,090	141.0	A	2337.0	10.0	16.0	60.0	3.0	169.3	
106	0.93	34.74	9,310	144.8	A	2303.0	8.0	18.0	59.0	3.0	187.7	
991	0.55	0.55	1,950	3.5	C	2545.2	5.5	9.0	22.0	0.5	5.9	
T1:												
111	3.15	3.15	3,510	17.9	C	2389.5	3.0	9.0	16.0	0.5	4.6	
112	2.54	5.69	3,910	32.2	C	2316.2	※1 3.7	※1 24.0	86.0	0.8	36.0	
							※2 1.7					
121	0.64	0.64	2,190	3.6	C	2258.0	3.0	7.0	31.0	0.5	4.6	
141	0.80	0.80	2,150	4.5	C	2245.0	3.5	7.0	28.0	0.5	4.6	
161	1.13	1.13	1,850	6.4	C	2294.0	4.0	13.0	33.5	0.5	8.4	
181	0.65	0.65	1,760	3.7	C	2335.5	3.0	7.5	29.0	0.5	5.0	
T2:												
201	2.19	2.19	2,600	13.6	C	2628.8	4.3	12.0	20.0	0.7	15.8	
202	1.82	6.49	5,140	40.3	C	2524.5	3.5	23.0	45.0	1.0	42.1	
221	2.48	2.48	3,140	15.4	C	2699.0	4.0	8.0	21.5	1.0	15.6	
211	1.19	1.19	1,820	7.4	C	2533.0	4.5	12.0	42.0	0.5	7.8	
212	1.39	2.58	3,090	16.0	C	2497.0	7.5	20.0	43.0	1.0	36.8	
T3:												
301	2.30	2.30	2,140	14.4	C	2854.5	6.0	8.0	41.0	1.0	15.6	
302	1.48	3.78	2,960	23.7	C	2738.0	6.5	7.0	35.0	1.5	26.7	
303	2.71	6.49	3,690	40.7	C	2651.5	3.0	7.5	23.0	2.0	43.1	
304	1.03	7.52	4,520	47.2	C	2584.0	3.5	8.0	30.0	1.5	49.4	



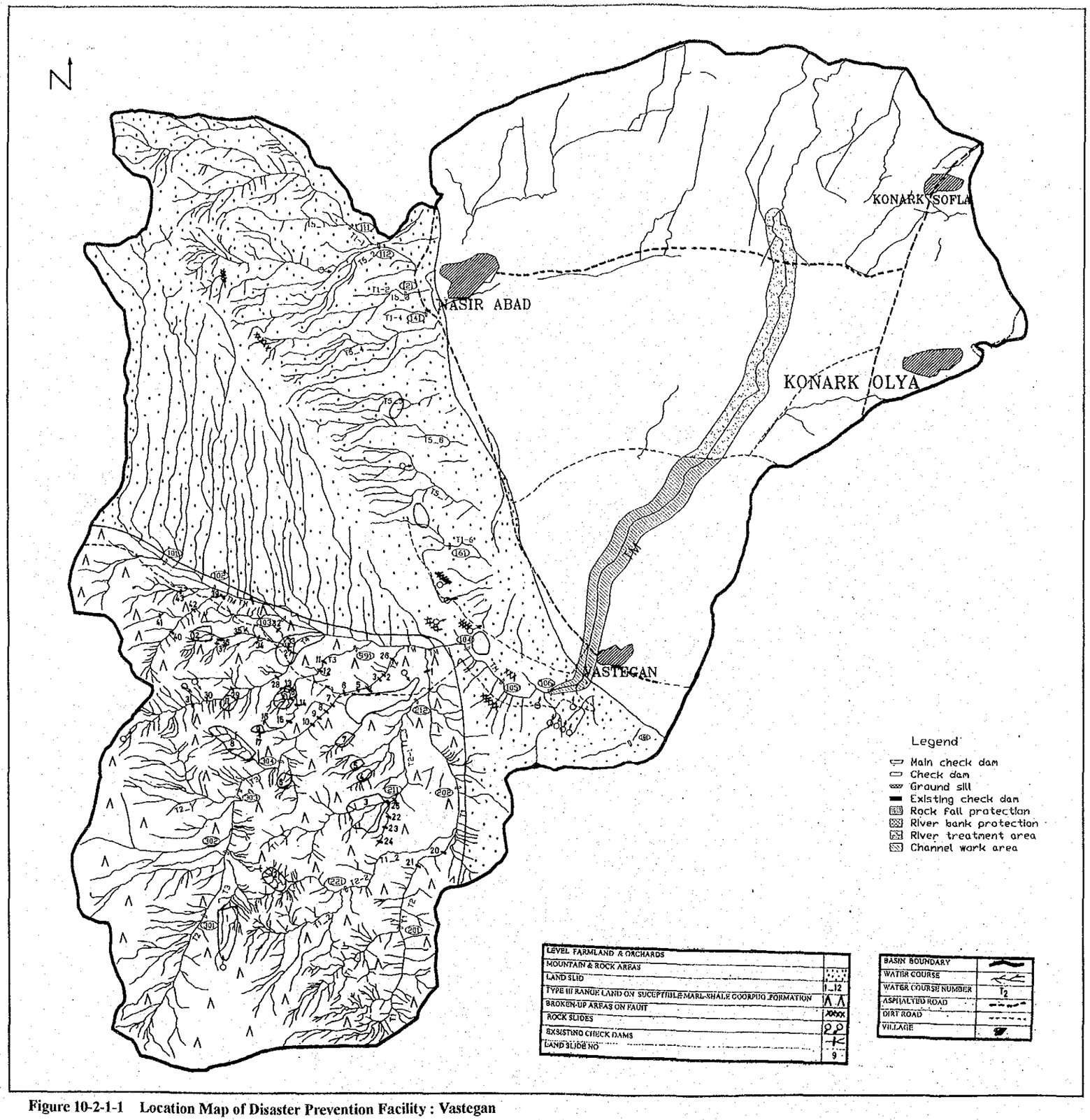


Figure 10-2-1-1 Location Map of Disaster Prevention Facility : Vastegan

10.2.2 River Treatment

(1) Present Condition of the Rivers

There are two major rivers in the master plan area. . The Gela River collects the water from western upland, the catchment area of which is around 35 km^2, and flows into the lowland causing a lot of flood and debris flow damage. Inundations used to occur from the bridge at Vastegan Village and covers towards the left bank because the elevation is slightly lower than that of the right bank and there are no dikes for flood protection.

On the upper reaches of Gela River, there are no suitable dam sites for storing floodwater. In addition, the planned check dams have no capacity for storing floods and after the completion of the check dams in the upstream, the riverbed scoring is expected on the lower reach, downstream of the lowest check dam (No.106). The flood prone plane forms gently sloped alluvial fan, therefore, as countermeasures, the river is improved with channel works and also its channel section is treated.

R.Aghabolugh, that flows through the marsh located north, borders eastern part of the master plan area. Upstream of R.Aghabolugh is the marshland and it functions as a retarding pond, therefore, there is no severe flood damage along this river.

(2) Present Condition of Gela River in the Plane

The profile of the Gela River, from the lowest check dam (No.106) to the bridge at Vastegan Village is approximately 1/20 to 1/50 (average : 1/40) with the distance of around 0.8 km. From the bridge at Vastegan Village, the Gela River stretches around 9 km down to the confluence with the R.Aghabolugh. The upper and middle reaches on this stretch, the length of which is 6.3 km, the river course is rather clear, inundation occurs very frequently, and the riverbed gradient is around 1/44~1/470. One irrigation canal crosses this stretch with siphon, at around 2.7 km from the bridge at Vastegan Village. The overburden of this siphon is estimated at around one meter below the riverbed and the river profile is restricted here.

(3) River Improvement Plan

Channel work sections are planned from the lowest check dam (No.106) to the bridge at Vastegan Village (hereinafter called as Sec.-1) and from the bridge at Vastegan Village to the siphon (hereinafter called as Sec.-2). River treatment section is planned from the siphon to the end: around 6.3 km from the bridge (hereinafter called as Sec.-3).

(4) Channel Work

Profile: River profile is planned in order to mitigate the original riverbed gradient and to reduce a

sharp change of profile at the adjacent section.

1) Sec.-1: Generally 1/50

2) Sec.-2: Embedded-type channel is planned here in place of embankment-type, so as to lessen the damage from that of embankment-type channel. Generally 1/95～1/110 is taken in order to reduce the volume of excavation.

Cross Section: The rate of the sediment mixture, 10 %, is applied and the design discharge is worked out as 160 m³/s. In due consideration of the damage of overflow from embankment, the channel section is generally embedded instead of forming embankment and cross sections of the channel are planned taking into consideration of existing river width, bridge spans and the siphon section as follows;

Sec.-1: Bottom width - 20 m, Side slope - 1:1, Height – 2 m (h = 1.4 m, allowance ≒ 0.6 m)
Sec.-2: Bottom width - 30 m, Side slope - 1:1.5, Height – 2 m (h = 1.4 m, allowance = 0.6 m)

Consolidation Dam: Consolidation dams are planned at the locations where the drop is necessary more than one meter, the upper most and the lower most ends of Sec.-1, and the locations where the profile changes in the adjacent section in Sec.-2. Drop check chute is allocated at the locations where the drop is necessary less than one meter

Ground Sill: Alternate sediment bars are apt to be formed in torrential rivers in alluvial fans, and meandering and local scouring due to the bar formation often cause damage to channel works. Studies on the countermeasures against alternate sediment bars by means of hydraulic experiments and rivers in the field had been carried out in Japan and cross dike structures such as consolidation dam and groundsill proved to be effective provided that these structures are placed with an interval shorter than the length of sediment bars. The interval of groundsill is basically taken two times of the channel width because it is proved to be effective through these studies.

River Bank Protection: In view of the existing river condition, profile and high rate of groundwater utilization in the plane, riverbanks are protected with gabion mattresses on Sec.-1 and the upper most part of Sec.-2 (transition section). The river course on Sec.-2 is gently curved to the left bank with the radius of approximately three thousand meters and thus there is no danger of scouring. However, for the safety precautions, stone pitching is applied only on the left bank slope.

Maintenance Road: On both banks of Sec.-2, maintenance roads, which are also served as farm road, are aligned with the width of 4 m. These roads connect to the road near Vastegan Village and the maintenance road of the upper irrigation canal. A certain amount of sedimentation is inevitable in the channel, especially on the transition section between Sec.-1 and Sec.-2 because of the change of

profile and the width of channel. Thus, several inclined slopes are necessary for removal of such sediments.
The bridge, which has two -15 m spans with one pier, are to be located immediate downstream of siphon.

The number of facilities planned is as follows and the drawings and locations are shown in ANNEX.

Sec.-1 : Consolidation dam – 2 Nos, Drop check chute - 4 Nos, Groundsill – 14 Nos, Mattress gabion – whole length on both banks
Sec.-2 : Consolidation dam – 1 No, Drop check chute - 5 Nos, Groundsill – 36 Nos, Mattress gabion – transition section on both banks

(5) River Treatment
In view of the existing river profile of Sec.-3, the riverbed gradient is taken 1/120~1/180, bottom width is 30 ~ 50 m, and the side slope is 1:1.5 with the height of 2 m (h = 1.4 m, allowance = 0.6 m).

(6) Implementation
In view of the effect of the channel work, the implementation waits until when the check dams in the upper reaches are completed or being constructed and the sediment trap ratio will be more than 50 %. However, the fact that flood and debris flow damage occurs in the alluvial fan plain in the lower reaches makes the residents in the plain feel unfairness if check dams are constructed first of all and then the river improvement, which will protect the damage in their farmland, comes after.

With reference to the vacant volume of check dams, the volume obtained from existing ones is around 120,000 m^3 (46%), while that of new ones will be 140,000 m^3 (54%). Roughly, they are almost even and in such a case it could be possible to commence the river improvement in the lower reaches from the beginning. In addition, the proportion of construction costs between check dams and river improvement is 1 to 4, therefore, the river improvement is to be implemented along with check dams from the upper section of Sec.- 2, where debris flow frequently damages the farmland, and Sec.- 3.

(7) River Reserve
Around 100,000 m^3 of excavated materials are generated from the channel work, although efforts have been made to reduce the volume. These materials may be used for road maintenance in Vastegan Area, sub-grade materials for road improvement which borders northern swamp, and farm consolidation on the left bank of the Gela River. However, the amount and the time of use of these materials are uncertain.

On the other hand, the present river width is 30 ~100 m and 80 m is predominant. Although the banks

of the river are not clear in many locations, the land adjacent to the river is generally abandoned. Therefore, 80 m of river reserve (22 m from the bank shoulder on one side) is planned in order to pile these excavated materials temporally.

(8) Effect

Through these works, inundation, especially on the left bank, with the area of approximately 450 ha of farmland will be freed.

(9) Consideration for Detail Design

Riverbed materials are to be sieved and analyzed and the static and dynamic stable gradients are to be examined. Then planned profile is reviewed together with the results of the detailed river survey. In addition, alternate bars are to be examined immediately after the big flood through field investigation.

10.2.3 Rangeland Vegetation Improvement

To improve the status of natural vegetation in rangeland, which would contributes in increase of livestock production, mitigation of over grazing and protection of soils from erosion, as well in maintenance of biological balance in the area, a "low cost" plan has been formulated. In formulating this plan the information and guidelines published by Forest and Range Organization and other relevant institutions in Iran have been considered.

The plan is based on the following principles:

- Structural measures are undertaken in accessible parts with slope less than 40%.
- Parts with slope more than 40% are improved through non-structure measures.
- Less closure of vegetation area, to avoid overgrazing in open adjoining areas.
- Use of easily applicable, propagative and sustainable improvement methods, with full consideration of ecological, social and economical conditions of the area.
- Speedy restoration/improvement of vegetation to avoid further deterioration of the area.
- Period for initial implementation, and the consequent treatment cycles is set at 10 years.

The implementation of plan will start from places 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 general inhabitants of Vastegan and Nasir Abad villages should take care of rangeland improvement works.

In this sub basin total area of rangeland is 1,142 ha of which 734 ha has slope less than 40%, and the remaining 408 ha is with slope more than 40%. These parts are used according to the following

arrangement:

(1) Parts with Slope less than 40%

The 734 ha is used for two purposes:

a) Establishment of Seed Production Plot

In first year a plot of 4 ha is established in rangeland nearby spring (Cheshmeh Bidak) where soil possess more moisture. The plot is closed to main road and nearby Vastegan village. It is fenced and permanently cared by 3 persons with a 24-hour watching schedule of 8 hours each, to provide regular care and ensure illegal entry into plot. A mixture of seeds (50:50) of Bromus (brome) and Agropyron (wheatgrass) grasses is sown at a rate of 7 kg/ha (4 ha*7 kg=28 kg/plot) to produce sufficient amount of seeds. These grasses are nutritious, very palatable and produce large quantity of herbage. Time of sowing is when soils have enough moisture and temperature is suitable for germination and growth (spring/autumn). Considering the physical features of the area, machinery limitation, and to reduce the cost, most of works are done manually. At sowing time, a herd of local livestock is guided into plot area to cause disturbance of soil. Herd is dismissed, then seeds are sown, and again herd is moved in, to hide them.

The produced seeds being about 280 kg (from 1 seed, 10 seeds) are collected (stored), and used in rangeland vegetation improvement works. And the herbage being about 700 kg (175 kg/ha, expected) is fed to herds and other animals, which are used by the project.

b) *Establishment of Vegetation Improvement Plot*

In second year the remaining 730 ha (734-4 ha) are divided into 10 plots of 73 ha size (730 ha/10 years) and 1 plot (73 ha) is undertaken for vegetation improvement works. The designated plot is not fenced but watched 24- hour by 3 persons (8-hour each). The seed collected from seed production plot is sown at a rate of 2 kg/ha (2*73=146 kg) in this plot to improve its vegetation status. In consequent years, upon designation of a new plot, an old plot is opened to herds and utilized in a sustainable manner. The entire area with slope less than 40%, will receive improvement works within 10 years. The same cycle is repeated with no time gap, to avoid any decline in achieved improvement. However seed-sowing area is 73 ha, whenever rangeland utilization norm (communal/village uses) does not permits, the work is done in few scattered smaller pieces, sum being 73 ha.

The 73 ha plot would bring-about an increase of 12.8 tons of herbage in production of rangeland. With seed sowing works, in an average, an increment of 175 kg/ha in production of rangeland is expected, so 175*73=12,775 kg (12.8 tons/year). Since at present average

production of rangeland is 182 kg/ha, with implementation of this plan a production of 357 kg/ha (182+175) is expected. Moreover, in growing season, the established grasses will cover an additional 30% of land surface, contributing to erosion control and conservation of the environment. At present in an average, 44% of land surface is covered by vegetation, by implementing this plan it would reach at 74% (44+30).

(2) Parts with Slope more than 40%

The remaining 408 ha with slope more than 40% is susceptible to erosion, so it is advisable to avoid/reduce grazing pressure on which as much as possible. On the other hand, complete closure of these parts would result in high grazing pressure on open areas, making the plan inefficient. Hence such parts are utilized under a rotational grazing program. Each year a plot of 41 ha (408 ha/10 years) is protected, by assigning watchman, with a 24-hour watching schedule (3 persons, 8 hours each). Each plot is protected for one year, then 90% of it is opened to herds, and 10% remain closed to ensure the natural dispersion of seeds into area. Entire of this part will receive improvement measure within 10 years, and the same cycle would be repeated with no time gap to maintain the achievement and ensure continuous dispersion of seeds into area.

However protected area is 41 ha, whenever rangeland utilization norm (communal/village uses) does not permits, the practice is performed in few scattered smaller pieces, sum being 41 ha.

Protection of 41 ha of rangeland will bring-about an increment of 3.0 tons in its herbage production. With protection in an average, an increment of 75 kg/ha is expected, so 75*41=3,075 kg (3.0 tons/year) of herbage. At present average production of these parts is 182 kg/ha. With project it would be 257 kg/ha (182+75). Furthermore, the improved vegetation will cover an additional 15% of bare soil, contributing to prevention of soil erosion and conservation of the environment. Presently 44% of land surface is vegetated, with project it would be 59% (44+15).

(3) Establishment of Watering Points for Livestock

Supplying potable water to animals is important to reduce the mortality rate and increase the livestock production. In addition it results in less movement of animals, their even distribution in rangeland and hence contributes in soil conservation. Three (3) watering points are established in rangeland, in places where no water is readily available to livestock, regardless of slope %. 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. An adult female goat weighing 40 kg is equivalent to one animal unit. Location of watering points is indicated in relevant Plan Map, presented in a separate volume devoted to Maps and Drawing.

With establishment of these facilities totally an increment of 4.3 tons in meat production of livestock (in grazing season=120 days) is gained. It has been known that daily provision of water to a grazing

animal will bring-about an increment of 0.04 kg/day in its weight, of which 50% would be in form of meat. About 1,800 animals are directly benefited from these facilities, so 0.04*120*1,800*0.5=4,320 kg (4.3 tons) of meat.

10.2.4 Orchard Terracing

In rangeland AL-1, most area is covered with the weathered marl soil that is not suited for cultivation from a viewpoint of soil texture aspect. However, some cultivable good soils, which are classified into Class III land "moderate" for irrigation (Soil series-1.3) are located on the hilly mound areas. Such areas are used mostly for grazing and partly for dry farming. Orchard terracing is proposed at two locations on such hilly mound areas as shown in Figure 10-2-4-3. This project aims following two effects from aspects of soil conservation and productivity.

Purposes of Project:

1) to drastically reduce annual soil loss from 81 t/ha (5.8 mm/yr) to negligible zero for 42ha (saving 2,436 m^3/yr totally).
2) to increase productivity from 80 kg/ha/yr of grass (dry weight) to 40 t/ha/yr of apple.

Proposed area size of two orchard terracing is 15ha for Area-1 and 27ha for Area-2, totally 42ha. Apple trees will be planted in the proposed areas. Irrigation water will be taken by a small diversion weir and carried by the open concrete canal.

Table 10-2-4-1 Orchard Terracing and Facilities in Vastegan

Facilities	Area-1	Area-2
Intake Weir	New Intake Weir : 1 weir (use Proposed Check Dam 304)	Existing Weir: 1 weir (use Existing Weir)
Irrigation Canal	New Canal: 1,300m Q = 24 lit/s Open Concrete Canal B 0.20m x H 0.20 m	Canal: 1,100m Q = 43 lit/s Open Concrete Canal B 0.25m x H 0.20 m
Orchard Terrace	Orchard Terrace: 15ha Slope: 13%	Orchard Terrace: 27ha Slope 13%

(Note) Unit water requirement = 1.61 lit/sec/ha

(1) Land Plan

Proposed area is narrow and long in shape as shown in Figure 10-2-4-3. Land slope is about 20% that is not so steep for orchard terracing, but enough steep for canalization. However, natural head of water is not enough for drip irrigation, and pipeline system is expensive for farmers. Apple trees are planted generally about 400 to 450 trees in 1 ha, so that land is planed as shown in Figure 10-2-4-4.

(2) Irrigation System

Irrigation system will follow the prevailing local system to avoid difficulty of canalization and to save cost. The prevailing local irrigation system is as follows.

1) Irrigation water is released to the distribution ditches from the main canal with a small quantity at 20 to 30m intervals.
2) Water can be controlled easily due to small water flow, and erosion is controlled easily by stone and gravel which are plentifully available in the field. If water is carried by large distribution ditch to the field, many drops are necessary to prevent erosion and cost may be so high. Small distribution ditches can be prepared by farmers themselves.

For conveying irrigation water to long distance in the field, permeability is to be enough slow as 1cm/hr. However, permeability of Soil series-1.3 is quite rapid at 8.73 cm/hr as described in Annex D-3. It is necessary to prevent seepage in this area. For preventing seepage, vinyl sheet placing is recommended as shown in Figure 10-2-4-1.

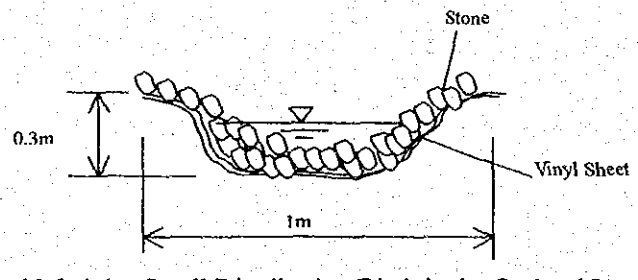


Figure 10-2-4-1 Small Distribution Ditch in the Orchard Terracing

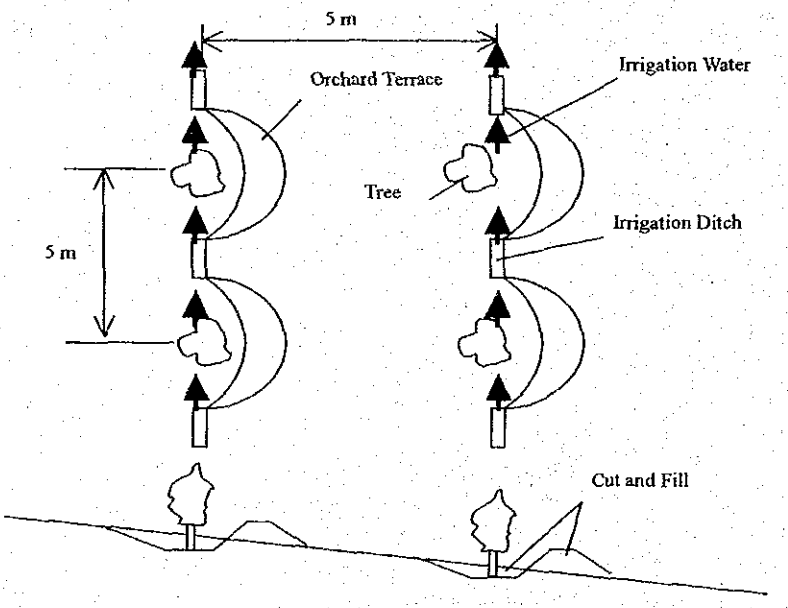


Figure 10-2-4-2 General Plan and Profile of Orchard Terracing

Trees are planted in the half-moon shape depot at each 5m distance and connected by the irrigation ditches as shown in Figure 10-2-4-2. Taking rapid permeability into consideration, irrigation ditch will be limited at 15m length or within 3 trees. Therefore, distribution ditches are placed at each 30m distance and one ditch irrigates within 15m at both sides. Alignments of the distribution ditches are as shown in Figure 10-2-4-4. From a viewpoint of water management, it is recommended to allocate the land to farmers able to cultivate within one distribution ditch so that farmers can manage watering without any conflicts among farmers. They can concentrate to the water distribution management of outlets connected to the main canal.

(4) Increase of Employment and Family Income

By this orchard terracing project with providing a land of 0.20 ha to each family, it can employ 210 families among 600 families in four villages, namely Vastegan, Nasir Abad, Konark Olya and Kanark Sofla, and increase annual family income by 6,112,000 Rial, that is equivalent to 60% of present income.

Participants:	210 families (42 ha/0.2ha/family)
Production per family:	8.0 t/family/yr of apples (40t/ha/yr x 0.2 ha/family)
Income per family:	6,112,000 Rial/yr (764 Rial/kg x 8000 kg/family)
	= equivalent to 60% of Present Family Income (10,300,000 Rial)
Benefit of the Project:	1,283,000,000 Rial/yr (764 Rial/kg x 40,000 kg/ha/yr x 42ha)

(5) Surface Erosion Protection in Vastegan

Present erosion and proposed erosion protection in Vastegan are summarized in Table 10-2-4-3, and its proposed soil protection plan is illustrated in Figure 3-16 in Database Map. As summarized in Table 10-2-4-3, present annual erosion is estimated at 28 t/ha or 2.0 mm. Improvement of rangeland by protection and seeding is proposed in Scenario-1. Protection is proposed to the rangelands with a slope more than 40% inclination and seeding is to those with a slope less than 40%. By the improvement of rangeland, annual erosion of rangeland will be reduced from 55 t/ha to 20 t/ha as shown in Table 10-2-4-2.

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

Rangeland		Area		Bare Soil Ratio		Soil Loss			
Veg.	Slope	Present	Sce.-2	Present	Sce.-2	Present		Scenario-2	
Zone	(%)	(ha)	(ha)	(%)	(%)	(t/ha)	(mm)	(t/ha)	(mm)
Protection									
AL-1	55%	453	411	25%	10%	81.5	5.82	38.3	2.74
EL-1	70%	98	98	21%	6%	70.5	5.04	32.9	2.35
Ave.	63%	551	509	23%	8%	76.0	5.43	35.6	2.55
Seeding									
AL-2	38%	130	130	25%	0%	38.8	2.77	4.6	0.33
BA	30%	354	354	27%	0%	37.0	2.64	5.8	0.41
EL-2	20%	107	107	21%	0%	12.9	0.92	2.6	0.19
Ave.	29%	591	591	24%	0%	29.6	2.11	4.3	0.31
Total	43%	1,142	1,100	24%	3%	55.5	3.96	19.9	1.42

However, erosions of rangelands AL-1 and EL-1 are still high as 38 t/ha (2.7 mm) and 33 t/ha (2.4 mm) even after protection. It is due to high inclination and insufficiency of restoration of vegetation. Therefore, the orchard terracing of 42 ha is proposed to reduce erosion in AL-1 rangeland as the plan for Scenario-2. The orchard terracing project can reduce erosion to negligible zero as shown in Table 10-2-4-3. Although its effect is limited on erosion reduction as a whole, it can increase the productivity of land drastically as explained above.

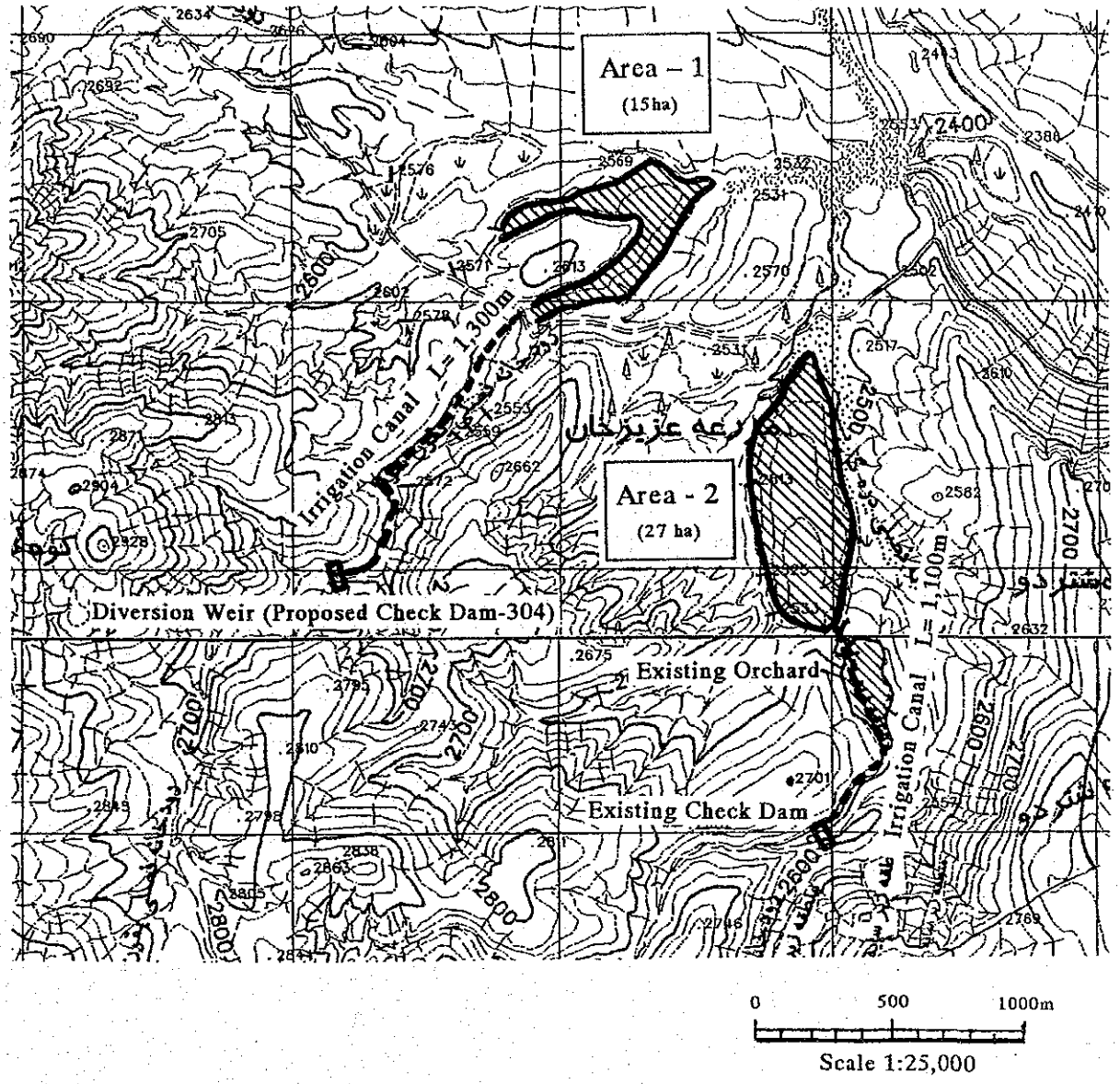


Figure 10.2.4-3 Location Map of Orchard Terracing

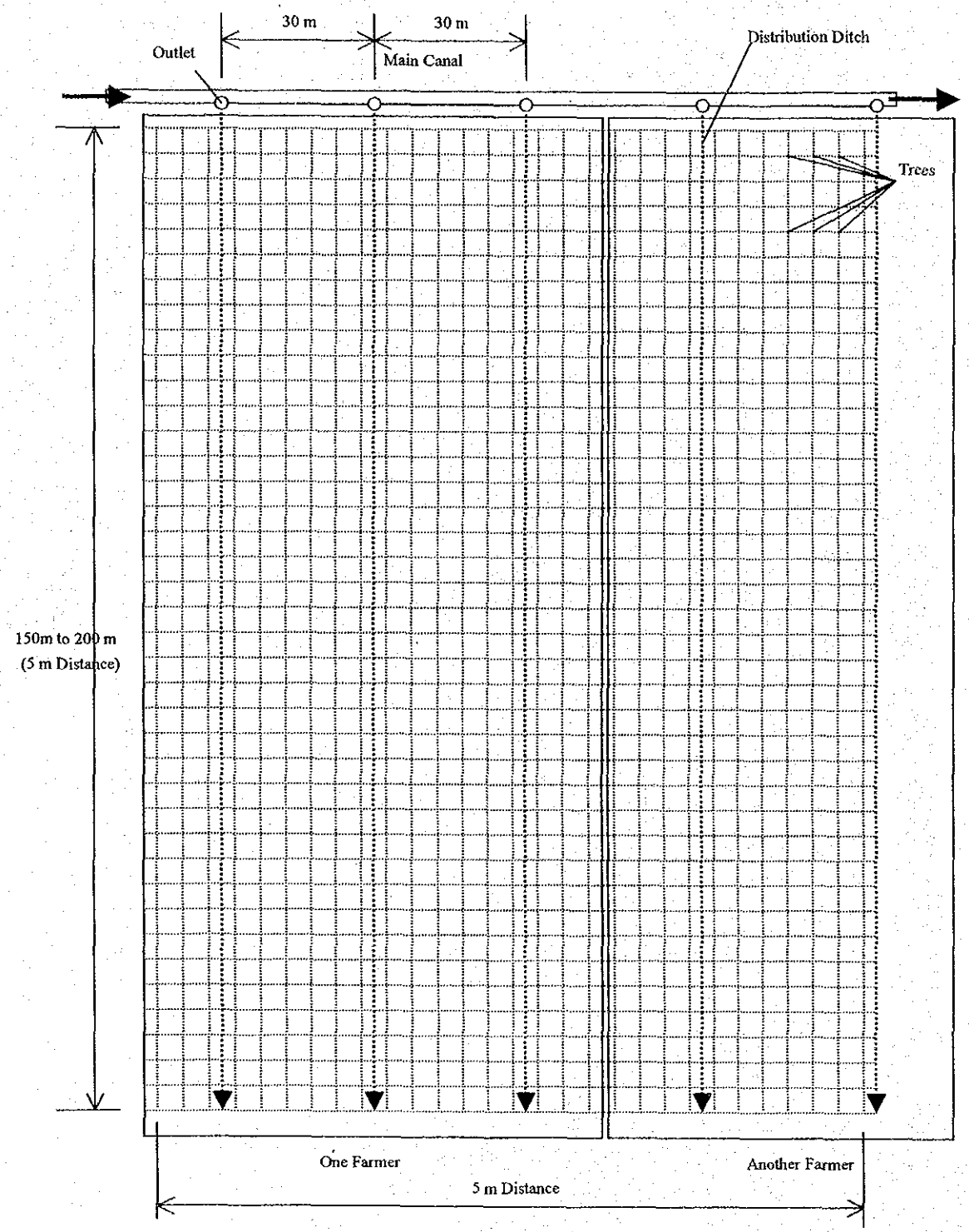


Figure 10-2-4-4 Plan of Orchard Terracing

Table 10-2-4-3 Summary of Soil Protection in Vastegan

Development Stage		Present						Scenario-1						Scenario-2					
Land Use		Area	Crop	Conservation Slope		Soil Loss		Area	Crop	Conservation Slope		Soil Loss		Area	Crop	Conservation Slope		Soil Loss	
slope		(ha)		Conservation Facility	L (m)	(t/ha)	(mm)	(ha)		Conservation Facility	L (m)	(t/ha)	(mm)	(ha)		Conservation Facility	L (m)	(t/ha)	(mm)
Farmland																			
IFL (Irrigated Farmland)																			
1	5%-13%	11		Basin Irri	2	0.0	0.00	11		Basin Irri	2	0.0	0.00	11		Basin Irri	2	0.0	0.00
		2	Wheat			0.0	0.00	2	Wheat			0.0	0.00	2	Wheat			0.0	0.00
		1	Alfalfa			0.0	0.00	1	Alfalfa			0.0	0.00	1	Alfalfa			0.0	0.00
		8	Fallow			0.0	0.00	8	Fallow			0.0	0.00	8	Fallow			0.0	0.00
2	2.70%	203		Furrow Irri	50	1.2	0.09	203		Furrow Irri	50	1.2	0.09	203		Furrow Irri	50	1.2	0.09
		38	Wheat			0.5	0.04	38	Wheat			0.5	0.04	38	Wheat			0.5	0.04
		17	Alfalfa			0.0	0.00	17	Alfalfa			0.0	0.00	17	Alfalfa			0.0	0.00
		148	Alfalfa			1.5	0.11	148	Alfalfa			1.5	0.11	148	Alfalfa			1.5	0.11
3	1.00%	582		Furrow Irri	50	0.5	0.04	582		Furrow Irri	50	0.5	0.04	582		Furrow Irri	50	0.5	0.04
		109	Wheat			0.2	0.01	109	Wheat			0.2	0.01	109	Wheat			0.2	0.01
		48	Alfalfa			0.0	0.00	50	Alfalfa			0.0	0.00	50	Alfalfa			0.0	0.00
		425	Fallow			0.6	0.04	423	Fallow			0.6	0.04	423	Fallow			0.6	0.04
4	1.00%	401		Furrow Irri	50	0.4	0.03	401		Furrow Irri	50	0.4	0.03	401		Furrow Irri	50	0.4	0.03
		75	Wheat			0.2	0.01	75	Wheat			0.2	0.01	75	Wheat			0.2	0.01
		33	Alfalfa			0.0	0.00	34	Alfalfa			0.0	0.00	34	Alfalfa			0.0	0.00
		293	Fallow			0.5	0.04	292	Fallow			0.5	0.04	292	Fallow			0.5	0.04
5	0.10%	1,906		Furrow Irri	50	0.2	0.01	1,906		Furrow Irri	50	0.2	0.01	1,906		Furrow Irri	50	0.2	0.01
		358	Wheat			0.1	0.01	358	Wheat			0.1	0.01	358	Wheat			0.1	0.01
		156	Alfalfa			0.0	0.00	163	Alfalfa			0.0	0.00	163	Alfalfa			0.0	0.00
		1,392	Fallow			0.2	0.01	1,385	Fallow			0.2	0.01	1,385	Fallow			0.2	0.01
6	0.10%	358		Furrow Irri	50	0.1	0.01	358		Furrow Irri	50	0.1	0.01	358		Furrow Irri	50	0.1	0.01
		67	Wheat			0.0	0.00	67	Wheat			0.0	0.00	67	Wheat			0.0	0.00
		29	Alfalfa			0.0	0.00	31	Alfalfa			0.0	0.00	31	Alfalfa			0.0	0.00
		262	Fallow			0.1	0.01	260	Fallow			0.1	0.01	260	Fallow			0.1	0.01
Total		3,461				0.3	0.02	3,461				0.3	0.02	3,461				0.3	0.02
		649	Wheat			0.1	0.01	649	Wheat			0.1	0.01	649	Wheat			0.1	0.01
		284	Alfalfa			0.0	0.00	296	Alfalfa			0.0	0.00	296	Alfalfa			0.0	0.00
		2,528	Fallow			0.4	0.03	2,516	Fallow			0.4	0.03	2,516	Fallow			0.4	0.03
DFL (Dry Farmland)																			
1	5%-13%	63	Wheat	none	100	11.1	0.79	63	Wheat	none	100	11.1	0.79	63	Wheat	none	100	11.1	0.79
Orchard		46				0.0	0.00	46				0.0	0.00	88				0.0	0.00
1	1.0%	5		Irri Ditch	5	0.0	0.00	5		Irri Ditch	5	0.0	0.00	5		Irri Ditch	5	0.0	0.00
2	16.5%	41		Orchard Terrace	5	0.0	0.00	41		Orchard Terrace	5	0.0	0.00	**83 (+42ha)**		Orchard Terrace	5	0.0	0.00
Tree Plantation																			
1	1.0%	69		Irri Ditch	5	0.0	0.00	69		Irri Ditch	5	0.0	0.00	69		Irri Ditch	5	0.0	0.00
River Bed																			
1	1.0%	11		none	0	0.0	0.00	11		none	0	0.0	0.00	11		none	0	0.0	0.00
Rangeland																			
AL-1	55%	453		none	100	81.5	5.82	453		**Protected**	100	38.3	2.74	**411 (-42ha)**		**Protected**	100	38.3	2.74
AL-2	38%	130		none	70	38.8	2.77	130		**Seeding**	70	4.6	0.33	130		**Seeding**	70	4.6	0.33
BA	30%	354		none	110	37.0	2.64	354		**Seeding**	110	5.8	0.41	354		**Seeding**	110	5.8	0.41
EL-1	70%	98		none	50	70.5	5.04	98		**Protected**	50	32.9	2.35	98		**Protected**	50	32.9	2.35
EL-2	20%	107		none	100	12.9	0.92	107		**Seeding**	100	2.6	0.19	107		**Seeding**	100	2.6	0.19
Total		1,142				55.5	3.96	1,142				20.6	1.47	1,100				19.9	1.42
Rock & Stone																			
RS-1	45%	727	Weathered Marl		100	81.8	5.84	727	Weathered Marl		100	81.8	5.84	727	Weathered Marl		100	81.8	5.84
RS-2	30%	1,001	Rock and Vegetation in cracks			13.7	0.98	1,001	Rock and Vegetation in crack			13.7	0.98	1,001	Rock and Vegetation in cracks			13.7	0.98
RS-3	36%	456	Rock and Vegetation in cracks			13.7	0.98	456	Rock and Vegetation in crack			13.7	0.98	456	Rock and Vegetation in cracks			13.7	0.98
Total		2,184				36.4	2.60	2,184				36.4	2.60	2,184				36.4	2.60
Rock																		0.0	0.00
R-1	50%	1,187	Weathered Marl		70	80.2	5.73	1,187	Weathered Marl		70	80.2	5.73	1,187	Weathered Marl		70	80.2	5.73
R-2	70%	668	Hard rock			13.7	0.98	668	Hard rock			13.7	0.98	668	Hard rock			13.7	0.98
Total		1,855				56.3	4.02	1,855				56.3	4.02	1,855				56.3	4.02
Village		159				0.0	0.00	159				0.0	0.00	159				0.0	0.00
Farmland		3,570				0.5	0.04	3,570				0.5	0.04	3,612				0.5	0.04
Tree Plantation		69				0.0	0.00	69				0.0	0.00	69				0.0	0.00
River Bed		11				0.0	0.00	11				0.0	0.00	11				0.0	0.00
Rangeland		1,142				55.5	3.96	1,142				20.6	1.47	1,100				19.9	1.42
Rock & Stone		2,184				36.4	2.60	2,184				36.4	2.60	2,184				36.4	2.60
Rock		1,855				56.3	4.02	1,855				56.3	4.02	1,855				56.3	4.02
Village		159				0.0	0.00	159				0.0	0.00	159				0.0	0.00
Total		8,990				27.7	1.98	8,990				23.2	1.66	8,990				23.1	1.65

(Note)

1) Detail analysis are in Table D-5-2-7 1) for Unit Soil Loss, in Table D-5-2-8(1) for Present, in Table D-5-2-9(1) for Scenario-1, in Table D-5-2-10(1) for Scenario-2.
2) Scenario-1 is following the cropping plan of Agriculture Plan Scenario-1, and the Rangeland Vegetation Improvement Plan.
3) Scenario-2 is planed to implement the Orchard Terracing Project (42ha) in Rangeland AL-1.

10.2.5 Groundwater Monitoring

Groundwater monitoring system should be established to observe groundwater table and water quality. The system consists of observation wells and database system. Density of wells is determined to be one well in every 10 km^2 at least. Also the depth of observation well is designed to be 60 meters based on the depths of existing wells. This observation well should be equipped with automatic data logger to obtain time series data for long term. Data processing and renewal is proposed to be conducted by computer system in PIC for future utilization of data. Then necessary equipment for groundwater monitoring system is listed as follows.

- Observation well(depth 60 m) 4 nos.
- Database system(data logger, computer, printer, software) 4 sets

It is proposed that Project Implementation Committee (PIC) operate and maintain this system. On the other hand, it is indispensable to consider participatory approach for effective conservation of groundwater resources. In general, villagers have poor knowledge of groundwater management. For the purpose of education to villagers, PIC should prepare programs for management of groundwater and execute them periodically. By this project, conservation of groundwater will be promoted.

10.2.6 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 10-2-6-1 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

In Vastegan, there are 4 lines of irrigation canal. Two of them have been improved with concrete lining and maintenance condition is not worse. However, the canal which locates on left bank of Bijeh Gerd is earth canal. Its capacity is estimated at 0.075 m^3/s. And the other canal which locates on right bank of Bijeh Gerd is too overage to keep stable utilization of water. Then these two canals are proposed to be rehabilitated. After rehabilitation of left canals, surplus water is estimated at 20 liter/s on the basis of field survey and investigation on topographical maps. As for right bank canal, it is not expected to produce surplus water. By these projects, it is possible to irrigate 13 ha of farmland in case of Alphalfa.

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

Canal	Production of Surplus Water (liters/s)	Water Demand (liters/s/ha)		
		Alfalfa	Vegetable	Apple
Bijeh Gerd left bank canal	20	1.58	1.88	1.61

Source: JICA Study Team and Revised Data of MOA
Note):Water demand is calculate in consideration of irrigation efficiency

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

- Improvement of Bijeh Gerd left bank canal (B 0.3 m x H 0.25 m) 1.7 km
- Improvement of Bijeh Gerd right bank canal (RCP ϕ 500) 2.3 km

(2) Agricultural Scheme

a) Potential of Development

In Vastegan, almost all farmland are irrigable. Farmland is located in alluvial fan and limited. According to the present land use, irrigable crop farmland is 3,524 ha, canals have been constructed, but planted farmland per year is 932 ha. It is quite different from irrigable farmland and planted farmland, because irrigation water source from surface as well as underground are quite limited. In crop farmland, wheat, barley, alfalfa, sugar beat, legume, potatoes, etc. are planted. It is said that irrigated agriculture has already been developed and some irrigation facilities become old. In such conditions, when the canals are rehabilitated, it is possible to obtain more water for irrigation and more agricultural production. Moreover, it could be expected that agricultural intensity would be increased with the provision of short

period growing seed selection and second cropping method in the irrigated farmland.

b) Development Plan

According to the above irrigation scheme plan, after rehabilitated the canal of Bijeh Gerd, production area increment in left bank will be reached 12.66 ha for alfalfa (or 10.64 ha for vegetable or 12.42 ha for apple). At present, wheat is planted in this left bank and as irrigation water is limited, alternate irrigation is applied. Considering the feed shortage for livestock, yield of crop, marketing conditions of products and village progress situations, it is recommendable to select the alfalfa to be planted firstly for livestock feed, (apple next and vegetable last).

Table 10-2-6-3 Estimated Production Increment by Rehabilitation of Canal (20litres/s)

	In case of Alfalfa	In case of Vegetable	In case of Apple
Gross Water Demand (litre/s/ha)	1.58	1.88	1.61
Increasing Area (ha)	12.66	10.64	12.42
Estimated Yield	9,456 kg/ha	20,000 kg/ha	40,000 kg/ha
Estimated Increasing Production (ton)	119.7	212.8	496.8

Note: (1) Alfalfa yield: average Vastegan data 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 10-2-6-4 Present and Future Crops Areas

	Present			Future (with plan)			
	Land area (ha)	Planting (ha)	Intensity (%)	Land are (ha)	Plantable (ha)	Intensity (%)	Difference (ha)
Irrigated Farmland							
1 Crops							
1) Wheat		563.6			563.6		+12.66
2) Alfalfa		282.8			295.5		
3) Others		2,663.7			2,651.0		-12.66
sub-total	3,461.0	3,510.1	28.3	3,461.0	3,510.1	28.7	
2. Orchard							
1) Apple		38.6			80.6		+42.0
2) Others		7.4			7.4		
sub-total	46.0	46.0	100.0	88.0	88.0	100.0	
Sub-total	3,507.0	3,556.1		3,549.0	3,598.1		
Dry farmland							
1 Crops							
1) Wheat		38.0			38.0		
2) Alfalfa		0.0			0.0		
3) Others		25.0			25.0		
sub-total	63.0	63.0	100.0	63.0	63.0	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	63.0	63.0		63.0	63.0		
Total	3,570.0	3,619.1		3,612.0	3,661.1		
Rangeland	1,142.0			1,100			-42.0
Others	4,278.0			4,278.0			
Grand total	8,990.0			8,990.0			

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

According to the cropping pattern, in irrigation farmland, potatoes, some legume and vegetables could be planted after wheat harvested. At present, according to the village survey, irrigated farmland is 932 ha, including wheat & barley are planted in 540 ha, alfalfa is in 271 ha, potatoes is in 47 ha for second crop; planting intensity is 33.0%. When short period grown seeds are selected and cropping patterns are developed, it would be possible to expand more intensity in whole irrigated farmland considering the limited irrigation water. Such as wheat in winter season + legume (+ vegetable) in summer season would be expected depending on the availability of water. Apple could be planted in same alfalfa farmland, affected little the production of alfalfa.

Ministry of Jihad-Agriculture and related institutes should develop the cropping patterns 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 seeds and cropping pattern, and promote the mechanization of agriculture with the provision of low interest loan to farmers.

10.2.7 Diversification to Milk Cow

(1) Potential of Development

In Vategan, total carrying capacity of livestock at present is 32,952 AUM including carrying capacity of rangeland (1,142 ha) of 3,475 AUM, straw from wheat of 10,862 and alfalfa of 18,615 AUM. Therefore, over grazing rate is of 5.2.

Table 10-2-7-1 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
540	10,862	271	18,615	1,142	3,475	32,852	16,368	14,190	170,280	5.2

On the other hand, AUM of cow, horse and donkey in villages is 62,880 AUM comparing to 29,477 AUM of wheat straw and alfalfa production. Over grazing rate is pointed at 2.1. Therefore, sheep and goat grazing as well as cow grazing in villages are both severely overgrazing. It is necessary to obtain a lot of feed for proper grazing.

Table 10-2-7-2 Estimated Total AUM for Cow, Horse and Donkey (Present, Village)

Straw from wheat		Alfalfa		Total	Present			Grazing
Area(ha)	AUM	Area(ha)	AUM	AUM	(head)	AU	AUM	Rate
540	10,862	271	18,615	29,477	1,048	5,240	62,880	2.1

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

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

(2) Development Plan of Diversification

However, it is possible to change the meat cow to milk cow in future for one of the method 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 509 could be raised at proper conditions with provision of canal rehabilitation.

Table 10-2-7-3 Estimated Total AUM for Cow (with plan)

Present Total		Additional Alfalfa		Total	Future			Grazing
Area(ha)	AUM	Area(ha)	AUM	AUM	(head)	AU	AUM	Rate
811	29,477	12.66	1,055	30,532	509	2,544	30,532	1.0

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

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

Table 10-2-7-4 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 10-2-7-5 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 10-2-7-6 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 cows, number of which will be reached 750 heads in the Vastegan Study Area. In that case, 606 households in Vastegan area will be benefited 1,998,750 litre or 3,298.27 litre/household which equivalents to 3,298,270 Rials per year per household.

This diversification plan should be promoted step by step with the help of Livestock Office, considering progress of artificial insemination, disease control, registering method, inspection method for milk cow as well as pasteurization, sterilization, disease control, inspection method for raw milk. Moreover, it is expected milk industry would be established near around to process and distribute the better quality milk.

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

(3) Marketing Plan of Milk

1) General

Analyzing the areas' conditions based on the above development potentials and policies, development plans would be designed for changing to cow grazing during the medium (10 years) or 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

a) 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:

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: Konark Olya, Konark Sofla, Nasir Abad and Vastegan: 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) with tank (plastic, 50 litre, 40 pieces)	1 unit
- 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 (606 households) will have benefit 449,080,000 Rials or 741,056 Rials per year per household.

b) 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 intention to produce milk products.

iii) Remarks for promotion:

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

(b) Group will be established within the cooperative. Group will be formed based on the

producers, members of which would grow same products or have intension to grow same products,

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

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

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

(f) 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: Konark Olya; 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) with tank (plastic, 50 litre, 100 pieces)	2 units
- Bulk cooler: stain less, electric operation	1 unit
- Land: relatively flat land with good access,	200m2

When collection and distribution center for milk is established, 250 households in village will have benefit 394,870,000 Rials (=2,263,000,000-1,868,130,000) or 1,579,480 Rials per year per household.

10.2.8 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 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 106 m^3/day and water demand in 2020 is estimated at 282 m^3/day. Then surplus water demand is 176 m^3/day. Water source is supposed to be enough to supply surplus water. Then it is planned to expand distribution tanks and connection pipeline for surplus water supply. Here, capacity of distribution tank is designed to be the volume of water supply for 12 hours and 30 % spare.

Table 10-2-8-1 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)
Konark Olya	1,600	170	2,283	411	241	157
Konark Sofla	400	42	571	103	60	39
Nasir Abad	700	74	999	180	106	69
Vastegan	1,000	106	1,427	257	151	98
Total	3,700	392	5,280	950	558	363

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. Rural Water and Waste Water Company (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.

Table 10-2-8-2 Propased Plan for Water Supply

Village	Distribution Tank	Pipeline
Konark Olya	B 7.8 m x L 7.8 m x H 3.0 m	PVC Pipe ϕ 75, L=900 m
Konark Sofla	B 4.2 m x L 4.2 m x H 3.0 m	PVC Pipe ϕ 50, L=200 m
Nasir Abad	B 5.4 m x L 5.4 m x H 3.0 m	PVC Pipe ϕ 50, L=400 m
Vastegan	B 6.3 m x L 6.3 m x H 3.0 m	PVC Pipe ϕ 75, L=600 m

10.2.9 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 participant group by providing knowledge and skill about maintenance of road and appurtenance facilities.

(2) Proposed Plan

The connection roads between Konark Sofla, Konark Olya, Vastegan and Nasir Abad are asphalt paved roads. These roads are comparatively not heavily damaged nevertheless roads are not well maintained. However, there is a small unpaved road which passes along the Gandoman Wetland. For improvement of access conditions from villages to farmlands, construction of gravel paved road is proposed. Widths of road and pavement are designed to be 4 m and 3 m respectively. Rural road will be maintained by PIC. As for farm road, villagers will have responsibility for construction and maintenance. Project components in Vastegan are summarized as follows. By these projects, expenditure of driving will be reduced.

- Construction of gravel pavement road 9 km
- Transfer of technology for maintenance of road and side drain 5 years
- Construction and maintenance of farm roads by farmers 476 km

10.2.10 Establishment of Cooperatives

Analyzing the areas' conditions based on the above development potentials and policies, development plans would be designed for handicraft during the short-term (5 years) 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 educa tion plan by government: short, medium term

④ Others (for formerly mentioned plans; 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: Konark Olya, Konark Sofla, Nasir Abad and Vastegan; 4 places

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

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

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

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

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

a) Purpose:

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

b) Size of facilities:

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

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

i) To be established by villagers' participatory scheme,

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

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

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

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

d) Structural measures:

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

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

iii) Proposed villages: Konark Olya, Konark Sofla, Nasir Abad and Vastegan: 4 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.

10.2.11 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 10-2-11-1 Number of village and household in Vastegan

No.	Village Name	Household	No.	Village Name	Household
1	Konarak Olya	250	3	Nasir Abad	100
2	Konarak Sofla	100	4	Vastegan	156

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 all 4 villages in the project area, Konark Olya, Konark Solfa, Nasir Abad, and Vastegan, meet the condition. 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 conducted 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 such enlightenment activities as project for sedimentation, flood and debris flow, implemented in other master plan areas.

d) Promotion of health services and nutritional education.

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.

According to the interview survey, carried out by JICA Study Team, about 100ha of farmland located along by the Gela River was flooded in 1998, and part of the land is still covered with sediment. This kind of problems should be discussed in the organization, and such actions as sediment removal should be taken by mutual aid among villagers.

10.2.12 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 10-2-12-1 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)
Diversification of Milk Cow			
Milk production (whole villages)	606 households	1,998,750,000	3,298,270 per h.h.
Milk processing center (4 villages)	606 households	449,080,000	741,056 per h.h.
	20 operators	129,500,000	6,475,000 per p.
Milk collection & distribution center (one village)	250 households	394,870,000	1,579,480 per h.h.
	7 operators	37,375,000	5,339,286 per p.
Handicraft facilities (4 places)	80 members	101,720,000	1,271,500 per p.
	80 weavers	96,000,000	1,200,000 per p.

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

10.3 K5-19a Chaman Goli-Bazoft

10.3.1 Construction of Check Dam

(1) Specific Sediment Discharge

Based on the topography, geological condition and riverbed condition, the specific sediment discharge for Gusale Bar River basin is applied 500 $m^3/km^2/year$, while that of the rivers of Feriak, Tabarak and others is adopted 300 $m^3/km^2/year$.

(2) Feriak River Basin

The catchment area of this basin is only 3 km^2 and has no flow in dry season. The oak forest seems well maintained, and farmland and houses are only located in the lower reaches. The riverbed gradient is steep in the middle reaches, however, it is mild in the upper and lower reaches.

Three main check dams of Type C are planned to mitigate the riverbed gradient, prevent the movement of unstable sediment left on the riverbed, prevent devastation of riverbed and river banks and reduce the sediment to be carried downstream, and protection of farmland and houses.

(3) Gusale Bar River Basin

Two right tributaries have large fan-shaped catchment areas and flood is very severe during snowmelt period and heavy rain. Judging from geology and river condition, debris flow is not so much in the upper right tributary than that of the lower.

a) Upper Reaches

On the right bank, gentle slope plateau is extending, while on the left bank a ridge with steep slope runs along the main road. Thick quaternary soil deposited on the right bank, while Marl and sandstone layers are formed on the left bank.

The deposited soil on the right bank is easily saturated and becomes muddy flow during snowmelt period and heavy rain. This area is categorized as perviousness erosion type and two countermeasures are considered; the vegetation work suited with soil condition and the channel work to prevent erosion by rainwater. However, the area is the utmost upper reaches and the tributary is very small stream without water most of the time, therefore only the vegetation work is to be applied here. In 1996, a severe debris/muddy flow occurred here and one of the Nomad tents was washed down. Three Nomads were killed and two or three were missing. The vegetation work should be implemented at the early stage.

b) Utmost Right Tributary Basin

This tributary has a large fan-shaped catchment area. Flood occurs frequently and causes some damage to the irrigation intake located at the narrow gorge in the middle reaches during snowmelt period and heavy rain.

Judging from the geological information, upper reaches seems to be stable, however, the river course in the lower reaches downstream of the narrow gorge is very devastated with very big boulders. Upstream of the irrigation intake at the narrow gorge, sedimentation is very scarce because of the flow velocity. Farmland and houses in the lower reaches are located apart from the river course and are not receiving serious damage from the river. In addition, a few temporary irrigation intakes made of earth mound are placed on the river course.

One main check dam with the height of 10 m is planned at the narrow gorge, immediate upstream of the irrigation intake in order to mitigate the riverbed gradient, prevent the movement of unstable sediment left on the riverbed, reduce the sediment to be carried downstream, and protect the existing irrigation intake. In addition, intake facility is to be installed on this check dam so as to stabilize the water for irrigation because this tributary has flow throughout the year.

c) Right Tributary Basin

This tributary also has a large fan-shaped catchment area. Flood occurs frequently and carries a lot of debris downstream from the riverbanks and the riverbed of the tributary, which are mainly composed of riverbank sediment. Farmland and houses in this basin are located on the riverbanks and are not receiving serious damage from the river.

Four main check dams with Type C are planned on this tributary in order to reduce the sediment to be carried downstream.

d) Right Tributaries on the Lower Reaches

Several short-steep tributaries flow into Gusale Bar River, just upstream of the sharp bent of

the river course. These tributaries are located on the old riverbank deposit, therefore, small and big gravels/boulders are flushed down during snowmelt period and heavy rain.

Three main check dams with Type D are planned on the three tributaries in order to mitigate the riverbed gradient and prevent the movement of unstable deposit.

e) Left Tributaries at Baghchnar and Dorak

Several tributaries flow down from the mountains with thinly vegetated and erosive slopes and pass through these villages. The riverbeds become deeper and deeper and the riverbanks are extended into the farmland adjacent to the rivers.

The countermeasures to be considered here are to construct one main check dam on each tributary as a model and then other check dams are to be implemented by people's participation. Thus, two main check dams and six check dams are allocated in Baghchnar, and one main check dam and two check dams are planned in Dorak.

f) Main River Course

Four main check dams with Type C are planned on the main river course of Gusale Bar River in order to mitigate the riverbed gradient, stabilize the foot of slope, prevent the movement of unstable sediment left on the riverbed, prevent devastation of riverbed and river banks and reduce the sediment to be carried downstream. Among these main dams, the one planned downstream of Dorak is to protect landslide by means of stabilizing the foot of landslide slope.

(4) Tabarak River Basin

The basin shares almost half of the master plan area in the south and has a large fan-shaped catchment area. Two left tributaries near Tabarak Olya, and three right ones near Ghale Tabarak and Tabarak Sofla have been devastated, whereas the main river course with no inhabitants is not so much.

a) Right Tributaries

In the utmost upper reaches of the right tributary, debris derived from the hillside collapse covers the foot of the hillside. At present, the debris seems to be halted its movement by oak forest, while the forest is decreasing because Nomad cut these oak trees for living. Therefore, the countermeasures to prohibit tree cutting and to preserve forest are necessary in order to prevent the debris movement.

As the right banks of the right tributaries are liable to collapse or to be eroded easily, one main check dam with Type C, and two check dams to be implemented by people's participation are planned in order to stabilize the foot of slope, prevent the movement of unstable sediment left

on the riverbed and prevent devastation of riverbed and river banks.

b) Left Tributaries

Devastation has been started in the upper reaches of the left tributaries because the villagers in Tabarak Olya and Nomad have been opened the oak forest in the area for cultivation. Countermeasures to prohibit opening forest and to preserve forest are necessary in order to prevent devastation.

Two main check dams with Type C are planned in order to stabilize the foot of slope, prevent the movement of unstable sediment left on the riverbed and prevent devastation of riverbed and riverbanks.

c) Main River Course

The devastation in the main river course is very limited, however, there is a landslide area located around 1 km upstream from Tabarak Sofla. Two check dams to be implemented by people's participation are planned in order to stabilize the foot of slope, prevent the movement of unstable sediment left on the riverbed and prevent devastation of riverbed and riverbanks.

(5) Other Tributaries

Main check dams are planned on the small tributaries, which flow Bazoft River directly.

a) Tributary-South of Chemghaleh

One small tributary located south of Chemghaleh, which crosses the road to Tabarak Sofla, sometimes causes flood and debris flow damage on the farmland and the road.

One main check dam with Type C is planned on this tributary.

b) Tributary-Southeast of Ghale Tabarak

Small farmland is located in the southeast of Ghale Tabarak and one small tributary with the catchment area of 0.5 km^2 runs through the farmland and joins into Bazoft River. The land in this area is so very erosive that the riverbed of the tributary becomes deeper and deeper and the riverbanks are extended into the farmland adjacent to the tributary.

One main check dam with Type C, and two check dams to be implemented by people's participation are planned in order to stabilize the foot of slope and prevent devastation of riverbed and riverbanks.

(6) Outline of Check Dams

The dimension of main check dams are listed in Table 10-3-1-1 and their location is also shown in *Fig. 10.3.1-1. The total number of check dams by type is summarized as follows;*

Main check dam (Type A) ..... 1 No.
Main check dam (Type B)..... 1 No.
Main check dam (Type C)..... 19 Nos.
Main check dam (Type D) ..... 3 Nos.
Check dam (Type D) ..... 14 Nos.

(7) 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 10-3-1-1.

(8) Effect of Check Dams

The check dams planned here are mainly considering preventing the devastation of the basins, therefore, the storing capacity for debris is rather limited. However, the effect of check dams is to secure stable intake of irrigation water, to secure farmland, orchard, and village and to stabilize the foot of landslide slope.

Based on Table 10-3-1-1, the total vacant volume (storing capacity for debris) of main check dams is around 53,800m^3, that of existing check dams 800m^3, and that of 14-check dams by people's participation 28,000m^3 (2,000m^3 per each) and totally become 82,600m^3. On the other hand, annual sediment discharge is estimated around 30,500m^3. Thus, the total vacant volume is equivalent to about 3-years of sediment discharge.

Table 10-3-1-1 Dimension of Main Check Dams in Chaman-Goli Bazoft

River: Site No.	ITEM											Remarks
	C.A. (km^2)	ΣC.A. (km^2)	I (m)	Q (m^3/sec)	Dam Type	C.EL (m)	H (m)	W (m)	L (m)	h (m)	Q_a (m^3/sec)	
T1:												
101	1.07	1.07	1,420	8.1	C	1722.8	3.8	7.0	27.0	0.7	9.7	
102	0.54	1.61	2,340	12.1	C	1591.5	4.5	6.0	29.0	1.0	12.1	
103	0.66	2.27	3,080	17.1	C	1550.0	4.5	13.0	30.0	1.0	24.4	
T2:												
201	6.07	15.62	2,680	87.7	C	1849.5	3.5	26.0	36.0	1.5	88.5	
202	3.11	18.73	4,330	105.2	C	1717.4	3.4	26.0	36.0	1.6	110.4	
203	2.15	22.54	5,730	126.6	C	1707.0	4.0	16.0	29.0	2.5	126.6	
204	7.45	43.77	9,520	204.0	B	1585.0	8.0	22.0	62.0	3.0	222.6	
205	0.51	66.39	9,950	309.5	E	1509.0	5.0	32.0	46.0	3.0	316.5	
206	0.08	66.47	10,200	309.8	E	1499.0	5.0	32.0	54.0	3.0	316.5	
211	0.67	0.67	1,160	5.1	C	1795.0	4.0	8.0	27.0	0.5	5.3	
221	0.99	0.99	1,730	7.5	C	1785.0	4.0	12.0	27.0	0.5	7.8	
231	7.96	7.96	7,060	60.1	C	1759.0	3.5	18.0	30.0	1.5	62.4	
241	12.4	12.4	5,080	79.5	C	1899.5	4.5	24.0	43.0	1.5	85.2	
242	0.45	12.85	5,550	82.4	C	1805.5	4.5	25.0	43.0	1.5	85.2	
243	0.56	13.41	6,360	86.0	C	1749.5	4.5	25.0	43.0	1.5	86.0	
244	0.14	13.55	6,770	86.9	C	1704.5	4.5	26.0	43.0	1.5	88.5	
251	9.55	9.55	4,720	65.4	A	1950.5	10.0	10.5	26.0	2.5	84.0	
261	0.23	0.23	820	1.7	C	1640.0	4.0	7.0	27.0	0.5	4.6	
271	0.23	0.23	580	1.7	D	1590.0	5.0	7.0	14.0	0.5	4.6	
281	0.05	0.05	490	0.4	D	1610.0	5.0	7.0	14.0	0.5	4.6	
291	0.09	0.09	610	0.7	D	1610.0	5.0	7.0	14.0	0.5	4.6	
T3:												
311	6.79	6.79	6,890	40.5	C	1627.5	4.0	12.0	32.0	1.5	42.9	
321	0.91	0.91	2,060	5.4	C	1635.5	4.0	11.0	34.0	0.5	7.1	
341	2.89	2.89	2,870	14.3	C	1599.8	3.8	11.0	34.0	0.7	14.8	
T4:												
401	0.42	0.42	1,230	2.5	C	1500.0	4.0	7.0	27.0	0.5	4.6	
T5:												
501	0.48	0.48	1,500	3.6	C	1500.0	4.0	7.0	27.0	0.5	4.6	

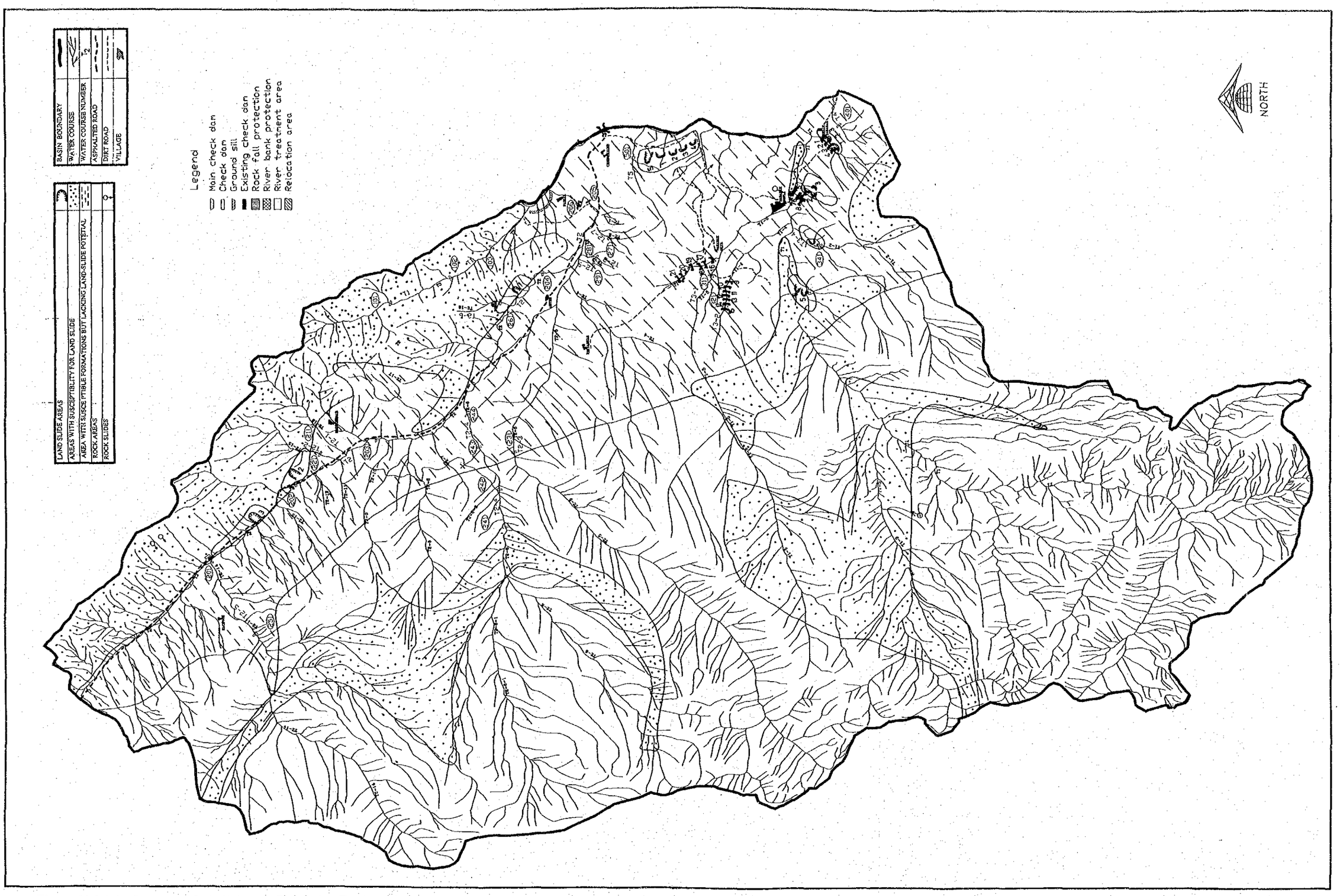


Figure 10-3-1-1 Location Map of Disaster Prevention Facility : Chaman Goli-Bazoft