3.5 Debris Flow Control Plan

3.5.1 Present Situation of Debris Flow Control Plan

Debris flow in five mountain streams occurred in the 2001 Floods in the area downstream of Tangrah. These streams are: (1) one stream in Tangrah, (2) two streams in Terjenly (3) one stream between Terjenly and Google Bozorg, (4) one stream in new Beshoily. During the 2001 Flood, three residents died due to miss-evacuation from debris flow in Tergenly village. Major features of these tributaries are summarized below.

Table 3.25 Major Features of Tributaries Occurring Debris Flow in 2001 Flood

Stream	Drainage Area (km^2)	Channel Length (km)	Channel Slope near Outfall	Relation to Village
Tangrah	53.5	11.3	0-5 degree	Directly hitting at village
Terjenly-1	1.1	2.7	5-15 degree	Directly hitting at village
Terjenly-2	1.5	2.0	5-15 degree	Directly hitting at village
between Terjenly and Google Bozorg	4.1	2.9	5-15 degree	No village
New Beshoily	7.6	4.4	0-5 degree	No village

Note: Streams are arranged from Tangrah towards lower reaches.

These debris-prone streams are covered by the Tangrah sub-basin in the middle-term watershed management plan as described in 3.2 Watershed Management Plan. So far MOJA-Golestan has been conducting the construction of masonry dams and gabion dams for debris and sediment control as mechanical measures in parallel with bio-mechanical and biological measures such as terracing, banquette, furrow, planting and so on. The plan's details are described in 3.2.

3.5.2 Improvement Directions

In parallel with the master plan study, MOJA-Golestan staff and team members have discussed on planning and designing for debris flow control structures at the sites. Although designing and construction works are still on going, the improvement directions are summarized below. Furthermore in the course of feasibility study, the team and MOJA-Golestan staff continued to collaborate together in the improvement works.

(1) Design Rainfall and Design Discharge

Since intensive downpour such as the 2001 and 2005 Floods has not been experienced for a long time in the region, both of the rainfall and flood discharge for designing spillway seems to be too much small. Furthermore observed meteorological data, in particular rainfall data in short duration (at least hourly rainfall), has not be stored yet enough to elaborate the design rainfall and the rainfall intensity and duration relationship. Therefore the most important issue is to store the short-duration rainfall for some effective years to modify the existing design rainfall and time duration relationship. For this purpose close collaboration works between MOJA-Golestan and MET-Golestan are necessary. For instance in the Madarsoo River basin, short-duration rainfall data at Tangrah and Dasht is useful for establishment of rainfall and time duration relationship in the middle reaches and the headwaters.

Until establishment of new rainfall and time duration relationship, the temporary modification of design rainfall estimation procedure would be necessary for the time being. The team prepared the temporary rainfall and time duration relationship in the Feasibility Study stage. This relation could be usable in the mountain slope receiving intensive rainfall in the Golestan Province. The paper is attached in ANNEX 3 in this report.

(2) Improvement Works in Debris-Prone Streams

The necessary improvement works in the said debris-prone streams is summarized below.

Table 3.26 Proposed Improvement Works in Debris-Prone Streams

Site Photo	Necessary Improvement Works
	**Tangrah** □ Construction of debris flow deposition basin immediately upstream of village □ Channeling works from basin to outfall
	**Terjenly (two streams)** □ Channeling works, in particular downstream of road crossing □ Installation of drainage culvert under the road
	**between Terjenly and Google Bozorg** □ Construction of debris flow deposition basin immediately upstream of the road □ Channeling works from basin to outfall including drainage culvert under the road
	**Beshoily** □ Construction of a series of sabo dams □ Closure of another stream at the bifurcation

(3) Preparation of Debris Flow Hazard Map

Regarding emergency evacuation for residents, debris flow hazard map shall be prepared as illustrated below. In both Tangrah and Tergenly villages, residential areas are located in the fan area, where is formed from debris and sediment deposits. Thus residents shall evacuate to nearby terrace.

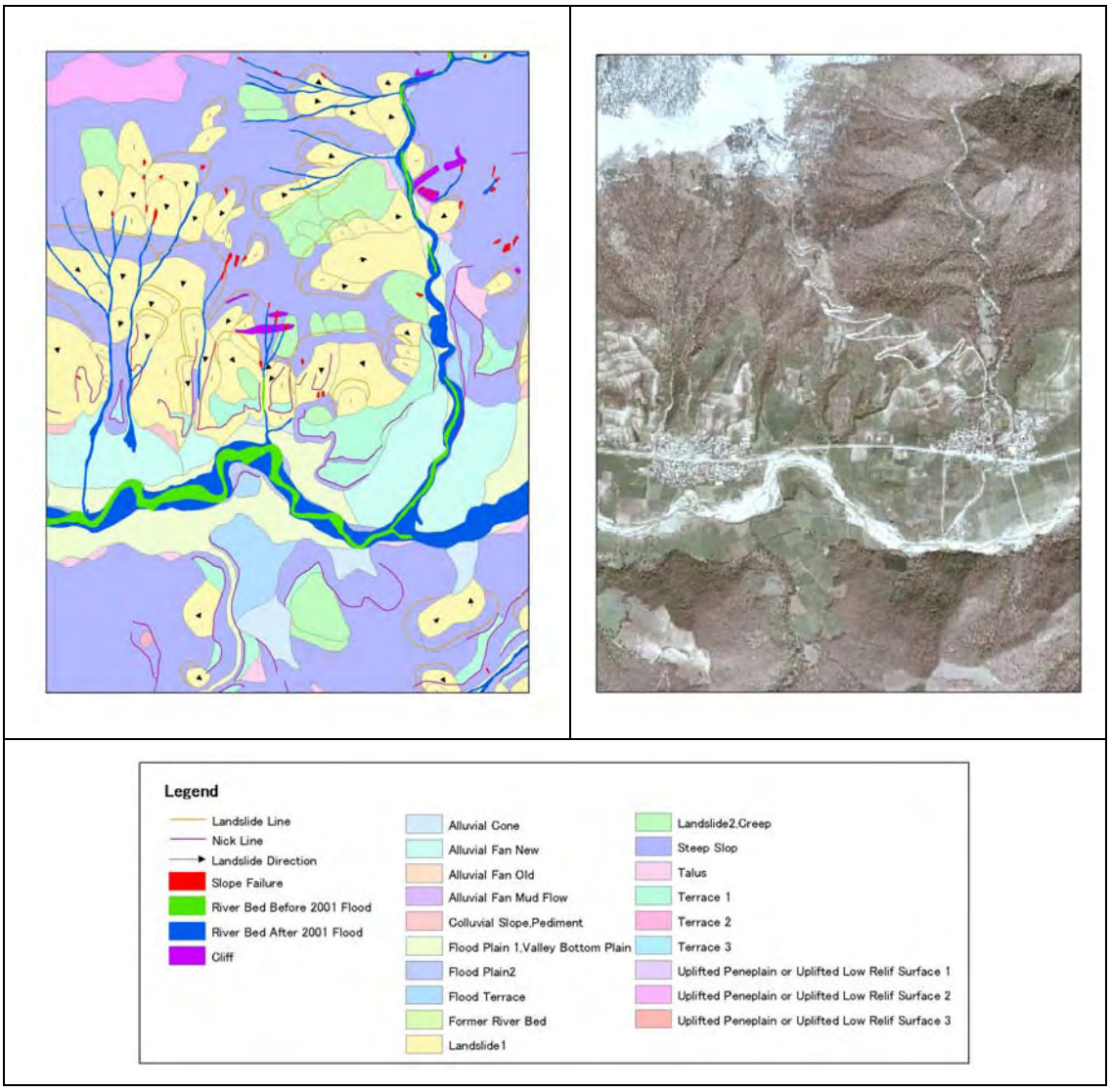


Fig. 3.24 Debris Flow Hazard Map
(prepared through aerial photo interpretation, geomorphological analysis)

3.6 Flood Control Plan

3.6.1 Present Status

After demolition of structures of road and riverbank during the disastrous 2001 flood, MOE and MORT conducted urgent rehabilitation works to the damaged structures. In particular, MOE has a responsibility to hydrological and hydraulic analysis for river structures. MOE is preparing two-phased plan: namely urgent measures and master plan.

(1) Urgent Measures

The major task of urgent measures is rehabilitation of structures damaged by the 2001 Flood. The river improvement stretch is about 65 km from Kalaleh Bridge through the Golestan Forest National Park up to Dasht Bridge. The design discharge in the urgent plan ranges between 250 m^3/s of the upper stretch near the Golestan Forest Park and 400 m^3/s of the lower stretch near the Kalaleh Bridge, on the basis of 50-year design flood.

MOE selected nine locations for the urgent river improvement works; namely 1) Golestan National Park, 2) Tangrah Check Point, 3) Terjenly, 4) Sadegh Abad Diversion Dam, 5) Loveh Bridge, 6) Korang Kaftar Bridge, 7) 14 Metry Bridge, 8) Ajen Ghareh Khojeh and 9) Kalaleh Bridge, from upstream.

Most of the locations were completed before the recent flood attacked in the Madarsoo River basin on 10 August 2005.

(2) Master Plan in the Golestan Dam Basin

MOE simultaneously has been formulating the master plan covering the Golestan dam basin including the Madarsoo River basin. A 100-year return period was adopted as a design scale. However, the master plan has not been finalized yet.

Under the above situation, the 2005 Flood made an attack to the Madarsoo River basin. The damage situations at major sites are summarized in Table 3.29. As described in the table, the recently rehabilitated structures and newly installed flood control structures were seriously damaged in one or two years after completion of construction works.

After the flood disaster, MOE has to prepare or modify their rehabilitation plan based on the damages experienced. Furthermore the master plan being prepared by MOE should be also adjusted to the statistic background of rainfall affected by recent successive floods in 2001, 2002 and 2005. Therefore, the JICA team proposed some recommendations from engineering and disaster management viewpoints to MOE so that the master plan and rehabilitation plan could be elaborated, and the structures to be constructed by MOE and MORT would be much more strengthened to the previous one. Furthermore some confusion and discrepancies originated from both parties' master plan could be avoided in this manner.

The recommendation points are:

(1) Hydrological Planning,

(2) Structural Considerations,

(3) Critical Constrictions of the Madarsoo River Course, and

(4) Road Improvement for Smooth Emergency Activities.

Table 3.27 (1) Flood Disaster Situation in the 2005 Flood along the Madarsoo River

	14 Metry Bridge One of serious constrictions in the lower reaches. Floodwater flowed down over the road. (Photo taken on August 10,2005)
	Loveh Bridge The right bank approach of submerged bridge part was washed away. Bolder spur dike to protect Loveh village was also washed away. (Photo taken on August 10,2005)
	Beshoily Bridge Serious constriction in the middle reaches. Floodwater inundated over the valley-bottom plain. (Photo taken on August 10,2005)
	River Bend in Terjenly village River floodwall fell down due to insufficient foundation depth. (Photo taken on August 12,2005)
	River Bend in Tangrah village River floodwall fell down due to insufficient foundation depth. (Photo taken on August 10,2005)

Table 3.27 (2) Flood Disaster Situation in the 2005 Flood along the Madarsoo River

	Golestan Forest Approach road of temporary bridge was washed away. (Photo taken on August 10,2005)
	Golestan Forest River floodwall downstream of the Dasht bridge fell down due to insufficient foundation depth. (Photo taken on August 12,2005)
	Dasht Bridge Floodflow near flood peak was passing over and through the Dasht Bridge. (Photo taken by MOJA-North Khorasan on August 10, 2005)
	Dasht Bridge Immediately downstream of the Dasht Bridge was seriously scoured. (Photo taken in middle of August, 2005)

3.6.2 Recommendations on Flood Control Plan

The following are recommendations to rehabilitation plan and flood control master plan being prepared by MOE and road improvement plan conducted by MORT.

(1) Hydrological Planning

According to previous study for urgent rehabilitation works, the design discharge was estimated at 250 m^3/s in the Golestan Park, and 400 m^3/s in the lower part of the Madarsoo River. However, the study results reveal the August 10 Flood in 2005 is almost equivalent to 25-year flood. The peak discharges might be 700 m^3/s at Dasht Bridge, 1,010 m^3/s at Tangrah, and 1,090 m^3/s at 14 Metry bridge based on hydro-hydraulic simulation made by the study team, as presented in Fig. 3.7.

Furthermore, the historical disastrous 2001 Flood was evaluated as an event in 55-year recurrence. Therefore a 100-year flood should be larger than the 2001 Flood. These hydrological considerations are important to improve the planning process for flood control in this region.

(2) Structural Considerations

According to MOE explanation, the river floodwall has a embedment of 1.5m deep underneath the riverbed surface. Thus many parts of the floodwall fell down during the 2005 Flood due to the local riverbed scouring at the foot of floodwalls.

Torrential stream riverbed tends to make local scouring seriously because of steep riverbed gradient and high floodflow velocity, in particular along the concave bank in the bend. Therefore, the determination of a suitable embedment depth of the riparian structures shall be considered carefully in comparison of previous and recent survey results.

In Japan, base elevation of the foundation is determined in the following manner.

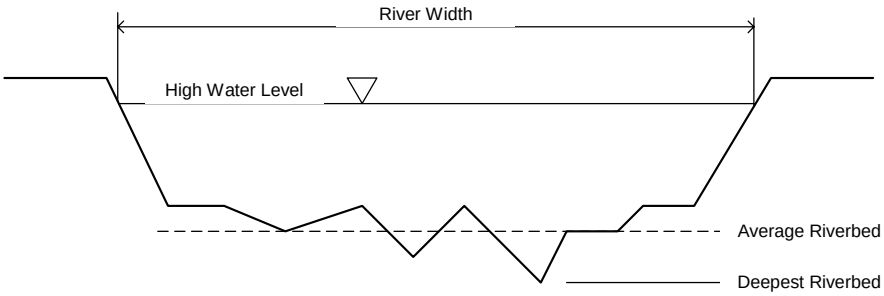


Fig. 3.25 General Parameters of River Channel

(a) Cross-sectional survey is made immediately after floods.

(b) Average riverbed height is estimated as:

Average riverbed height = high water level – (area below high water level / river width at high water level)

(c) Riverbed scouring depth is estimated as:

Riverbed scouring depth = average riverbed height – deepest riverbed height

(d) Design riverbed scouring depth shall be set up enveloping scouring depth at each cross-section in a river stretch. It may be set up at the maximum depth in a stretch.

(e) Structural foundation base shall be designed at 1 to 2 m deep below design scouring depth as:

Design structure foundation base = average riverbed height – design scouring depth – margin safety depth (1 to 2 m)

(3) Critical Constrictions of the Madarsoo River Course

According to the cross section survey along the Madarsoo River obtained from MOE-Golestan, the flow capacity analysis is carried out for the existing low water channel. The results of flow capacity and existing low water channel arrangement are shown in Figs. 3.26 and 3.27. It is assumed that the critical constrictions of the Madarsoo River are in the lower reaches for about 10km from Golestan Dam and the existing bridge sections except the Kalaleh Bridge. Especially, the 14 Metry bridge and the Besh Oily bridge sections make the narrowest portions due to bridge construction in the middle reaches of the Madarsoo River, and in the recent flood, those narrow sections have caused the flood inundation in and around the bridge section (refer to Table 3.27).

To prevent the flood damage to the existing farmland on the floodplain, the river improvement, including the river widening and reconstruction of the existing bridge, is proposed.

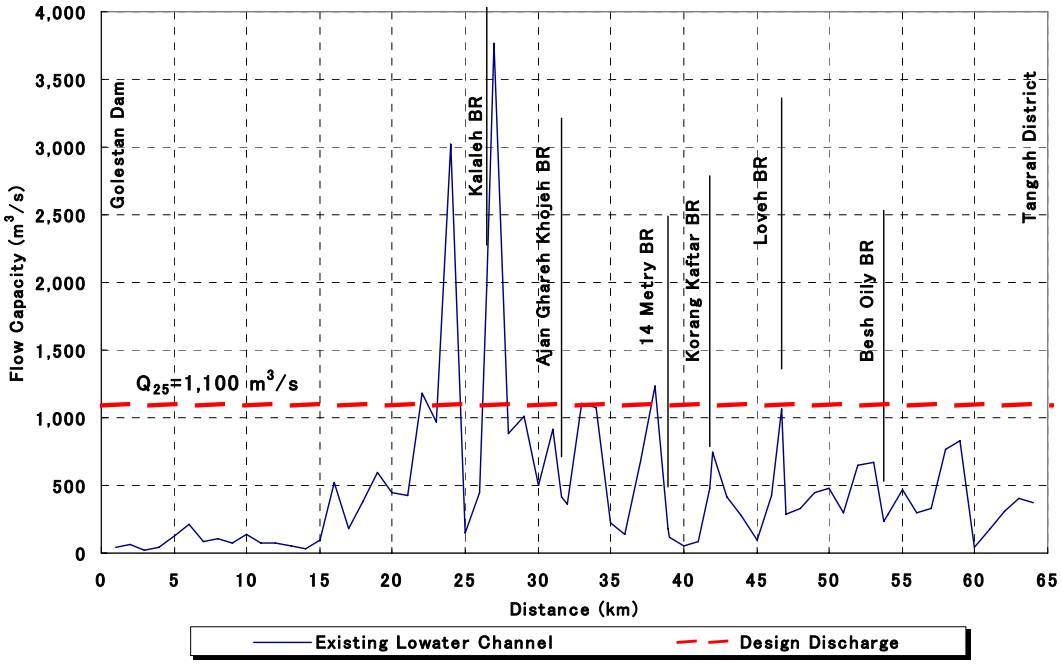


Fig. 3.26 Flow Capacity in the Low Water Channel along the Madarsoo River

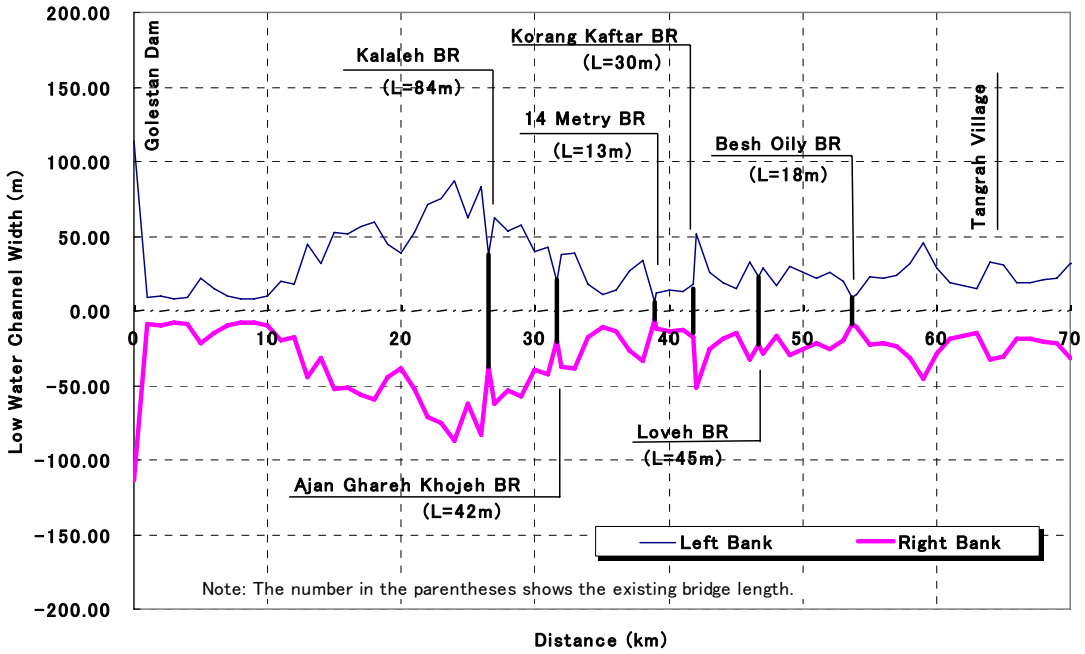


Fig. 3.27 Existing Low Water Channel Arrangement

Proposed Flow Section for the Low Water Channel

According to the interview survey to MOE-Golestan office, it is obtained that there is a design scale for the river improvement and the design scale for the Madarsoo River basin is a 25-year return period for a rural area or a 100-year return period for an urban area.

In the lower and middle of the Madarsoo River, the large floodplain is spread due to the river meandering and sediment deposition for a long time. At present, the floodplain is utilized as farmlands. The residential area along the Madarsoo River is comparatively located on the higher elevation than the floodplain in order to protect the residential area from the flood damage.

Consequently, the river improvement for low water channel is proposed to introduce the design scale of a 25-year return period based on the current land use aspects. The following table shows the design discharge in the hydrological study results.

Table 3.28 Probable Design Discharge with the 2001 Flood Type

Return Period	Design Discharge (m^3/s)			
	Golestan Dam	14 Metry Bridge	Tangrah	Dasht Bridge
25- year	1,100	1,100	1,050	700
50- year	1,600	1,600	1,450	1,050
100- year	2,300	2,300	2,050	1,450

The required flow sections are provided with the uniform flow calculation by Manning's formula based on the design discharge. The determination of proposed flow sections follows the criteria as follows:

- Roughness coefficient for the uniform flow calculation is adopted for n=0.035 based on the field reconnaissance.
- Proposed design water level shall be in accordance with the existing floodplain surface as much as possible to avoid the flood damage spreading further into landside area due to dike breaching and/or collapse.

- Proposed design flow velocity is set for less than 3 m/s without riverbank protection, principally. When the flow velocity is more than 3 m/s, the placement of required revetment works and groundsill works shall be considered to protect the riverbank and riverbed stabilities.
- Proposed river width is minimized as much as possible to reduce the required land acquisition and compensation cost in the project implementation.

Based on the above criteria, the proposed low water channel arrangement and typical cross sections are shown in Fig. 3.28 and Fig. 3.29, respectively.

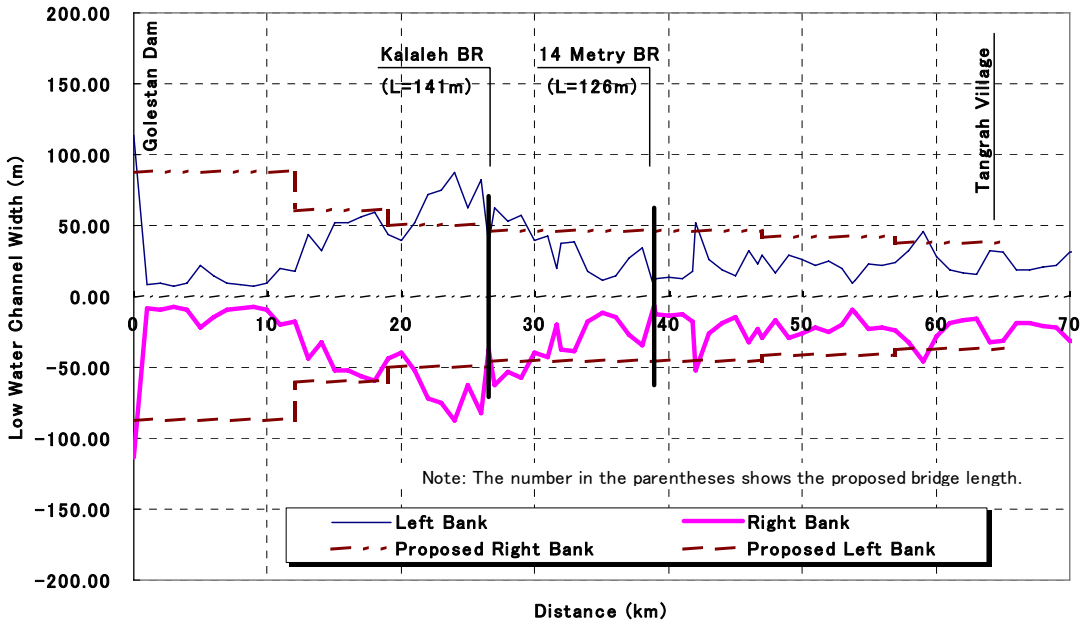
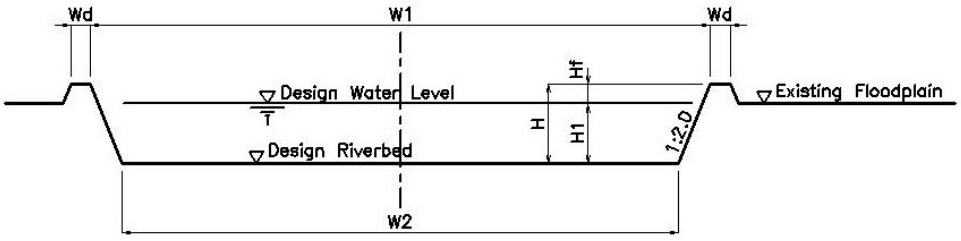


Fig. 3.28 Proposed Low Water Channel Arrangement



Typical Cross Section of the Proposed Low Water Channel

Dimensions

River Stretch	W1 (m)	W2 (m)	Wd (m)	H1 (m)	Hf (m)	H (m)	Riverbed Gradient
0.0km to 12.0km	178.0m	160.0m	5.0m	3.0m	1.0m	4.0m	i=1/600
12.0km to 19.0km	121.0m	105.0m	5.0m	3.0m	1.0m	4.0m	i=1/260
19.0km to 26.5km	101.0m	85.0m	5.0m	3.0m	1.0m	4.0m	i=1/175
26.5km to 47.0km	91.0m	75.0m	5.0m	3.0m	1.0m	4.0m	i=1/135
47.0km to 57.0km	84.0m	68.0m	5.0m	3.0m	1.0m	4.0m	i=1/110
57.0km to 64.0km	74.0m	58.0m	5.0m	3.0m	1.0m	4.0m	i=1/80

Note:
1. These proposed cross sections are provided with the method of uniform flow calculation
2. Roughness coefficient n=0.035 is applied to this consideration based on the field survey.

Fig. 3.29 Typical Cross Section of Low Water Channel

(4) Road Improvement for Smooth Emergency Activities

During 2001 flood, the main road between Kalaleh and Tangrah has been closed here and there along the Madarsoo River caused by flood inundation from the Madarsoo River and/or debris flow avalanches from the mountain streams, so that it is experienced that the sufficient emergency activities to rescue the victim have hardly done with the main road and have been delayed.

To avoid road closing during and immediately after the flooding, it is proposed that the existing road system shall be raised to strengthen against flood damages, especially between 14 Metry bridge and Tangrah village. The appropriate height of raising road shall be determined with flood inundation model simulation.

According to the flood simulation analysis without countermeasures, it is assumed that four (4) locations between 14 Metry bridge and Tangrah on the main road are covered with water on the condition of the 100-year flood.

The following table and Fig. 3.30 show the submerged location and its estimated water depth based on the flood simulation analysis.

Table 3.29 Presumed Main Road Damage

Location	Presumed Main Road Damage due to Flood Inundation		
	Stretch Length (m)	Max. Water Depth (m)	Remarks
Besh Oily (1)	1,070	3	A 100-year return period
Besh Oily (2)	480	4	Ditto
Terjenly	480	3	Ditto
Tangrah	1,200	3	Ditto

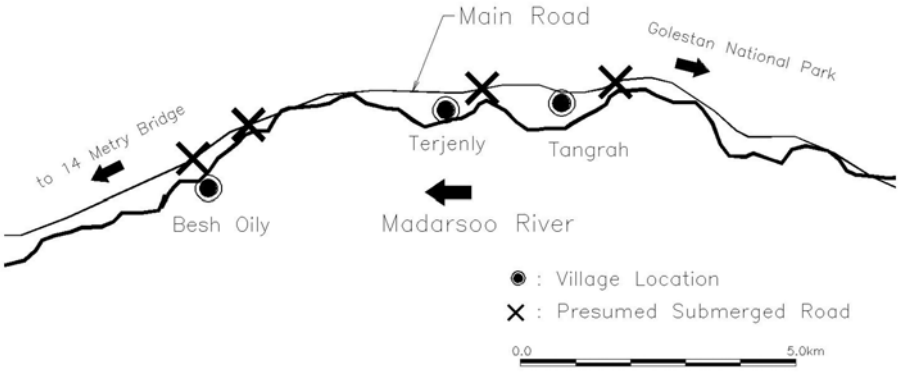


Fig. 3.30 Presumed Locations of Submerged Main Road

The height of the proposed road raising is recommended to add the freeboard height (1.0m) on the required height in order to ensure the traffic situation during flood time.

The typical cross section of the proposed road raising is shown in Fig. 3.31.

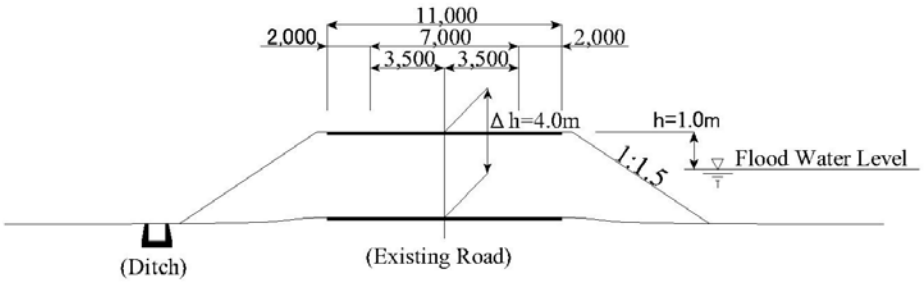


Fig. 3.31 Typical Cross Section of Proposed Road Raising

3.7 Floodplain Management Plan

3.7.1 General Concept of Floodplain Management

In general term, floodplains are the lowlands adjoining the river channels, streams or other watercourses, or the shorelines of oceans, lakes, or other bodies of water. They are lands that have been or may be inundated by floodwater. Floodplains are shaped by dynamic physical and biological processes: climate, the hydrological cycle, erosion and sediment deposition, extreme natural events, and other forces.

Floodplain management is a broad concept combining various flood management regulatory systems so as to totally reduce flood losses and to conserve natural and cultural resources. Normally floodplain management could be divided into five management systems, but weighting of the combination will vary in accordance with situations of country or region.

Table 3.30 Floodplain Management Framework

1. Development Policy - Regional development plan - Rural/Agricultural development plan - Urban/City development plan
2. Land Use Regulations - Urban planning - Housing code - Land use zoning
3. Flood Control Structural Plan - Dams and reservoirs - Dikes and floodwalls - River channel excavation and dredging - Land treatment
4. Alleviation of Flooding Impacts - Flood insurance - Tax adjustment - Disaster assistance - Post-flood recovery
5. Flood Preparedness - Flood proofing - Flood preparedness education and training - Flood forecasting and warning system and emergency plan

In Iran there are no experiences to adopt the floodplain management system. As easily understood in the above table, most of the management systems are based on the national legal system. Therefore application of full-scale floodplain management depends on national policy, legislative preparation and decision-making process.

Some frameworks, however, could be applied to the Madarsoo River basin without national legislative preparation so that the objectives of the master plan, in particular to save people's life, could be realized in the Madarsoo floodplain. This is the standpoint of the master plan for the floodplain management.

3.7.2 Madarsoo River Floodplain and its Management Frame

In the lower reaches of the Madarsoo River, floodwater has eroded erosive soils of the Gorgan Plains together with free meandering and channel downcutting. Finally the river course forms lower terraces at 5-10 m lower than the Gorgan Plain and with about 1 km

width. At present the river flows its free meandering courses inside of the lower terraces.

In addition to the topographic features, villages and irrigated farmlands are traditionally located in the Gorgan Plain (upper terraces), while only extensive farmlands are situated in the lower terraces. Thus, if proper information on the flood hazard area is provided to residents living in the lower reaches, they will not directly suffered from floods at least.

Typical features of the lower Madarsoo floodplain are illustrated in the following figure.

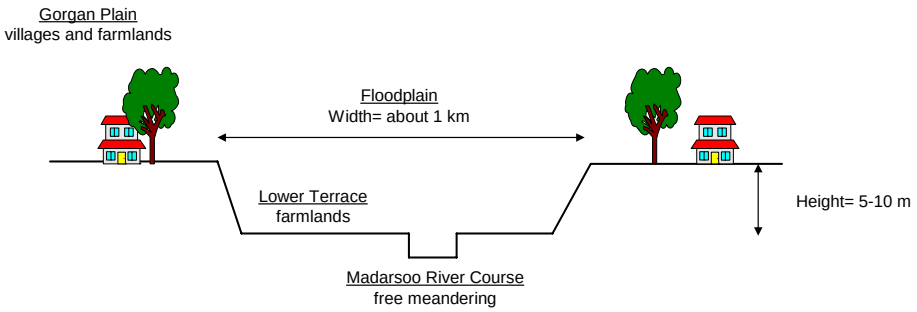


Fig. 3.32 Typical Features of the Lower Madarsoo Floodplain

In due consideration of the above mentioned situation, the suitable and bare minimum frameworks are tabulated below for the Madarsoo River floodplain management.

Table 3.31 Floodplain Management Framework in the Madarsoo River

Management Frame	Responsible Agencies
1. Development Policy	
- Rural development scheme (HADI)	Housing Foundation of Islamic Revolution
2. Flood Control Structural Plan	
- Dams and reservoirs	MOE, MOJA
- Dikes and floodwalls	MOE, MOJA
- River channel excavation and dredging	MOE, MOJA
- Land treatment	MOJA
3. Alleviation of Flooding Impacts	
- Disaster assistance	Provincial Disaster Management Committee (PDMC), Imam Khomeini Relief Foundation, Red Crescent
- Post-flood recovery	Provincial Governor's Office
4. Flood Preparedness	
- Flood preparedness education and training	Proposed in the master plan
- Flood forecasting and warning system and emergency plan	PDMC, Proposed in the master plan

Essential frameworks are (1) rural development scheme, (2) flood preparedness education and training, and (3) flood forecasting and warning system and emergency plan. As for alleviation of flooding impacts, activities on disaster assistance and post-flood recovery are already well organized among the related agencies. It was proven in the recent flood occurred in 10 August 2005. These three schemes are closely related each other as illustrated in the following figure.

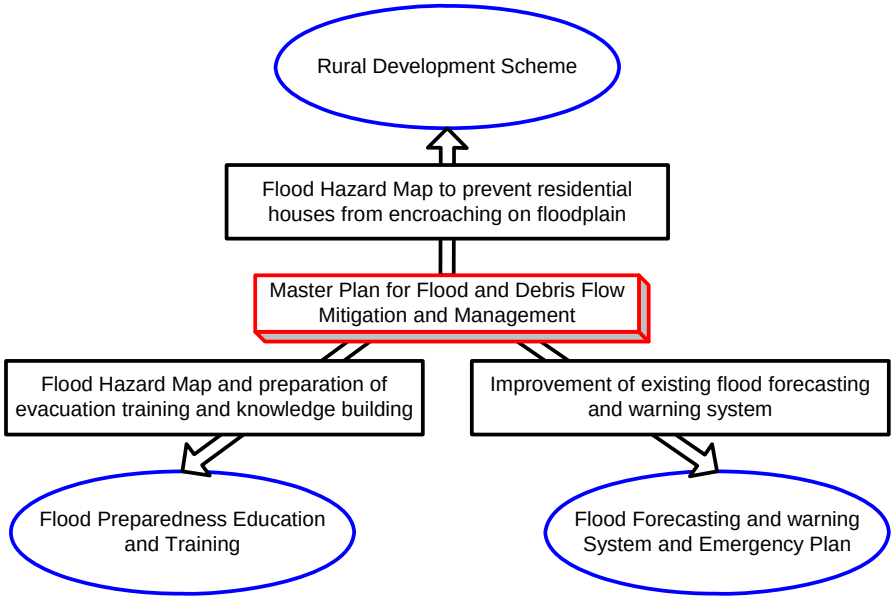


Fig. 3.33 Relationship among Floodplain Management Frames and Master Plan

(1) Rural Development Scheme

Flood hazard map including debris flow hazard area is prepared in the course of the study. Using the hazard map, Housing Foundation shall prevent the residential houses from encroaching on the Madarsoo floodplain so as to keep the safe conditions against floods.

(2) Flood Preparedness Education and Training

Also using flood hazard map, knowledge building and training is made in the flood-prone villages in the course of the public hearing.

(3) Improvement of Existing Flood Forecasting and Warning System

Improvement direction of existing flood forecasting and warning system is proposed in the Master Plan as described in 3.4 Golestan Forest Park Disaster Management Plan.

As described above, the flood hazard map plays a central role in the proposed floodplain management plan.

3.7.3 Publication of Flood and Debris Flow Hazard Map

Dissemination of the flood hazard map is broadly adapted in the world as one of the useful non-structural flood mitigation measures. Through dissemination of the flood hazard map, the residents could aware the extent of the possible flood inundation area and the available evacuation routes during floods.

The flood hazard map could also be the guidance for appropriate urban planning and land development. The flood hazard map, in general, contains the information on: (1) the probable extent of flood inundation and (2) the evacuation sites and evacuation routes to be taken during floods. The extent of the probable flood inundation is delineated on the base map.

The available evacuation sites as well as evacuation routes for each unit of the local communities should be further selected by the relevant local government agencies based on the base maps, and the flood hazard map should be finalized. The flood risk map thus prepared should be disseminated to the public through a bulletin, an information board and other available information tools.

Regarding debris flow hazard areas are delineated following debris fans in the debris flow prone torrents located in the Golestan Forest Pak down to Tergenly village. The debris fan is identified though geomorphological analysis and aerial photograph interpretation. This figure was already presented in Fig. 3.24.

3.8 Flood Preparedness Plan

3.8.1 Necessity of Flood Preparedness

Flood preparedness is usually regarded as comprising measures that enable governments, organizations, communities and individuals to respond rapidly and effectively to flood disaster situations. In general flood preparedness measures are:

- Provisions for emergency action, such as evacuation
- Provision of warning system
- Emergency communications
- Public education and awareness
- Training including exercises and tests

The flood preparedness is the most critical and important part in the entire disaster management because it is the nearest and closest provisions to the residents who might be casualties in the floods. The relations between the master plan and flood preparedness are illustrated in the following figure.

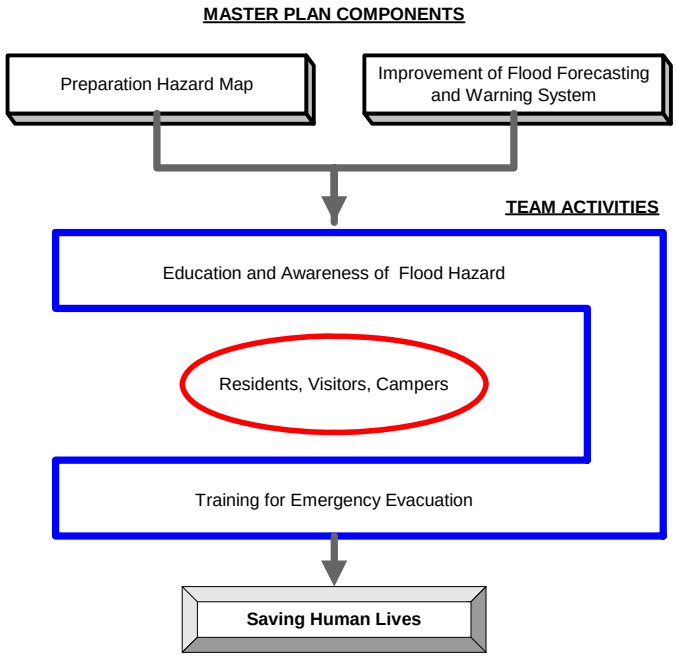


Fig. 3.34 Master Plan Components and Team Activities in Flood Preparedness

3.8.2 Flood Preparedness Activities

Target people are who suffer from severe flood disaster damage including visitors and campers in the Golestan Forest Park. In particular, visitors and campers may have little knowledge and information concerning the risks of flood disaster in the area. When a flood and debris flow disaster occurs, such people would easily panic resulting in a more severe damage, as witnessed in the 2001 flood. In this context, it is necessary to publicize the flood and debris flow hazard map to visitors and campers in the Golestan Forest Park as well as the local inhabitants to avoid such panic and to encourage them make:

- Efforts to save their own lives;
- Efforts to help each other; and

- Efforts to inform administrations.

In relation to the hazard map, the following public information efforts are also effective for the disaster preparedness:

- Installation of signboards;
- Distribution of leaflet/newsletter; and
- Dissemination of information through Internet.

The team prepared newsletter and Internet homepage to disseminate useful information on flood preparedness. Furthermore, as illustrated in the above figure, the team conducted education and awareness on flood hazard and evacuation training to the village residents through preliminary public hearing in the master plan stage as well as public hearing in the feasibility study stage. The following figure shows photos taken during the preliminary public hearing in the disaster prone villages, Dasht and Terjenly, which were held in September 2005.

Dasht village

Terjenly village

Fig. 3.35 Preliminary Public Hearing in Disaster Prone Village, September 2005

3.9 Summary of Master Plan Component

3.9.1 Proposed Component in the Master Plan

As discussed in Section 3.2 to 3.8, the master plan components became more concrete, their necessary costs are estimated and implementation schedules were proposed. The following table summarizes the proposed master plan components.

Table 3.32 Summary of the Proposed Master Plan Component and Sub-Scheme

Master Plan Component		Sub-Scheme	Component/Scheme Digest	Project Cost (million Rials)
1	Watershed Management Plan	5 sub-basins	Conducting improvement measures combining mechanical, bio-mechanical and biological engineering measures	79,374
2	River Restoration and Improvement Plan	Ghiz Ghaleh	Rehabilitating the damaged earth dam to consolidate stored sediment and constructing channel system in Ghiz Ghaleh	55,890
		Gelman Darreh and Dasht-e-Sheikh	Constructing channel system in three rivers of Gelman Darreh and Dasht-e-Sheikh	195,200
3	Golestan Forest Disaster Management Plan	Flood forecasting and warning system	Improving existing meteo-hydrologic monitoring system, data transmission and processing system to utilize real time data for flood forecasting, and installing warning posts	3,300
4	Debris Flow Control Plan	Assistance for MOJA activities	Constructing sediment control structures and channeling works in debris flow affected villages	-
5	Flood Control Plan	Recommendation to MOE and MORT plans	Rehabilitating damaged structures in both of the 2001 and 2005 floods and establishing the master plan for the Golestan dam basin	-
6	Floodplain Management Plan	Publication of flood hazard map	Publishing the flood and debris flow hazard map and utilizing it for evacuation activities and land use management	-
7	Flood Preparedness Plan	Extension of flood warning system	Installing warning posts at villages located in the middle and lower reaches to announce the flood warning to the villagers	3,300
		Educational assistance	Conducting education and awareness of flood hazard and training exercise for evacuation in the villages	-

As summarized above, the master plan integrates newly proposed plans and on-going projects since they are closely related each other. Watershed management plan, including debris flow control plan, is being conducted by MOJA, and flood control plan is also being conducted as a rehabilitation part by MOE and MORT.

3.9.2 Implementation Plan

Regarding the newly proposed projects, their implementation programs were already proposed in parallel with presentation of each component in the previous sections. As for on-going projects such as MOE and MORT rehabilitation projects, these projects are being conducted to restore the damaged structures. In addition to the urgent implementation, hydrological review and re-planning are also necessary as proposed in this report.

Based on the above considerations, the implementation plan is summarized in the following table.

Table 3.33 Implementation Plan of Master Plan Component

M.P. Component		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1.	Watershed Management Plan											
2	River Restoration Plan											
	Sediment Control Dam											
	River Improvement											
3.	Golestan Forest D.M. Plan											
4.	Debris Flow Control Plan											
5.	Flood Control Plan					→	→	→	→	→	→	→
6.	Floodplain Management Plan		→	→	→	→	→	→	→	→	→	→
7.	Flood Preparedness Plan		→	→	→	→	→				→	→
	Extension of Flood Warning											
	Educational Assistance		→	→	→	→	→	→	→	→	→	→

→: Continuous conducting the scheme

3.10 Project Evaluation

3.10.1 Economic Evaluation

The Project consists of 7 components as (1) Watershed Management Plan, (2) River Restoration and Improvement Plan, (3) Golestan Forest Park Disaster Management Plan, (4) Debris Flow Control Plan, (5) Flood Control Plan, (6) Floodplain Management Plan, and (7) Flood Preparedness Plan. Results of the economic evaluation are given by each component hereunder.

Watershed Management Plan

This component is planned by the MOJA, and under studying its detail. The purposes are (1) to mitigate damages caused by flood/debris flow, (2) to control run-off to the rivers, (3) to lengthen time-lag of run-off to the river after rainfall so that peak discharge could be attenuated.

For the above purposes, the MOJA has several counter-measure as (1) terracing in farmland, (2) banquette in farmland and in rangeland, (3) furrow in rangeland, (4) changing dry farming and/or strip cropping, (5) fertilizing the rangeland, (6) seeding in the rangeland, (7) mass seeding, (8) planting and/or reforestation, (9) tending forest and/or reforestation. There are several land conditions ranging from moderate slope to steep slope in the whole catchment area. Therefore, these counter-measures should be applied according to such land conditions.

The MOJA has plans to use land after making the above mentioned counter measures as to plant such fruit trees as olive, walnut, corylus, peach, apple, atriplex, quercus (oak), etc. Among them, atriplex is the provender for livestock, and oak has big and strong root, in other words it may have capability to keep water massively and to protect soil erosion.

From the above-mentioned contents of planning, following economic benefit items may be derived due to the execution of the plan as:

(1) From the terrace field and banquette field including furrow, it is expected that such agricultural products as Olive and so on may be generated. These products will contribute to the farmers' income. It means that the plan contributes to the rural economy.

(2) From the fertilizing and/or planting atriplex as provender, it is expected that breeding of such livestock as sheep, goat and cow will be promoted more than the present situation. From sheep and goat, meat supply to markets could be expected. In other words, this work also contributes to the rural economy.

(3) Cow breeding is usually made for milk, cheese and butter production. Therefore, the dairy industry will also be promoted.

(4) To keep water by roots of such trees and grasses contributes to lengthen time-lag of runoff to the river after rainfall so that peak discharge could be controlled as mentioned above. It means that people may have a lead-time to evacuate from floods after receiving a warning given by the natural phenomenon like heavy rainfall or by an artificial warning system for natural disasters as the JICA Study Team proposed named as "Flood Preparedness Plan". The Flood Preparedness Plan will be discussed later. Therefore, it is expected that damages caused by floods will be decreased or mitigated.

(5) To control of soil erosion contributes to decrease sedimentation of the river so that the river condition and/or discharge capacity of the river will be kept in original situation. This may also contribute to lengthen the lifetime of the Golestan Dam in the downstream of the Madarsoo River.

A part of this Watershed Management Plan is included in the next "River Restoration Plan" discussed hereunder.

River Restoration and Improvement Plan

The project site of the river restoration plan is located in the Dasht area upstream of the Madarsoo River. Three major river systems join together in the Dasht plain. These are Gelman Darreh, Dasht-e-Sheykh and Ghiz Galeh rivers. Among them, the watershed management is also planned in the Dasht-e-Sheykh and Ghiz Galeh basins. Therefore the watershed management plan should be premised as an antecedent project.

The River Restoration and Improvement Plan will produce the project benefits in combination with three plans, namely (1) the watershed management works (WM or WMP), (2) the sediment control works (SC or SCD) and (3) the river improvement works including the erosion control works (RI or RIW).

Following benefits are estimated by deriving from the abovementioned plans.

Table 3.34 Summary of Basic Unit of Benefit Expressed by Land Value

(1,000 Rials/ha)

Land Value Due to Mitigation of Flood Damages						Land Value Newly Developed Productive Area Due to Watershed Management Works	
Residential Area			Irrigated Agricultural Area			Farm Land	Range Land for Livestocks
Houses and Movables	Public Facilities (20%)	Total	Decrease in Productivity	Public Facilities (10%)	Total	New Production of Farm Land	Decrease in Productivity
566,955	113,391	680,346	5,779	289	6,068	56,653	238

Table 3.35 Estimation of Annual Average Flood Damages by Combination of Plans under the Present and Future Conditions

Under the Present Condition (Million Rials)

Return Period (Year)	Under the Witout Project Condition	Under the Condition with WM		Under the Condition with WM + SC		Under the Condition with WM + SC + RI	
		Remaining Damages	Benefit	Remaining Damages	Benefit	Remaining Damages	Benefit
1	0	0	0	0	0	0	0
5	396	386	10	342	53	0	396
10	565	551	14	495	70	0	565
25	**942**	**902**	**40**	**819**	**123**	**0**	**942**
50	1,341	1,285	56	1,024	317	23	1,317
100	1,663	1,596	66	1,163	500	66	1,597

Under 2025 Year Condition (Million Rials)

Return Period (Year)	Under the Witout Project Condition	Under the Condition with WM		Under the Condition with WM + SC		Under the Condition with WM + SC + RI	
		Remaining Damages	Benefit	Remaining Damages	Benefit	Remaining Damages	Benefit
1	0	0	0	0	0	0	0
5	791	772	19	685	107	0	791
10	1,131	1,102	29	990	141	0	1,131
25	**1,779**	**1,711**	**68**	**1,556**	**224**	**0**	**1,779**
50	2,398	2,306	92	1,897	501	47	2,351
100	2,884	2,777	107	2,122	762	124	2,760

(Note) WM: The Watershed Management Works.
SC: The Sediment Control Dam Construction Works.
RI: The River Improvement Works.

Designed scale of the facilities is for flood/debris flow in 25 years in return period. Damages are to be converted into annual average amount by using probability analysis. The above table shows its result. In this case, the target year is set at 2025 so that the benefit (= the amount of damages expected to be decreased with the project) is estimated under both present and 2025-year conditions.

On the other hand, for the annual average benefit for the SCD, the followings could be estimated because debris flow brings the crushing damages to the houses and household properties if it occurs.

Table 3.36 Summary of Annual Average Debris Flow Damages and Calculation of Economic Benefit

WMP and SCD under the Present (Million Rials)

Return Period (Year)	Under the Witout Project Condition	Under the Condition with WMP		Under the Condition with WMP + SCD	
		Remaining	Benefit	Remaining	Benefit
1	0	0	0	0	0
5	1,361	1,361	0	0	1,361
10	1,905	1,905	0	0	1,905
25	2,517	2,497	20	0	2,517
50	2,796	2,762	34	0	2,796
100	**2,956**	**2,915**	**41**	**0**	**2,956**

WMP and SCD under 2025 Year Condition (Million Rials)

Return Period (Year)	Under the Witout Project Condition	Under the Condition with WMP		Under the Condition with WMP + SCD	
		Remaining	Benefit	Remaining	Benefit
1	0	0	0	0	0
5	1,944	1,944	0	0	1,944
10	2,722	2,722	0	0	2,722
25	3,597	3,567	29	0	3,597
50	3,995	3,946	49	0	3,995
100	**4,224**	**4,165**	**58**	**0**	**4,224**

(Note) WMP: Contribution from the works on Watershed Management Plan.
SCD: The works on Sediment Control Dam.

In addition to the above, the annual average economic benefit produced by the erosion control structure (ECD) is to be calculated because the riverside agricultural area is completely washed away and it will be no longer usable if the erosion occurs. Accordingly, the direct economic benefit of erosion control works is the amount of damages to the riverside agricultural area to be protected. The results of annual average economic benefit derived from ECD are shown in the following table.

Table 3.37 Summary of Annual Average Erosion Damages and Calculation of Economic Benefit

ECD under the Present Condition (Million Rials)				ECD under 2025 Year Condition (Million Rials)			
Return Period (Year)	Under the Witout Project Condition	Under the Condition with ECD		Return Period (Year)	Under the Witout Project Condition	Under the Condition with WMP	
		Remaining Damages	Benefit			Remaining Damages	Benefit
1	0	0	0	1	0	0	0
5	1	0	1	5	3	0	3
10	2	0	2	10	5	0	5
25	3	0	3	25	7	0	7
50	4	0	4	50	8	0	8
100	**5**	**0**	**5**	**100**	**10**	**0**	**10**

(Note) ECD: The works on Erosion Control Dam.

Summary of financial and economic costs and their annual disbursement is shown in the following table.

Table 3.38 Summary of Project Cost and Its Annual Disbursement

(Million Rials)

Item	Total Cost	Disbursement									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
WMP Only											
Financial Cost	55,471	18,484	8,227	10,490	6,849	8,344	2,717	180	180	0	0
Economic Cost	50,074	16,686	7,427	9,469	6,183	7,532	2,453	163	163	0	0
WMP + SCD											
Financial Cost	117,474	25,717	14,421	26,862	22,494	24,287	3,260	216	216	0	0
Economic Cost	90,163	20,222	10,991	20,465	17,179	18,528	2,453	163	163	0	0
WMP + SCD + RIW											
Financial Cost	312,670	25,717	14,421	26,862	22,494	35,918	24,247	40,861	40,861	40,645	40,645
Economic Cost	240,690	20,222	10,991	20,465	17,179	30,159	16,189	31,453	31,453	31,290	31,290

The annual operation and maintenance cost is applied at 3 % of the cost for the watershed management plan, and 5 % is applied for equipment portion (60 % of the direct construction cost) of the other two works.

Using a cash flow of the said cost and benefit, the economic evaluation is made. For evaluation, the Net Present Value (NPV, i.e. B-C in terms of the present value), the Economic Internal Rate of Return (EIRR) and the Benefit-Cost Ratio (B/C Ratio) are adopted as evaluation indicators. The discount rate is applied at 10 % taking similar projects in developing countries into account. The results are summarized in the following table.

Table 3.39 Summary of Economic Evaluation Results

Evaluation Indicator	Under the Present Condition			Under the 2025-Year Condition		
	WM Only	WM + SC	WM + SC + RI	WM Only	WM + SC	WM + SC + RI
NPV	71,667	59,492	-13,852	71,778	63,856	-7,732
EIRR	21.08%	16.40%	8.86%	21.10%	16.77%	9.38%
B/C Ratio	2.89	1.94	0.90	2.90	2.01	0.94

(Note) NPV is expressed by "million Rials".

As shown in the above table, the watershed management plan (WM) indicates a quite high viability of 21.08 % of EIRR under the present socio-economic condition (hereinafter referred

to as "at present condition") and 21.10 % under the future socio-economic condition in 2025 (as "at 2025-year condition" hereinafter referred to).

On the other hand, in the cases of combination of WM + SC and of WM + SC + RI, EIRRs are gradually come smaller than that in the WM only as 16.40 % and 8.86 % at present condition, and 16.77 % and 9.38 % at 2025-year condition. It implies that comparing with the result of the WM only, costs for the other 2 cases are greater than the amount of benefits.

As mentioned above, the case of full combination (WM + SC + RI, the whole works of this component) shows that the EIRR is less than the applied discount rate of 10 %. It means that the project may not be feasible from the economical viewpoint as far as the EIRR indicates.

Needless to say, this kind of project is so called as public works. Especially the works of SC and RI are the pure public works. Several international financing institutions such as World Bank recommend that the EIRR of 5 % can be acceptable as viable from the viewpoint of the basic human needs for the projects in public works.

Furthermore, usually the works of RI need a great of costs but the socio-economic benefits is derived rather not so much comparing with the costs. However, combination with WM and SC shows an enough viability to conduct the project as 16.40 % at the present condition and 16.77 % at 2025-year condition.

Accordingly, the project of this component has the viability to conduct from the viewpoint of basic human needs, but it should be considered to making choice of optional work items taking priority into account.

Golestan Forest Park Disaster Management Plan

The Golestan Forest National Park (hereinafter referred to as "the Golestan Forest") has only one route passing through it. Before the 2001 Flood, this route was also using as a business trunk road connecting to Mashad, in addition to recreation purpose. But after the said flood, the Government has provided another detour route to Mashad. Therefore, for estimation of economic benefit of this component, it may be enough to be taken damages to people for the recreation purpose as campers or visitors to the Golestan Forest into account.

There are a lot of attractive places and/or historical heritage in the Golestan Province including the Golestan Forest. Following table shows a numbers of tourists together with the museum of the Golestan Forest.

Table 3.40 Number of Tourists in Golestan Province and Visitors of Museum of Golestan Forest

Year	Number of Tourists in the Golestan Province (People/annum)			Number of Visitors to DOE Museum of Golestan Forest National Park (People/annum)	
	Domestic People	Foreigners	Total	Number of Visitors	Remarks
2000	42,518	648	43,166	n.a.	Before the 2001-Flood/Debris Flow, the number of visitors were around 30 % higher than the number of 2001 and it has been increased by 5 – 10 % every year. And, the visitors do not always enjoy in the Golestan Forest National Park.
2001	21,957	420	22,377	10,912	
2002	32,368	482	32,850	8,526	
2003	112,735	1,074	113,809	5,159	
2004	114,802	1,657	116,459	7,850	

Sourse: The Cultural Heritage and Tourism Organization(CHTO), Gorgan.

Among the data above, the number of visitors to the museum of the Golestan Forest is somewhat relating to the people for recreation purpose passing through the Golestan Forest, but all of them may not entirely enter into the Golestan Forest for recreation purpose.

There is another information as shown in the table below.

Table 3.41 Information on Visitors to Restaurants near Both Entrances of the Golestan Forest

Average Number of Visitors to Take Lunch in the Restaurants Located Near the Entrances of the Golestan Forest at the Up-stream Side and Down-stream Side of the Madarsoo River	500,000 People/ annum

Remarks:
There are restaurants near the entorances in up-stram side and in down-stream side, and some campers and/or visitors take their lunch at these restaurants. However, 2 times or 3 times of this number of campers and/or visitors carry their own cokking sets, and they cook by themselves for their lunch and/or dinner. Therefore, this number does not reflect the actual number of campers and/visitors to the Golestan Forest National Park. But, it may be sure that this number of people must be visited to the Park for their recreation.

Sourse: The Cultural Heritage and Tourism Organization(CHTO), Gorgan.

If one tenth (1/10) of the above number of visitors to the restaurants near both entrances of the Golestan Forest is usually visiting to the Golestan Forest shown in the above table, average number of campers and/or visitors for recreation purpose will be calculated at 208 people per day.

On the other hand, according to the information, 194 persons have lost their life with no any survivals in the 2001 Flood because the route passes through narrow valley. This is not so much different number with the above mentioned calculated one. From this viewpoint, it may say that the said assumption is reasonable. If it is assumed that, (1) frequency of flood in the Golestan Forest is one fifth (once every 5 years), (2) the average age of campers and/or visitors who are working at present: 40 years old, (3) the annual damages to human life caused by floods can be estimated at around Rials 5,875 million/annum [=Rials 55,521,629 × 0.7(life cost: 30 % should be deducted) × 16.804 (Coefficient of New Hoffmannsche Method) × 45 families × 20 %(discount rate for estimation safety)]. Following box is a pigeonhole of the said assumption and estimation process.

Table 3.42 Estimation of Flood Damages of Human Life in the Golestan Forest

(1)	Annual Average Visiters to the Golestan Forest National	50,000	Assumed at 1/10 of the above number of visitors.
	For Reference:	208	/day as an average number of peoples per day:
(2)	Population in Urban Area by Sensus 1375:	36,817,789	
(3)	Number of Households in Urban Area by Sensus 1375:	7,948,925	
(4)	Average Family Size as of 1996/97:	4.63	persons/HH
(5)	Annual Number of Families visited to the Golestan Forest National Park:	10,795	HHs/annum
(6)	Daily Number of Families visited to the Golestan Forest National Park:	45	Families/day assumed that the people may visit to the Park during 8 months from April to November.
(7)	Average Income Level of People Living in Urban Area:	55,521,629	Rials/annum estimated based on Iran Statistic Year Book 1382.
(8)	Frequensy of Flood/Debris Flow in the Golestan Folest National Park:	20%	It means that the Flood/Debris Flow may occur once 5 years according to a discharge analysis.
(9)	Average Expected Working Period Assumed after Casualtie:	27	years, in case that average age at the time of death due to flood is 40 years old.
(10)	Coefficient of New Hoffmannsche Methode:	16.804	
(11)	Average Annual Damages Caused by Flood/Debris Flow in the Golestan Forest National Park:	5,875,061	1,000 Rials/annum.

The items from (2) to (4) and (7) are excerpts from the Iranian Statistic Year Book 1382. In this case, it is assumed that almost of the campers and/or visitors who are enjoying in the Golestan Forest are the urban residents.

If floods occur, the people who are just enjoying in the Golestan Forest must surely lose their life. It means that they lose their expected all the incomes to be gotten in the future after their ends.

As a result, the amount of around Rials 5,875 million may be lost as damages in total in case of the same scale of the 2001 Flood as shown in the above estimation. If the damages in 5-year flood are assumed to be 1/10 of the said amount, the annual average damages to casualties caused by flood can be estimated by using a following formula:

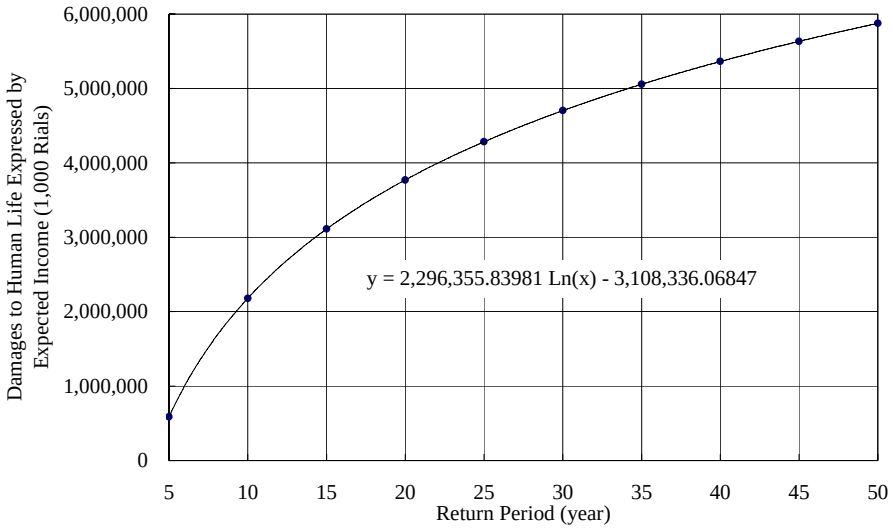


Fig. 3.36 Relationship between Return Period and Damages to Human Life Expressed by Expected Income

The amount of annual average damages to expected income in total is estimated at a sum of Rials 669 million per annum as shown in the following table.

Table 3.43 Estimation of Annual Average Damages to Expected Income

Without Project

2005-price Level (1,000 Rials)

Return Period (Year)	Exceedance	Difference of Exceedance	Direct Damages by Return Period (Million Rials)		Annual Average Damages by Return Period (Million Rials)	Cummulative Annual Average Damages (Million Rials)
			Amount	Mean	Segment	
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	587,506	293,753	235,002	235,002
10	0.1000	0.1000	2,179,219	1,383,362	138,336	373,339
25	0.0400	0.0600	4,283,348	3,231,283	193,877	567,216
50	**0.0200**	**0.0200**	**5,875,061**	**5,079,205**	**101,584**	**668,800**

At present, several places destroyed caused by the floods in the past are under rehabilitated. But, these works are only for rehabilitation to the former state. Therefore, if no any drastic measures are made, the same damages will suffer again in the future. Most important measures are to inform to the people who are coming to enjoy in the Golestan Forest when the flood likely occur.

A systematic flood warning system is one of such measures. This component is a plan to establish a suitable Flood Forecasting and Warning System. Annual cost disbursement is planned as follows:

Table 3.44 Annual Cost Disbursement for Golestan Forest Park Disaster Management Plan

(Million Rials)

Item	Cost in Total	Annual Disbursement				
		2007	2008	2009	2010	2011
Financial Cost	3,215	995	688	526	526	480
Economic Cost	2,902	898	621	475	475	433

Using a cash flow of the said cost and benefit, the economic evaluation is made in the same manner of the above "River Restoration Plan". Also for evaluation, the Net Present Value (NPV, i.e. B-C in terms of the present value), the Economic Internal Rate of Return (EIRR) and the Benefit-Cost Ratio (B/C Ratio) are used as evaluation indicators in this component too. The discount rate is applied at 10 % taking similar projects in developing countries into account. The results are summarized as shown in the following table.

Table 3.45 Summary of Economic Evaluation Result

Evaluation Indicator	Under the Present Economic Condition	Under the 2025-Year Economic Condition
NPV	1,513	3,039
EIRR	10.47%	15.06%
B/C Ratio	1.80	2.61

(Note)
NPV is expressed by million Rials.

As shown in the above table, both EIRRs at present condition and at 2025-Year condition are higher than 10 % of the applied discount rate as 10.47 % and 15.06 %, respectively. Thus the Golestan Forest Park Disaster Management Plan has enough viability to execute.

Debris Flow Control Plan

This component consists of construction of sabo dam and channel improvement works in the debris flow prone villages in the area downstream of Tangrah village. It is under planned by MOJA, and will be executed by them.

For instance, Terjenly Village has no any rangeland, but they are breeding lots of livestock such as sheep, goat and cow in the residential area. Therefore, if once floods occur, damages are not only to houses and household movables but also to livestock in their residential area. Therefore the amount of land value of the residential area is rather high comparing with Dasht village.

Following table shows a land value per unit area of damaged area caused by the 2001 Flood. If the village could be protected from floods, these damages will be mitigated depending upon flood scale.

Table 3.46 Damageable Land Value of Terjenly Village

1,000 Rials/ha

Land Value Due to Mitigation of Flood Damages					
Residential Area			Irrigated Agricultural Area		
Houses and Movables	Public Facilities (20%)	Total	Decrease in Productivity	Public Facilities (10%)	Total
985,369	197,074	1,182,443	10,400	520	10,920

(Note) Damages to Houses and Movables include the damages to breeding livestock because they are breeding livestock in residential area.

Flood Control Plan

This component consists of river improvement works for the mainstream of the Madarsoo River. Basically the flood control plan shall be conducted by MOE in cooperation with MORT for the road improvement part. Rehabilitation works have been progressed to the damaged portions by the 2001 Flood. However, the recent 2005 Flood destroyed again rehabilitated structures. Now MOE is going to restart their rehabilitation works.

After the recent 2005 Flood, the JICA team gained new and reliable meteo-hydrological information and simulated results. The team made some recommendations for the flood control plan. These are (1) necessary hydrological designing, (2) necessary foundations of the flood control structures, (3) considerations to improve the river constriction parts, (4) considerations to improve the road between 14 Metry bridge and Tangrah for ensuring the emergency activities during floods.

The constrictions bring about flood damage for the huge areas of several hundred ha upstream of the locations. As discussed above, even in rural areas, following amount of damages per ha might be brought about from the floods. If it is taken into consideration that the targeted areas are the urban areas, they should have several times greater value of land to be damaged when the areas will be left as it is without any counter measures.

Table 3.47 Summary of Land Value to be Damaged in Rural Area

Million Rials/ha

Village	Residential Area	Irrigated Agricultur-al Area
Dasht Village	680	6
Terjenli Village	1,182	11

Floodplain Management Plan

In the lower reaches of the Madarsoo River from the Kalelah Bridge, the river-terrace structure has been developed with several meters (5 or 6 m, or sometimes 10 m) height differences between upper and lower terraces. The upper terrace is the Gorgan Plain where people live on. Villages and public facilities like roads are constructed on the plain. People

who live along the river-terrace (lower terrace) use it as the agricultural area. Therefore, there will be no any human damages, while there will be agricultural damages during floods.

However, because of lack of information concerning the flood occurrence and/or lack of suitable information network system on flood forecasting and warning, people, especially farmers, come into such river-terrace for operation and maintenance of their agricultural land located on it, and they lose their life. As already discussed in the Golestan Forest Park Disaster Management Plan, damages to expected lifetime of the people after their ends will become a huge amount.

If the people can receive the following warning and/or information and they obey such warning and/or information, they should not lose their life:

- Public announcement on specified area to be inundated by floods, and
- Warning to forbid anybody to enter such specified area during inundation.

For realizing this system practically, there should be good reliability between people and the Government. Thus an effort to establish the reliability of the Government is to be needed to the residents too. For this purpose, a suitable and reliable flood forecasting and warning system should be developed.

From this viewpoint, this component may be closely connected with the next component of flood preparedness plan.

Flood Preparedness Plan

This component comprises:

(1) To establish a flood forecasting and warning system,

(2) To establish a system for avoidance and/or mitigation from or of flood damages for making smooth activities of evacuation from floods based on the flood forecasting and warning system above,

(3) To develop flood hazard maps, and

(4) To take activities as training and/or education for developing the public awareness for making people rouse their self-consciousness so that they can take smooth activities avoiding from dangers of floods.

If these systems could be practically realized and successfully functioned, social effects (or socio-economic effects) derived from such systems and such functions will be great with a little fund of the Government. Considerable social effects and/or socio-economic effects may be as follows:

- To save the people's life (this will mitigate the damages to all the incomes to be gotten in the future after their ends as already discussed above),
- To stabilize the mind of the people,
- To generate a reliability of the people against the Government, and
- To ensure the good relationship between the people and the Government.

Of course, there will be a lot of hurdles to realize the said systems as (1) to revise the Law and the Regulation, (2) to restructure the existing official organizations of the Government, (3) to improve the relationship among the existing official organizations of the Government, (4) to recruit suitable experts for the systems, (5) to improve the working system in Iran because the flood forecasting and warning system should continuously function without any pause. Natural disasters do not wait for people's actions.

The most important thing is to start from a part that could be easy to do. One success leads the next success. Strengthening staffs' capacity of the Government will be gradually established and ensured through this process, and strengthening staffs' capacity of the Government lead

further success after that. Then, the people will become to rely on the Government's staffs to do their best for operating the systems.

This component is proposed to give such opportunity. From the socio-economic viewpoint, this component is quite valuable.

3.10.2 Environmental and Social Evaluation

Generalities

The proposed master plan would be implemented in the Madarsoo River basin, suiting in Golestan, North Khorasan and Semnan provinces, to reduce flood/debris flow damages, to mitigate soil erosion/land degradation and to safeguard lives and properties of the people against disasters. Part of the Golestan National Park being under authority of DOE occurs in the project area. The captioned project is inline with laws of Socio-Economic and Cultural Development Plans of the country, as well as compatible with Islam philosophy, which require the Islamic Government to protect the entire citizen against disasters.

At international level the project is in harmony with Agenda 21 of Earth Summit-Rio 1992, which emphasis on care for fragile mountainous areas (watershed). Traditional works for conservation of river basins have been done for a long time in Iran, with late/less response. The project aims to introduce modernized/improved structural and non-structural disaster mitigation/management measures into the Madarsoo River basin and to establish a model for being propagated in other similar basins in the country. MOJA is the project proponent, and DOE-Golestan is competent agency collaborating with the project in environmental related matters.

Revised version of JICA Guidelines for Environmental and Social Considerations published in April 2004, categorizes the projects as shown below:

Table 3.48 Categorization on Environmental and Social Considerations in the JICA Guidelines

Category	Description
A	Projects likely to have significant adverse impacts on the environment and society. Projects in sensitive sectors with characteristics liable to cause adverse environmental impacts, as well projects located in or near sensitive areas are also fall in category A.
B	Projects are classified as category B if their potential adverse impacts on the environment and society are less adverse than those of category A. Most of impacts are site-specific and reversible through normal mitigation measures.
C	Projects with minimal adverse impacts on the environment and society are in category C.

For details on JICA Environmental Guidelines, see Scoping for the Study attached to this Report.

Based on review of background and examination of formal documents prepared for this master plan, from environmental viewpoint it falls in Category B of JICA categorization, with following justification.

(1) The proposed master plan is of disaster management in nature and sprit, aiming at reducing flood/ debris flow damages, preventing soil erosion/land degradation, thus enhancing the status of ecosystem. Such works are environment-friendly, widely known, easily accepted by people, and executed with relatively small-scale in a limited area.

(2) Structural measures are established in a limited area and are designed to counter deterioration of physical and biological environments, without inserting any impact on social environment.

(3) However part of the Golestan National Park occurs in the study area, but no structural measures are proposed/constructed in the park. Instead of structural measures, flood forecasting and warning system is proposed to save visitors and campers in the Park from disastrous floods.

(4) Locations of historical/cultural sites existing in the area have been pinpointed, marked on the maps and provided to the study team, for being refers when selecting sites for establishment of structures. As a result, no construction work is done at such sites and no harms to those assets.

(5) According to environmental laws and regulation prevailing in Iran, only large-scale projects correspond to A category of JICA categorization, thus requiring conduct of EIA. On the other hand, the captioned plan is of small-scale and for disaster prevention purpose.

(6) The project neither plans involuntary resettlement, nor proposes any change in existing institution and customs.

(7) No peat-land, mangrove forest or coral reef occur in the project area.

DOE published its revised version of Environmental Guidelines and Standards in the autumn of 2003. According to the guidelines, 18 kinds of projects are expected to have significant adverse impacts on the environment and society, hence require environmental impact assessment prior to their implementation. The captioned project is not of these kinds. For list of projects (18 kinds) and organization chart of DOE see Scoping for the Study attached to this report.

Project Components and their Environmental Evaluation

To cope with disasters of flood and debris flow, and assure safety of inhabitants of the river basin, master plan of the project proposes structural measures such as construction of river improvement and sediment control structures, and non-structural measures such as installation of warning system and provision of hazard maps indicating the safe location for sheltering upon warning. In this context the master plan contains seven components as tabulated below.

Table 3.49 Master Plan Component and their Salient Features

Item No.	Component	Main Area to be Conducted	Major Works to be Done
1	Watershed Management Plan	Headwaters and middle reaches	Afforestation, land treatment, and on-site rainfall detention
2	River Restoration and Improvement Plan	Headwaters	Reconstruction of dam in Ghiz Ghaleh, construction of flood control channels in Dasht area
3	Golestan Forest Park Disaster Management Plan	Middle reaches	Establishment of flood forecasting and warning system and emergency activities
4	Debris Flow Control Plan	Middle reaches (Tangrah to Beshoily)	Construction of debris flow control dams and canals along with watershed management
5	Flood Control Plan	Middle and lower reaches	Construction of flood control structures to protect farmlands and villages
6	Floodplain management Plan	Middle and lower reaches	Publication of flood-hazard map and land use control in the flood-hazard area
7	Flood Preparedness Plan	Entire basin	Improvement of early warning system and training activities for emergency

To justify the overall environmental effect of the proposed project, its components together with relevant alternatives are individually discussed here. The discussion is based on collected data/information, consultation with Iranian experts, results of field surveys, exchange of view with local people and conduction of Scoping for the Study, documents of which are presented

in Annex of this report. To accelerate the works and accomplish tasks on time, part of investigation was entrusted to local consult companies/capable individuals, but supervised by the team. Reports of study conducted by Iranian institutions (MOJA-Golestan, Mazandaran-Golestan Regional Water Board) in parts of the basin, were also reviewed.

(1) Watershed Management Plan

This includes afforestation, land treatment, and on-site rainfall detention works, and aims at disaster prevention and enhancement of environmental status of the area. These approaches are environmental-friendly and Iranian experts have sufficient knowledge/skill to execute and maintain them without causing any harm to the environment. These activities are cost-effective, compatible with Islamic teachings and in harmony with people believe. Thus local people would cooperate in execution/maintenance works, ensuring success of the project.

Moreover watershed management tasks have been practiced for a long time in Iran, and local people are quite aware of their equable and equitable benefits, thus no adverse social impacts (conflict among communities/increase in income disparities) is expected. Furthermore this plan will leads to efficient/sustainable utilization of natural resources, creation of job and reduction in migration rate, thereby contributing to enhancement of living status (economically/spiritually) of inhabitants. Vegetation/forest established and rainwater detained through these works, are not only important for environmental enhancement and reduction of flood damages, but also important for keeping the livestock sector alive, because most of livestock depends on natural vegetation/water sources occurring in the areas. Forests will provide cleaner air and healthier society.

Considering the points mentioned above and realizing the fact that presently no better alternative is known, this watershed management plan from environmental point of view is justified as acceptable, thus it can be implemented. But project is advised to pay careful attention to the following points and take proper precautions accordingly.

(a) In afforestation works, trees should be so selected to avoid introduction of any plant diseases in the area, since some exotic plants may serve as hosts for plant pathogens and encourage their spreading to endemic plants.

(b) In land treatment activities, which require disturbance of soil, some air pollution may occur. To nullify/minimize this impact, works must not be conducted in windy hours.

(c) Rainwater detained must be properly managed to avoid occurrence of impacts such water logging, salinity, and spread of water related diseases in the area.

(d) Regular consultation with a well experienced/knowledgeable environmental expert in all stage of the project.

(2) River Restoration and Improvement Plan

This item involves construction of some structures, which are beneficial for protecting people and farmlands against flood and sedimentation hazard. Some jobs are created and overall social status in associated villages is enhanced. Construction of reservoir and channels has been practiced in Iranian territory dating back to millenniums BC (before Christ) as evidenced in Choqazanbil area in southern Iran. Thus Iranians are very familiar to such tasks and have sufficient background/ knowledge and experience to accomplish them. Since local people know benefit of this plan they would cooperate in works for its realization. But the plan has some defects such as:

- In construction phase there might be some noise and air pollutions by machinery and as a result of soil disturbance.

- Construction activities might bring-about temporary soil erosion.
- Natural vegetation and wildlife in the area are disturbed.
- Machinery and employees engaged in construction works would generate some wastes.

With due attention to points mentioned earlier in section of Generalities, and since a present there is no better alternative to this plan, from environmental viewpoint it is conditionally acceptable, and some of conditions are set herein.

- Heavy construction works should be done in day hours to minimize disturbance of people and wildlife.
- Works requiring disturbance of soil should be haltered in windy hours to minimize the air pollution.
- Wastes generated by machinery (discarded oil) as well by employees should be properly collected and disposed in designated place.
- Dam site should be properly guarded (fenced) to prevent accidental collapse of people and animal into it.
- Since there are many known and unknown historical/cultural objects in the area, the project should highly consider this matter and take proper precautions. In construction phase whenever employees face any ruin/strange object should immediately report it to the nearest office/representative of Cultural Heritage and Tourism Organization.

Moreover the project is advised to have regular contact and consultation with authorities in Cultural Heritage and Tourism Organization and DOE.

(3) Golestan Forest Park Disaster Management Plan

This item proposes establishment of flood warning system and means of evacuating the visitors and campers in case of emergency. Such activities have their deep roots in Iranian history and culture, and are outlined in holy Quran (Surah Abniya, Ayeh 75 to 77; Surah Noah Ayeh 28). In ancient time, when a heavy flood (Noah flood) occurred, Noah warned his tribe to evacuate, and guided to a safe place through his paperless hazard map. So such activities are very suited to Iranian society and acceptable by the people. They involve only simple construction work, not require large space, and capable of saving lives of people through timely operation. Therefore from environmental viewpoint this plan is acceptable and can be implemented. But project should take some precautionary measures such as:

(a) The established instruments should be properly maintained and occasionally tested in normal case to ensure their efficient operation in emergency cases.

(b) Test operation should be done in day hours and people are informed about the test well in advance, to avoid any public panic and social disturbance.

(c) Since the instruments are established in the national park, their coloring and decoration is important in matching them with natural environment of the park.

(4) Debris Flow Control Plan

Under this plan some small dams are erected in waterways to minimize the flow of debris toward villages, particularly in Tangrah to Beshoily axis. Implementation of this plan will contribute to social stability and health of inhabitants, by safeguarding them against disasters. Under present condition people find the villages unsafe and may migrate to other areas, which has its own social impacts, or remain in villages and suffer psychological stress, which cause decline in health (mental) of people, and impose additional spend for medical care on the society. Therefore from humanitarian

(social environment) point of view the plan is welcome, but it is un-pleasure to natural environment, since the proposed dams will insert some negative impacts on flora and fauna at all stage of the project. Upon completion, the erected dams are nuisance to creatures transiting in relevant waterways, and would lessen the natural beauty of landscape. Significant alternative to this plan is the relocation of villages subjected to debris flow, which requires long time study and careful consideration from economic and social aspects. Relocation is a time consuming and expensive approach involving complicated formalities and sophisticated arrangement. In affairs dealing with people's life, "no action" is not a reasonable alternative. Therefore from environmental viewpoint this plan is acceptable with caution. In this context the project should consider the following points:

(a) To construct minimum number of dams in highly dangerous location with proper design, using natural materials such as boulder and stone,

(b) To increase safety coefficient of the area, in addition to structural measures, undertake some non-structural measures such as installation of instruments for monitoring and conveying the status of debris flow to certain station and thereby to people,

(c) To take some measures for conserving/enhancing the natural vegetation, which could contribute in reduction of damages of debris flow,

(d) To reveal the actual impact of dams on the environment, periodical survey on flora and fauna in dam site should be conducted, and

(e) Regular consultation with authorities in DOE and NRGO of Golestan province is highly recommended.

(5) Flood Control Plan

This plan aims at protecting the farmlands and villages against flood with defined return period. Since livestock largely depend on farm residue, this approach will contribute to sustainability of livestock sector and diet of people. With protection people will get more hope on life and confidence on agriculture/livestock activities, which could enhance the economy and social stability of the area. The advantage and disadvantages of this plan are more or less similar to that of plan given under item (4). Therefore all issues discussed for item (4) should be noted for this plan too.

(6) Floodplain Management Plan

This plan is of advisory and precautionary types, involving not structural measures, hence inducing no any adverse impact on the environment. In contrary it will play an important role in safety of people, with a low cost and less complicity. Therefore from environmental point of view it can regarded as highly acceptable, and executed at any time.

(7) Flood Preparedness Plan

Under this plan the existing disaster warning system is improved and people are trained to safeguard themselves against disaster and efficiently evacuate in case of emergency. This plan is inline with the strategy of Iranian government for enhancing the capability and readiness of nation in facing disasters. It also matches the effort of State Corps of Unexpected Events, which prepare and disseminate materials to promote the knowledge and understanding of public on disaster and prepare them for dealing with crises of unexpected events.

Conclusion

By considering the points explained and discussed above, it can be concluded that all the plans proposed by the team are environmentally sound and can be implemented with proper arrangement and efficient management. But the project should consider the following points:

- To involve experienced and knowledgeable environmental experts in all stages of the projects (design, construction, operation and maintenance).
- To report any abnormality to relevant institutions immediately (DOE, NRGO and Cultural Heritage and Tourism Organization) and seek their advice for solving the problem.

3.11 Selection of Priority Projects

3.11.1 Criteria for Selection of Priority Projects

Among the master plan components summarized in Table 3.32, priority projects are selected for the feasibility study. For this purpose, the following criteria are set up to screen the suitable priority projects out of the components. The high priority is given to:

(A) Project(s) being located in the most seriously damaged areas; around 200 casualties in the Golestan Forest Park in the 2001 Flood and various cropping damages as well as casualties in Dasht village in the 2001 and 2005 Floods,

(B) Project(s) bringing out the project effects to save human lives or to improve worsening conditions for a short period; for instance, improvement or rehabilitation works to the existing system such as flood forecasting system and rehabilitation of breached dam in the Ghiz Galeh,

(C) Project(s) having high economic efficiency for mitigation of flood damages and saving human lives; flood forecasting and warning system in the Golestan Forest Park,

(D) Project(s) having suitable and essential themes on technology transfer; hydrological designing, structural designing and construction methodology on sediment control dam and erosion control structure, and preparation of flood hazard map on hydraulic simulation,

(E) Project(s) being core concepts with possibility of future expansion in their legal frame work or to the similar river basin; preparation of hazard map in floodplain management and flood preparedness, and designing and constructing process of sediment control dam and erosion control structure.

On the other hand, the on-going project(s) and/or projects that preliminary designing was already completed shall be excluded.

3.11.2 Priority Projects

In due consideration of the criteria enumerated above and salient features of the master plan components, selection process of priority projects are tabulated in Table 3.50. As a selection result, the following three projects are selected.

(1) Construction of sediment control dam in the Ghiz Ghaleh River basin and erosion control structure downstream of Dasht village,

(2) Flood forecasting, warning and evacuating system for Golestan Forest Park disaster management, and

(3) Publication of flood and debris flow hazard map.

In addition, educational assistance for community disaster management is demonstrated in the feasibility study stage as a pilot project.

Regarding on-going projects, the team can provide necessary information and assistance for safe and reasonable designing in the course of the feasibility study stage. These projects are (1) debris flow control plan by MOJA, (2) flood control plan by MOE, and (3) road rehabilitation by MORT. These projects are also essential to mitigate flood damages and to save human lives from disastrous floods.

No.	Component	Target Area	Major Measures	Specific Features	Priority Project
1	Watershed Management Plan	Headwaters and middle reaches	Watershed management program following the program that the MOJA formulated: mechanical, bio-mechanical, and biological measures	MOJA: planning & implementing	Completion of designing
2	River Restoration Plan	Headwaters: Ghiz Ghaleh, Dast-e-Sheikh, Gelman Darreh Rivers	(1) Construction of sediment control dam for consolidation of stored sediment by the dam breached in the 2001 Flood, (2) Erosion control downstream of Dasht village	New proposition by JICA Team	Urgent needs in Ghiz Ghaleh basin and in the downstream of Dasht village
			(3) River improvement along the three rivers		Long term process
3	Golestan Forest Park Disaster Management Plan	Middle reaches: Golestan Forest Park	Flood forecasting, warning and evacuating system (1) Establishment of real time monitoring system (2) Establishment of early warning system (3) Establishment of evacuating system	New proposition by JICA Team for improvement of existing system	Urgent needs
4	Debris Flow Control Plan	Hillside of middle reaches: Tangrah to Beshoily	(1) Construction of sediment control dam and canal (2) Land treatment and biological measures	MOJA: planning & construction	On-going
5	Flood Control Plan	River course of middle and lower reaches: Tangrah to Golestan Dam entrance	(1) Bank protection in/around housing areas of villages and immediately up and downstream stretches of bridges (2) Improvement of major riparian structures: bridges, revetment	MOE & MORT: planning & construction	On-going
			(3) Elevating road for emergency activities	New proposition by JICA Team	Long term process
6	Floodplain Management	Middle and lower reaches	(1) Publication of flood and debris flow hazard map	New proposition by JICA Team	Urgent needs
			(2) Land use regulation in flood-prone areas		Long term process
7	Flood Preparedness Plan	Entire basin	(1) Extension of flood warning system	New proposition by JICA Team	Long term process
			(2) Educational assistance for community disaster management		Conducting in F/S stage

Table 3.50 Flood and Debris Flow Mitigation and Management Master Plan and Priority Projects

ANNEX I

Environmental Scoping for the Study

Director	T. Director	Officer

Environmental Scoping for the Study

1. Title of the Cooperation Project and Name of the Project Proponent

Title of the Cooperation Project: The Study on Flood and Debris Flow in the Caspian Coastal Area Focusing on the Flood-Hit Region in Golestan Province in the Islamic Republic of Iran

Name of the Project Proponent: Deputy for Watershed Management, Forest, Range and Watershed Management Organization, Ministry of Jihad-e-Agriculture, Islamic Republic of Iran

2. Categorization and its Justification

Environmental Impact: ***Category B***

This project falls in Category B of JICA categorization, with following justification.

1) The proposed project is of disaster management and mitigation in nature and sprit, aiming at reducing flood/ debris flow damages, preventing soil erosion/land degradation, thus enhancing the status of ecosystem. Such works are environment-friendly, widely known, easily accepted by people, and executed with small scale in a limited area.
2) Structural measures are established in a limited area and so design to counter deterioration of physical and biological environments, without inserting any impact on social environment.
3) However part of Golestan National Park occurs in the study area, but no structural measure is proposed/constructed in the park. Instead of structural measures, flood forecasting and warning system is proposed to save visitors and campers in the Park from disastrous floods.
4) Locations of historical/cultural sites existing in the area have been pin pointed, marked on the maps and provided to the study team, for being refers when selecting sites for establishment of structures. So no construction work is done at such sites, thus no harms to those assets.
5) According to environmental laws and regulation prevailing in Iran, only large-scale projects correspond to A category of JICA categorization, thus requiring conduct of EIA. While captioned project is of small scale and for disaster prevention purpose.
6) The project neither plans involuntary resettlement, nor proposes any change in existing

institution and customs.

7) Watershed management tasks have been practiced for a long time in Iran, and are quite familiar/ acceptable to inhabitants, thus no adverse social impact (conflict among communities, increase in income disparities) is expected.
8) No peat-land, mangrove forest or coral reef occur in the project area.

3. Outline of the Project Environment

3.1 Background of the Study

In general the provinces of Golestan, Mazandaran, and Gilan in Caspian coast are subjected to disasters of flood and debris flow. Madarsoo River basin is one of disaster prone basins in Golestan province, in which about 300 persons, and thousands of livestock were killed as consequences of floods/debris flow, which occurred in summer of 2001 and 2002. In addition to lives causalities, many infrastructures such as bridges and roads were destroyed, causing economic and psychological damages to people. The Madarsoo River originates in northern side (Caspian side) of Alborz Mountains, after passing the Golestan National Park it joins the Gorgan River, and thereby empties into Caspian Sea. The Madarsoo River with a length of about 100 km, has a catchment area of 2,364 km^2 in which 60,000 people inhabit. Average annual rain in this basin is about 1,000 mm, with uneven distribution (time/location) pattern.

In addition to Madarsoo River basin, there are some other basins in Caspian coastal area, having similar hazardous topography and climatic conditions. Of these Nekka River basin in Mazandaran province, and Maslee River basin in Gilan province could be mentioned.

In this circumstance the Government of Iran has taken some emergency actions for lessening the panic of the people and enhancing their safety mostly through non-structure measures such as providing emergency relief and advise on relocation. But the Government has not drawn any concrete plan for disaster prevention and basin management, therefore formulating a master plan bearing short, mid, and long terms objectives, and comprising of structural and non-structural measures is an important task to revert the confidence of inhabitants in Caspian coastal area.

In response to official request of the Government of Iran, Japan International Cooperation Agency (JICA) dispatched a Study Team to Iran in October 2004, for realizing the formulation of such master plan.

3.2 Objectives and Goals of the Study

Objectives

i) To formulate a master plan up to the target year 2025 for prevention of flood and debris flow disaster in Madarsoo River basin,
ii) To select priority projects among the measures/schemes proposed in the above-mentioned master plan and to carry out the feasibility study on them,
iii) To prepare technical manual and guidelines, containing planning and designing of flood and debris flow countermeasures, applicable not only to Madarsoo basin but also to similar other basins in Caspian coastal area, and

iv) To pursue technology transfer to counterpart personnel in the course of the study, mainly focusing on planning and designing processes on flood and debris flow disaster mitigation and management.

Goals

1) The projects, which are proposed through the study, will be carried out, and disaster of flood and debris flow will be mitigated.
2) The provincial offices in the Caspian coastal area will conduct the proper planning and designing with necessary measures for flood and debris flow disaster mitigation and management.

3.3 Study Area

The study area is mainly the Madarsoo River basin in Golestan province with a drainage area of 2,364 km^2. Some of similar basins in Caspian coastal area are also covered; these include Nekka River basin in Mazandaran province, and the Maslee River basin in Gilan province.

3.4 Target Year

The master plan for prevention of flood and debris flow disaster in Madarsoo River basin shall be formulated setting the target year at 2025.

3.5 Project Components

To cope with disaster of flood and debris flow, and assure the safety of inhabitants of river basins the master plan shall propose structural measures such as construction of river improvement and sediment control structures, as well non-structural measures such as installation of warning system and provision of hazard maps indicating the safe location for sheltering upon warning. Following this context the master plan contains seven components as tabulated below.

Table 1 Master Plan Components: Flood and Debris Flow Mitigation and Management Master Plan

No.	Component	Major areas to be conducted
1	Watershed Management Plan	Headwaters and Middle Reaches
2	River Restoration Plan	Headwaters: Ghiz Ghaleh and Dast-e-Sheikh River Basins
3	Golestan Forest Park Disaster Management Plan	Middle Reaches: Golestan Forest
4	Debris Flow Control Plan	Middle Reaches:
5	Flood Control Plan	Middle and Lower Reaches: Tangrah to Golestan Dam Entrance
6	Floodplain Management Plan	Middle and Lower Reaches: Tangrah to Golestan Dam Entrance
7	Flood Preparedness Plan	Entire Basin

4. Overall Environmental and Social Conditions

4.1 Legal Framework of Environmental and Social Consideration

The Islamic Republic of Iran has established comprehensive environmental legislations, which are rooted in the Constitution and the Islamic culture and philosophy. These legislations are effective instruments for protection of the environment, management of natural resources, and realization of sustainable development. Article 50 of Constitution of the Islamic Republic of Iran states that: " It shall be considered a public duty in the Islamic Republic to protect the natural environment in which the present as well as future generation shall have a developing social life. Therefore, economic activities or otherwise which cause pollution or an irreparable damage to environment shall be prohibited." This Article provides foundation and strength to all environmental laws, regulations, standards and guidelines prevailing in the country.

The Department of the Environment (DOE) is the principal organization for administering the environmental status in Iran. The DOE is responsible for protection and enhancement of the environment, prevention and control of any form of pollution/degradation leading to disturbance of environmental balance, and dealing with all matters related to wildlife and aquatic biota of the territorial waters. Defining and presenting the environmental rules, regulations and standards, ensuring proper implementation of environmental legislations and monitoring the status of environment in the country are also among responsibilities of this department. DOE is attached to Office of President of the country, and the president appoints its head. DOE has a Provincial Directorate in every province, which monitors status of the environment as well as the implementation of environmental programs in the province.

4.1.1 Laws

Among environmental legislations prevailing in Iran, those related to this study are listed in Table below with brief content.

Table 2 List of Environmental Legislations Prevailing in the Islamic Republic of Iran

Legislation	Brief Content
(1) Civil laws	
Law of nationalization of water-1968	Designation of water as a national resource
Environmental protection and enhancement law- 1974 (amended in 1992)	Protection and enhancement of ecosystem
Law on conservation and utilization of Forests and rangeland- 1975	Sustainable and wised utilization of Forest and rangeland
Law of just distribution of water-1982	Definition of pollution and prohibition of water pollution
Law on prevention of water pollution-1994	Prevention of water pollution
Law of third five-year socio-economic and cultural development plan of Iran- 2000	Requirement of EIA for large production and service providing projects
Law of fourth five-year socio-economic and cultural development plan of Iran- 2004	Necessity of conducting EIA on large projects, in accordance with guidelines provided by DOE
Environmental Guidelines and Standards,	Itemization of projects requiring EIA, and guidelines for

published by DOE in the year 2003	conducting EIA
Regulation on limits of bed and banks of rivers, stream, wetlands, and water supply and irrigation/drainage networks- 2000	Identification and delineation of limits of river banks
Regulation concerning the requirement of environmental impact assessment (EIA) in developmental projects- 1994	Mandatory of conducting EIA for large projects
Regulation for conducting EIA-1997	Preparation of EIA in accordance with the guidelines of Department of the environment
2) Islamic Laws	
Islamic punishment law (Taazirat)- 1999	Punishment for causing environmental pollution, damaging public facilities (dam, canal), and destroying cultural/historical heritages.

EIA; Environmental Impact Assessment. DOE; Department of the Environment (Iran)

4.1.2 Competent Agency

According to item 1 of Clause II of the Minutes of Meeting on Inception Report of the Study agreed upon between the Ministry of Jihad-e-Agriculture (the project proponents) and Japan International Cooperation Agency (JICA) on November 7, 2004 in Tehran, Department of the Environment (DOE) is one of the parties collaborating with this Study. So General Directorate of Environment in Golestan province will coordinate all the environmental related matters.

4.1.3 Projects Subject to Environmental Impact Assessment

(1) In accordance with Regulation for Conducting Environmental Impact Assessment (EIA)-1997, performing EIA for large projects become mandatory. Article 1 of this Regulation states that: Executors of Plan and Projects named in Article 2 of this Regulation are required to prepare EIA Report, along with Feasibility Study (F/S) Report for their plan and projects in accordance with guidelines of the Department of the Environment (DOE).

Article 2: Plan and projects requiring EIA are:

① Petrochemical plants of any scale

② Refineries of any scale

③ Power plants with production capacity of more than 100 Mega-Watt

④ Steel industries:

a) Steel mills with production capacity of more than 300,000 ton/year
b) Rolling mills with production capacity of more than 100,000 ton/year.

⑤ Dams and other water structures:

a) Dams with height of more than 15 m, or affiliated facilities of more than 40 ha, or reservoir area of more than 400 ha.
b) Man-made ponds with area of more than 400 ha.
c) Irrigation/Drainage projects of area more than 5,000 ha.

⑥ Industrial complex with area more than 100 ha

⑦ Airports with runway length of more than 2,000 meters.

(2) Environmental Guidelines and Standards published by DOE in 2003, instruct the project proponents to conduct Environmental Impact Assessment (EIA) on their project in accordance with Guidelines provided by the Department of the Environment. Projects requiring EIA are:

(a) Petrochemical plants of any scale
(b) Refineries of any scale
(c) Power plants with production capacity of more than 100 Mega-Watt
(d) Steel industries:
  - Steel mills with production capacity of more than 300,000 ton/year
  - Rolling mills with production capacity of more than 100,000 ton/year.
(e) Dams and other water structures:
  - Dams with height of more than 15 m, or affiliated facilities of more than 40 ha, or reservoir area of more than 400 ha.
  - Man-made ponds with area of more than 400 ha
  - Irrigation/Drainage projects of area more than 5,000 ha
(f) Industrial complex with area more than 100 ha
(g) Airport with runway length of more than 2,000 meters.
(h) Agro-industries with an area more than 5,000 ha
(i) Large slaughtering complex
(j) Dumping ground for wastes of cities more than 200,000 population, and new cities
(k) Compost making factories
(l) Oil and gas pipeline projects
(m) Oil terminal projects
(n) Oil storing facilities
(o) Large afforestation projects
(p) High way construction
(q) Railway construction
(r) Eco-tourism projects

4.1.4 Procedures

If the project component proposed in the Master Plan or adopted as a priority project in the Feasibility Study falls under the category listed above, the project proponent has to follow DOE guidelines when implementing the project. Otherwise prepare Environmental

Management Program and Environmental Monitoring Program depending on possibility and adversity of the predicted environmental impacts.

Whenever EIA is required the following procedures should be followed:

- Executors of plan and projects should prepare preliminary project summary and submit it to Department of the Environment (DOE) for consideration. DOE will provide its comments and advise to the executor within one month.
- EIA report prepared by project proponent should describe the situation for Construction Phase and Operation Phase separately, and include countermeasures and costs for minimizing the negative impacts of project on the environment.
- The prepared EIA report should be concluded in one of the three following forms and submitted to Department of the Environment for consideration.
  a) Due to its serious negative impacts on the environment, implementation of subject plan or project is not recommended.
  b) With comprehensive countermeasures for reducing its negative environmental impacts, implementation of subject plan or project is acceptable.
  c) With simple environmental consideration, the plan or project can be implemented.
- Department of the Environment shall examine the EIA Report and notify the executor about its decision within three months.
- In conducting EIA the following components must be considered:

I. Study of Impacts on Physical Environment
- Soil: Morphology and quality
- Water: Quantity and quality
- Climate and Air: Climate changes and air quality
- Secondary impact on soil, water and air

II. Study of Impacts on Biological Environment
- Impacts on fauna
- Impacts on flora
- Impacts on habitats, landscape and route of migratory birds

III. Study of Impacts on Social, Economical and Cultural Environments
- Impact on people health and living standard
- Education, employment and housing
- Religious belief, cultural values and historical heritage

IV. Impact on related Developmental Plans in the other sectors
- Agriculture, industry and service sectors
- Land consolidation
- Land use

4.1.5 Information Disclosure

Information disclosure is stipulated in Executive By-Law No. 156 approved by Environmental High Council in December 1997. Article 64 of Law of Fourth Five-Year Socio-economic and Cultural Development Plan of Iran- 2004 emphasis on disclosure of environmental related issues through radio, television, and other mass media.

In accordance with Clause 7 of Minutes of Meeting on Inception Report agreed upon between the Ministry of Jihad-e-Agriculture (the project proponent) and Japan International Cooperation Agency (JICA) on November 7, 2004 in Tehran, the public information on this project would be made through publication of News Letters.

4.1.6 Stakeholders Participation

Public participation is emphasized in documents published by Department of the Environment (Introduction of Environmental Impact Assessment- 1997), as well as in Laws of Ministry of Jihad-e-Agriculture (1992), which stipulate establishment of a Ministerial Deputy for promoting Extension and Public Participation in developmental projects and handling the relevant affairs.

4. 2 Outline of the Location

4.2.1 Population

Population density of Golestan province is higher than that of whole Iran as shown in Table below. The JICA study team is figuring the data up for Madarsoo River basin by field (village) survey.

Table 3 Statistics on Population and Household- 2004

Items	Whole Iran	Golestan Province	Madarsoo River Basin
Population (1000)	67,477	1,614	60
Population Density (persons/km^2)	41	77	25
Average household size (persons)	4.4	4.6	6.0
Women Heads of Household (%)	8.7	7.7	2.0

4.2.2 Race

In general local people can be divided into Turkmen, and non-Turkmen (Farsis, Baluch) groups; all being Muslim comprising of Shiite and Sunni fates.

4.2.3 Economy

According to the Article 44 of Constitution of the Islamic Republic, the economy of Iran is

composed of three sectors: private, state, and cooperative. Presently, only 2.5% of the country's economy is owned by cooperatives; the most predominant ownership is concentrated in state and private sectors. About 60% of Gross National Product (GNP) comes from governmental firms, mostly through export of oil and gas.

Since the beginning of the First Developmental plan in fiscal year 1989, the Iranian economy has seen a constructive growth. In 1995, the Gross Domestic Product (GDP) rose 4.5% to 13,880.2 billion Rials, compared to 1994. Meanwhile, regardless of oil revenues, the GDP grew 5.4%. Figures for GNP and GDP for 1990 to 1995 are presented below:

Table 4 Recent Changes of National Economy

Unit: Billion Rials

Item	1990	1991	1992	1993	1994	1995
GNP	10,997.5	12,377.9	12,985.6	13,370.8	13,163.5	13,707.6
GDP	10,664.9	11,824.8	12,477.8	13,071.0	13,280.4	13,880.2
GDP (Oil excluded)	8,400.2	9,308.1	9,924.3	10,425.7	10,784.3	11,362.4

GDP is composed of four major sectors, agriculture, industry and mine, services and oil. Trend of GDP for the year 1990 to 1995 is shown below:

Table 5 Recent Changes of GDP and Sectoral Products

Item	1990	1991	1992	1993	1994	1995
Agriculture	2,967.5	3,120.2	3,351.6	3,535.7	3,605.5	3,739.4
Oil	2,264.7	2,516.7	2,553.5	2,645.3	2,496.1	2,517.8
Industry/mine	2,391.8	2,802.3	2,932.2	2,970.0	3,114.9	3,293.1
Services	4,499.6	4,945.9	5,343.5	5,743.7	5,885.2	5,956.2
GDP	*10,664.9*	*11,824.8*	*12,477.8*	*13,071.0*	*13,280.4*	*13,880.2*

In the year 2000, shares of economic activities in GDP are tabulated below:

Table 6 Sectoral Share of GDP (Unit: %)

Agriculture	12.9
Mining	0.6
Manufacturing	12.9
Oil	22.4
Water, electricity, gas	0.9
Construction	3.5
Trade/Tourism	14.5
Transport/Communication	6.3
Services	26.0

4.2.4 Education

Schooling situation for whole Iran and the Golestan province is summarized in Tables Below:

Table 7 Schooling Situation in Iran- 2002

Schooling Level	Number of Students		
	Male	Female	Total
Pre-School	160,822	168,240	329,062
Primary School	3,924,999	3,588,016	7,513,015
Lower Secondary School	2,698,328	2,255,566	4,953,894
Upper Secondary School	2,020,296	1,964,854	3,985,150
Pre-University	182,732	294,496	477,228
University /Higher Education	98,589	106,437	205,026

Table 8 Schooling Situation in Golestan Province- 2002

Schooling Level	Number of Students		
	Male	Female	Total
Pre-School	5,708	5,875	11,583
Primary School	99,068	91,054	190,122
Lower Secondary School	65,474	51,918	117,392
Upper Secondary School	43,728	41,667	85,395
Pre-University	3,650	5,749	9,399
University /Higher Education	1,616	1,512	3,128

Since there are no many schools and educational facilities in Madarsoo River basin, and many children do farm works to assist their parents, rate of literacy in the basin seems to be low. JICA study team will determine the exact situation of schooling in the basin by conducting socio-economy survey in December 2004.

4.2.5 Land Use

Major types of land use in Iran, Golestan province and Madarsoo River basin for the 2001 is shown in Table below:

Table 9 Land Use Unit: (100 ha)

Land use Type	Whole Iran	Golestan Province	Madarsoo River Basin
1. Agriculture			
a) Annual Crops			
- Irrigated	5,524	290	149
- Rainfed	5,496	331	313
b) Fruit Trees	2,068	18	
c) Others (fodder)	113	-	
2. Forests	124,000	3,792	675
3. Rangeland			
- Good	93,115	-	73,220
- Fair	372,905	11,432	7,139
- Poor	433,979	1,884	14,336

Note: Figures in the Madarsoo River Basin shall be clarified during the following stage.

4.2.6 The Environment

The environmental status of Madarsoo River basin is summarized below.

Social Environment

- Local people are mainly composed of Turkmen, Persian (Farsis) and Baluch, all being Muslim, consisting of Shiite and Sunni fates Population density in the area is very low (25/km^2) as compare to whole Iran and the Golestan province.
- Major economic activities are agriculture (grain/fruit production) and livestock breeding. Due to low agricultural productivity and absence of any industry in the area, most of young persons go to large cities, undertake simple jobs, collect some money and send home to support their families. People in some villages such as Lueh economically are poor, because have no suitable land to cultivate, and psychologically under stress due to regular damage by floods and debris. Women of this village go nearby villages and work as farm labor for large landowners against a small salary of 20,000 Rials ($2.5) per day.
- In some villages such as Besh Oily, population of women is higher than that of men.
- Most of the villages possess water and electricity, telephone system, Mosque, primary school, graveyard, and Rural Islamic Council, which deal with daily life affairs of people. But there is lack of sporting facilities in the villages.
- Major problems in most of villages are:
  - ✓ Low agriculture productivity attributed to decrease in soil fertility and land productivity brought about by erosion, debris flow and flood.
  - ✓ Unemployment due to absence of any large industry in vicinity of the basin to engage some of the local people.

Natural Environment

- Topographic conditions of Madarsoo River basin is categorized into following parts:
  - ✓ Mountain and highland area of headwaters, which suffer from overgrazing, poor vegetation cover and soil erosion,
  - ✓ Steep valley of the middle reaches, consisting of Golestan National Park, and being the steepest part over the entire stretch of Madarsoo River, and
  - ✓ Alluvial plain and hills of the lower reaches, where agricultural land extends over the floodplain, and villages scatter along the river course.
- Bedrock consists of limestone, sandstone and shale, marl, conglomerate, and dolomitic limestone, chiefly belonging to pre-Cambrian and Ziorasic period.
- Soils are of gravelly loam, loamy-sand, loam, clay loam, and clay in texture with good to fair permeability, and slight, moderate and severe erosion classes.
- Terrain varies from rugged areas to level or slightly undulating terrain. Since the basin situates between Caspian Sea and the arid interior, its climate varies from wet to moderately arid, with a mean annual precipitation of about 1000 mm, and temperature range of –25^{o}C to +35^{o}C.

- Land use is comprised of agricultural land, forest, rangeland, and residential areas.
- One natural park with following characteristic occurs in the basin (see Fig. 1):
  - ✓ Official name: Golestan National Park
  - ✓ IUCN management category: II (National Park), IX (Biosphere Reserve)
  - ✓ Date of establishment: 1956. In 1977, it was recognized by UNESCO, as part of the international network of Biosphere Reserves.
  - ✓ Land Tenure: Government.
- Plant diversity of the park includes rare species which area valuable treasures of biodiversity. Various mammals such as the large Iranian deer, ram, leopard, ewe, and boar, as well birds such as partridge, falcon, quail, starling can be found in this park.

Public Pollution

- An asphalt road, which runs parallel to Madarsoo River and passes through the Golestan national park, forms a part of international corridor linked to neighboring countries, Turkmenistan and Afghanistan, and the sacred place of Shiite Muslim, Mashhad city. Peak traffic density of the road is about 25,000 automobile units/day, which insert noise and air impacts on people, and disturb the wildlife in national park. Since the park attracts thousands of tourists every year, some camping areas with modest facilities have been established within the park to host guests. Improper handling of solid waste and sewage generated by tourists may induce some adverse on the environment.

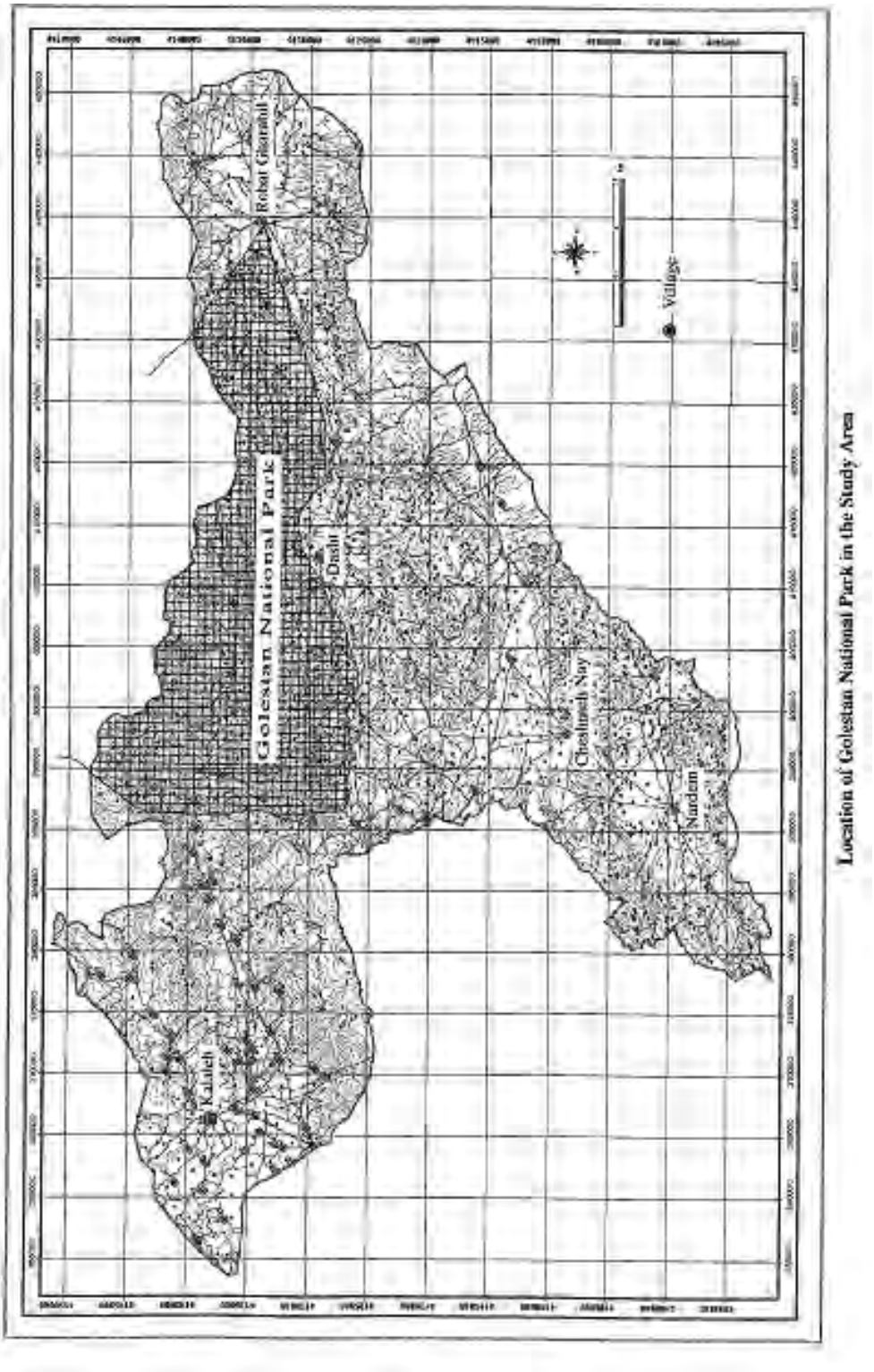


Fig. 1 Location of Golestan National Park in the Madarsoo River Basin

4.2.7 Other Socioeconomic Situation

There are some mosque and other religious enclosures in the basin, to which the Project should pay attention in construction phase. Since in accordance with the Islamic doctrine and people belief, none of them should be damaged or eliminated.

5. Adverse Environmental and Social Impacts

The project intends to safeguard the people and enhance their confidence on economic activities through minimization of flood and debris flow damages, by introducing some structural measures such as river training works and establishment of few small dam/dike for flood/debris flow control, along with non-structural measures. Such limited activities would not insert serious impacts on the environment. Mover-over the project is advised to take all necessary precautions to avoid occurrence of any adverse impact during the construction, operation and maintenance activities.

Major components of the projects and relevant environmental issues summarized in Table below:

Table 10 Major Project Components and their expected Environmental Effects

Project Component		Environmental Element	Reason/Basis
Structural Measures	a) Construction of Control Dam/dike	Soil erosion	Dam construction may cause temporary erosion in construction time.
		Noise and air pollution	Construction machineries would generate noise and emission of gas.
		Change in landscape	Some structures are erected in virgin areas, affecting the landscape.
		Impact on natural beauty	Artificial structures would lessen the natural beauty.
		Impact on wildlife	Check dam would hinder transit/ movement of creatures in the area.
		Impact on historical site/cultural heritage	Many historical sites/cultural heritages exist in the area, which could be damaged during construction phase.
	b) River Training Works	River widening and riverbed dredging	Temporary soil erosion and increase in water turbidity in construction period.
	c) Other Construction Works	Establishment of access roads/detouring	Noise and air pollution caused by machineries, and temporary soil erosion during the construction period.
Non Structural Works	Flood Warning System	Establishment of warning instrument and evacuation place/route	Such works insert some minor impacts on ecosystem in installation period, and affect the landscape when erected.

Result of Scoping is given in Table below, and Matrix for project components is shown in Table 12.

Table 11 Scoping Result

Environmental Elements			Rating	Justification
Social Environment	1.	Change in population distribution	C	No relocation/resettlement is planned
	2.	Involuntary resettlement	C	No resettlement is proposed
	3.	Change of life style/livelihood	D	Not expected. Development is of small scale
	4.	Dispute among local residents	C	If project benefits are not properly distributed
	5.	Impacts on indigenous people, ethnic minority, nomadic tribe	B	Landless people are less benefited than landholders
	6.	Impact on agriculture and forestry	C	Some changes in land use may be proposed
	7.	Impacts on fishery	D	No large fishery activities in the basin
	8.	Impacts on secondary industry (including mining)	D	No large mining in the area
	9.	Impacts on tertiary industry (including tourism)	C	Construction works may insert some temporary impacts (noise) on tourists visiting the area
	10.	Income amplification differences	B	Holders of agricultural land/livestock are more benefited than others
	11.	Local community disruption	C	If no proper distribution of project resources
	12.	Impacts on land transportation	D	Not expected.
	13.	Impacts on inland navigation	D	No inland navigation in the basin
	14.	Impacts on rights of water use, fishery and common	D	Not expected
	15.	Spread of water-related diseases	C	Relation of flood water harvesting and water borne diseases should be considered
	16.	Increase of use of agrochemicals, its residue in soil	C	Project will safeguard farmlands against disasters. This may encourage input of agrochemicals
	17.	Generation of waste, dredged/ excavated soil	B	River training works may generate spoil soil
	18.	Degradation of sanitary condition during construction period	C	Construction works may bring-about increment in water turbidity, and cause air pollution
	19.	Ruin of/damage to natural, historical and cultural heritage	C	Project activities may insert some impacts on natural environment and on historical/cultural heritages
	20.	Degradation of valuable landscape	B	dams and flood warning instruments erected in the area may impose adverse impacts on landscape
Natural Environment	21.	Inducement of earthquake	D	Not expected. Project is of small scale
	22.	Generation of landslide	D	Not expected. The activities are counter to landslide
	23.	Sedimentation in backwater area	D	Not expected
	24.	Impacts on downstream reaches	C	No significant impact is expected
	25.	Soil erosion	B	Project activities, particularly at construction phase, will cause soil erosion
	26.	Salinization of soil	D	Not expected
	27.	Soil contamination	B	Discarded oil by machineries, particularly at construction phase may cause soil contamination
	28.	Watershed diversion	D	Not expected.
	29.	Impacts on groundwater	D	Not expected
	30.	Change of river flow regime	B	River training works and establishment of structural measures may affect river flow regime
	31.	Cold water hazard	D	Not expected
	32.	Eutrophication	D	Not expected
	33.	Turbid water flow	C	During the construction phase, turbidity of water would increase
	34.	Change of river bed material composition	B	With construction of structures for flood/debris flow control, the composition may change
	35.	Impacts on terrestrial flora and fauna	C	Most of flora and fauna are in Golestan national park, in which no construction work is done
	36.	Impacts on aquatic organisms	B	River training works may induce some impacts on aquatic organisms

Environmental Elements			Rating	Justification
	37.	Impacts on protected species/ endemic species	C	Such species are mainly in Golestan national park, in which no construction work is done.
	38.	Air pollution	C	Some air pollution by machineries, particularly at construction phase
	39.	Emission gas/odor	C	Some gas emission by machineries, particularly at construction phase
	40.	Noise pollution /vibration	C	Some noise pollution by machineries, particularly at construction phase.

Ratings:

A – Potential for significant adverse impact

B – Potential for some adverse impact

C – Not clear. Impact should be identified in the course of the Study

D – Unlikely to have adverse impact

EIA; Environmental Impact Assessment.

Table 12 Scoping Matrix for Project Components

(River Training, Construction of Structures for Debris Flow/Flood Control)

Name of Cooperation Project			The Study on Flood and Debris Flow in the Caspian Coastal Area Focusing on the Flood-Hit Region in Golestan Province, Iran											
Environmental Item/Issue		Likely Impacts	Overall Rating	Planning Phase		Construction Phase				Operation Phase			
				Land Acquisition	Change of Land use plan, Control of Rights on Fishing and Water Use for construction	Extension of River width	Construction of check dam/dike, Banking, New Channel, and Related Facilities	Operation of Construction Equipment and Vehicles	Restriction of the economic and other activities around river	Drainage	Water Sharing	Appearance/Occupancy of building structures such as embankment, water control facilities, floodgate	Increasing influx of settlers
Social Environment: *Regarding the impacts on "Gender" and "Children's Right", might be related to all criteria of Social Environment	1	Involuntary Resettlement	*C*	*C*	*C*	*C*	-	-	-	-	-	-	-
	2	Local economy such as employment and livelihood, etc.	*B*	-	*C*	-	-	-	-	-	-	-	*B*
	3	Land use and utilization of local resources	-	-	-	-	-	-	-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	*C*	-	-	-	-		-	-	-	-	*C*
	5	Existing social infrastructures and services	*C*	-	-	-	-	-	*B*	-	-	-	*C*
	6	The poor, indigenous and ethnic people	*B*	-	*B*	-	-	-	-	-	-	-	*B*
	7	Misdistribution of benefit and damage	*B*	-	*B*	-	*B*	-	-	-	*C*	-	*B*
	8	Cultural heritage	*C*	*C*	*C*	*C*	*C*	*C*	-	-	-	-	*C*
	9	Local conflict of interests	*C*	*C*	*C*	-	*C*	-	*C*	-	*C*	-	*B*
	10	Water Usage or Water Rights and Rights of Common	*C*	*C*	*C*	-	*C*	-	-	-	-	-	*C*
	11	Sanitation	*C*	-	-	*C*	*C*	*C*	-	-	-	-	*B*
	12	Hazards (Risk) Infectious diseases such as HIV/AIDS	*C*	-	-	-	-	-	-	-	-	-	*C*

Name of Cooperation Project			The Study on Flood and Debris Flow in the Caspian Coastal Area Focusing on the Flood-Hit Region in Golestan Province, Iran										
				Planning Phase		Construction Phase				Operation Phase			
Environmental Item/Issue		Likely Impacts	Overall Rating	Land Acquisition	Change of Land use plan, Control of Rights on Fishing and Water Use for construction	Extension of River width	Construction of check dam/dike, Banking, New Channel, and Related Facilities	Operation of Construction Equipment and Vehicles	Restriction of the economic and other activities around river	Drainage	Water Sharing	Appearance/Occupancy of building structures such as embankment, water control facilities, floodgate	Increasing influx of settlers
Natural Environment	13	Topography and Geographical features	-	-	-	-	-	-	-	-	-	-	-
	14	Groundwater	*C*	-	-	-	*C*	-	-	*C*	-	-	-
	15	Soil Erosion	*B*	-	-	*B*	*B*	*B*	-	-	-	-	-
	16	Hydrological Situation	*C*	-	-	*C*	*C*	-	-	-	-	-	-
	17	Coastal Zone	*C*	-	-	-	*C*	-	-	-	-	-	-
	18	Flora, Fauna and Biodiversity	*C*	*C*	*C*	*C*	*C*	*C*	-	*C*	-	*C*	*C*
	19	Meteorology	-	-	-	-	-	-	-	-	-	-	-
	20	Landscape	*B*	*C*	*C*	*C*	*B*	*B*	-	-	-	*B*	-
	21	Global Warming	-	-	-	-	-	-	-	-	-	-	-
Pollution	22	Air Pollution	*B*	-	-	*B*	*B*	*B*	-	-	-	-	-
	23	Water Pollution	*B*	-	-	*B*	*B*	*B*	-	-	-	-	*C*
	24	Soil Contamination	*B*	-	-	*B*	*B*	*B*	-	-	-	-	-
	25	Waste	*C*	-	-	*C*	*B*	*C*	-	-	-	-	*B*
	26	Noise and Vibration	*B*	-	-	*B*	*B*	*A*	-	-	-	-	*C*
	27	Ground Subsidence	*C*	-	-	-	-	-	-	*C*	-	-	-
	28	Offensive Odor	-	-	-	-	-	-	-	-	-	-	-
	29	Bottom sediment	*C*	-	-	*C*	*C*	-	-	-	-	-	-
	30	Accidents	*B*	-	-	*B*	*B*	*B*	-	-	-	*B*	*B*

Rating: *A* Serious impact is expected, *B* Some impact is expected *C* Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses) — No impact is expected.

6. Alternative

Without Project (No Action or no development) Alternative

Without project the local people and tourists visiting the area are subjected to economic and psychological damages of flood and debris flow. No action alternative is contrary to Iranian law, and Islamic doctrine, which require the Islamic Government to protect the entire citizen against disasters, and emphasis on wise utilization of God-gifted natural resources. Care for fragile mountainous areas (watersheds) is the sprit of Agenda 21 of Earth summit- Rio 1992.
Without project the income of farmers would further decrease, forcing them to leave the agricultural occupation and seek simple job in large cities, bring-about “imposed migration” and causing social disturbance.
Since all the National Development Plans of Iran, emphasis on implementation of efficient rural and agricultural development projects, no action alternative, cannot be justified.

Therefore “with Project” alternative should be carefully examined in light of technical, economic, environmental and social viewpoints, and a Master Plan is formulated by adopting the most effective disaster prevention measures. After conducting Feasibility Study on selected priority project(s), they can be executed, starting from the most urgent one.

Table 13 (below) summarizes the master plan components, major countermeasures and alternatives except for without-project alternative, and their environmental effects anticipated.

Table 13 Master Plan Components and their Alternatives

Master plan components	Area to be mainly conducted	Major countermeasures/ Alternatives (A)	Environmental effects
Watershed Management	Headwaters and middle reaches	Afforestation, land treatment, on-site rainfall detention, etc.	Positive effects in natural and social environment
		(A) No effective alternatives	-
River Restoration Plan	Headwaters	Reconstruction of reservoirs in the Dast-e-Sheikh and construction of flood control channels in Dasht area (flood and sediment control)	Some negative effects during construction. Positive effects in natural and social environment as a whole
		(A) No realistic alternatives	
Golestan Forest Park Disaster Management Plan	Middle reaches	Establishment of flood forecasting and warning system and emergency activities	negative environmental effects during construction, but minimul
		(A) Restriction of camping activities	Negative effects in social environment
Debris Flow Control Plan	Middle reaches (Tangrah to Beshoily)	Construction of debris flow control dams and canals in parallel with watershed management	Some negative environmental effects during construction
		(A) Resettlement of debris-flow-prone villages	Negative effects in social environment
Flood Control Plan	Middle and lower reaches	Construction of necessary flood control structures to protect farmlands against 25-year flood and villages against 100-year flood	Some negative environmental effects during construction
		(A) Full-scale flood control structures against 100-year flood	Much larger negative environmental effects during construction
Floodplain management Plan	Middle and lower reaches	Publication of flood-hazard area and landuse control in the flood-hazard area	No significant environmental effects
		(A) Full-scale flood control structures against 100-year flood	Much larger negative environmental effects during construction
Flood Preparedness Plan	Entire basin	Improvement of early warning system and training activities for emergency	No significant environmental effects
		(A) Full-scale flood control structures against 100-year flood	Much larger negative environmental effects during construction

7. Terms of Reference

7.1 Objectives

The main objectives of the environmental and social considerations study are to:

(1) Minimize/mitigate the environmental and social impacts to be caused by the proposed project/action,

(2) Disclose information on proposed project and possible environmental impacts to be caused by implementing it at an early stage,

(3) Conduct accountability on implementing the project and incorporate stakeholder opinions into decision-making processes regarding environmental and social considerations, and

7.2 EIA Requirements

According to Iranian laws, and environmental guidelines introduced in 2003, only large projects require EIA, while other small development activities should simply be evaluated to ensure their environmental soundness and public acceptability. Therefore concern authorities are advised to assess the project from social, economic, and environmental viewpoint to assure the public on its socio-economic benefits and environmental soundness through information disclosure and timely contact with local people.

7.3 Study Area

The study area for environmental evaluation is priority project area that will be selected in the course of master plan formulation, as mentioned in the Inception Report agreed upon between JICA and Iranian Government on November 7 in Tehran.

7.4 Study Period

The study period for the environmental and social consideration extends in the feasibility study stage, as mentioned in the Inception Report agreed upon between JICA and Iranian Government on November 7 in Tehran.

7.5 Scope of Work

The scope of work for the environmental and social consideration study is the following:

<u>Phase I Formulation of Master Plan: Environmental Scoping and IEE</u>

(1) Scoping for environmental and social considerations

(2) Environmental examination for flood and sediment control structures

(3) Collection of data / information for clarification of existing environment

(4) Initial Environmental Examination for the Master Plan

A checklist useful for the IEE study is put in Attachment G. Some modification or adjustment to the target basin shall be necessary in adoption.

In accordance with the DOE Guidelines, the following 'pre-EIA' document composition could be referred to for document preparation.

1) Name of company, client and project,
2) Name and address of the project implementation agency,
3) Goals and objectives of plan,
4) Salient features of the project,
5) Project phasing and its implementation schedule,
6) Construction materials and their procurement details,
7) Location of the project,
8) Basic needs and potentials for the project,
9) Necessary manpower and supply potential,
10) General conditions of the region and the project area,
11) Positive and negative effects of the project,
12) Extent and significance of the environmental effects by the project, and
13) Countermeasures required controlling and remedying the negative environmental effects by the project.

Phase II Feasibility Study

(1) Careful examination of components of projects proposed for undergoing feasibility study, and verifying their environmental and social soundness
(2) Introduction of countermeasures for nullifying/minimizing the adverse impacts (if any) of the component/activity, including suggestion for alteration of associated approach
(3) Preparation of environmental report/document in accordance with JICA format and Iranian (DOE) formal style

Some of items to be covered by environmental examination are as follows:

1) Study on physical environment- topography, geology, hydrology, climatology, and soil
2) Study on biological environment- flora, fauna and habitats
3) Study on social, economic and cultural environment- population, economy, landuse, environmental laws and regulations, as well as historical/cultural heritages
5) Examination of project impacts on physical, biological, socio-economic and cultural, environments
6) Recommendation for conservation/enhancement of environment status in the project area

In the course of the Study, the Public Consultation Meeting (PCM) is to be held three times: the 1st PCM is held on the Draft Scoping for environmental and social considerations study,

the 2nd PCM is held on the result of environmental and social considerations study for the Master Plan, and the 3rd PCM is held on that for the feasibility study.

Attachment A Data and Information Related to Golestan National Park

Golestan National Park (GNP) is one of the UNESCO designated Reserves and the first Iranian National Park. With an area of about 92,000 ha, the park is suited among three provinces of Golestan, Khorasan, and Semnan. The complex of various geomorphologic, geologic, hydrologic and climatic conditions provide a wide range of biotypes leading to a rich species and biodiversity. A total number of 1340 vascular plant species belonging to 110 families and 561 genera have been known from the park. This is astonishing because surface area of the park covers only 0.06% of Iran, but 19% of species, 45% of genera and 69% of families of Iranian vascular plants occur in the park. A large number of species are local endemic to this park. Some of flora species such as *Populus caspica* (poplar) and *Taxus baccata* (yew) are listed as endangered species in Red Data Book of Iran- 1999.

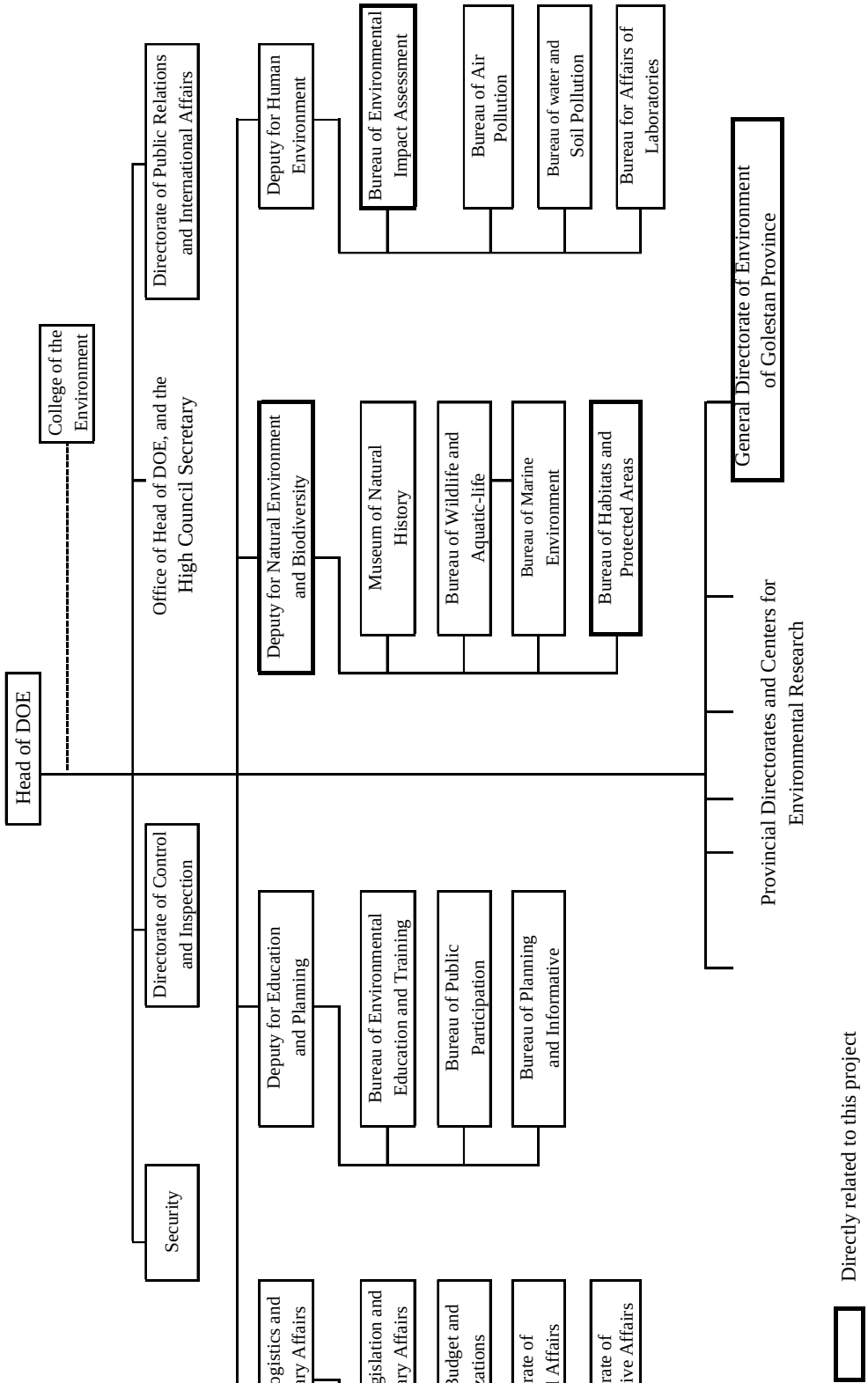
The park provide habitat for many wild animals such as Sus scrofa (wild pig) Cervus elaphus (red deer), Felis chaus (wild cat), Ursus arctos (brown bear), and Ovis ammon (wild sheep). Birds of the park include owls, pheasant, passerines, woodcock, and sparrow hawk.

However, for long the park has been used for conducting scientific research, and generating artistic photograph of natural scenery, DOE intends to establish research stations, and visitor centers in the park to enhance its scientific and recreational values. In 1997, Iranian Government launched a national project titled: Golestan National Park Improvement Project, to boost the status of the park in all aspects. It is believed that the park meets the required criteria for being designated as a World Heritage (natural site) in Iran.

Attachment B

Organization Chart of Department of the Environment (DOE)

Islamic Republic of Iran



Attachment C List of Sites of Historical, Cultural, and Religious Importance in the Study Area

Name	Type	Location
Arab Boran She Tappeh	Ancient hills	Vicinity of Arab Boran village
Tappeh Ghareh Shur Yek, Dou	Ancient hills	Vicinity of Ghareh Shur village
Seh Tappeh	Ancient hills	Obeh Gavemishi area
Tappeh Bastani	Ancient hill	Vicinity of village of Chay Ghochan Bozorg
Seh Tappeh Bastani	Ancient hills	Vicinity of Kangar village
Tappeh Bastani	Ancient hill	Vicinity of Aman Ghajeh village
Tappeh Morsal	Ancient hill	Between Aman Ghajeh and Kangor villages
Ghaleh Barbar	Ancient castle	Vicinity of Ghaleh Barbar village
Tappeh Hossein Abad	Ancient hill	Vicinity of Hossein Abad Ghorbani
Tappeh Hydar Abad	Ancient hill	Vicinity of Hydar Abad village
Narges Tappeh	Ancient hill	Vicinity of Tagek village
Imam Zadeh Abdolah	Religious enclosure	Vicinity of Tagek village
Baniyal Tappeh	Ancient hills	Vicinity of Baniyal village
Gilan Tappeh Yek, Dou	Ancient hills	Vicinity of Achar village
Tappeh Bastani	Ancient hill	Vicinity of Adarvish village
Mengoli Tappeh	Ancient hills	Ghojeh Maz village
Ajen Gharehkha	Historical site	Vicinity of Ajen Gharehkha village
Gharavol Tappeh	Ancient hills	Vicinity of Gharavol village
Taluneh Ajan	Historical site	Vicinity of Taluneh Ajan
Kateb	Historical site	Vicinity of Kateb village
Ajan Salekh	Historical site	Ajan Salekh area
Seh Tappeh	Ancient hills	Vicinity of Ajen Sangerly village
Yekeh Ghozeh Bala	Historical site	Yekeh Ghozeh Bala area
Yekeh Ghozeh Paien	Historical site	Yekeh Ghozeh Paien
Haji Hassan	Historical site	Vicinity of Haji Hassan village
Tappeh Shekh	Ancient hill	Vicinity of Shekha village
Tappeh Kazem Khajeh	Ancient hill	Vicinity of Kazem Khajeh village
Ginely	Historical site	Vicinity of Gineli village
Ghanjigh	Historical site	Ghanjigh area
Tappeh Sariseyed	Ancient hill	Vicinity of Terjenly village
Ghareh Tappeh	Ancient hill	Vicinity of Terjenly village
Shoghal Tappeh	Ancient hill	Vicinity of Sadegh Abad village
Ghoosh Tappeh Yek, Dou	Ancient hills	Vicinity of Sadegh Abad village
Tappeh Agh Ghamish Yek, Dou	Ancient hills	Vicinity of Agh Ghamish village
Tappeh Korang Kaftar	Ancient hill	Vicinity of Korang Kaftar village
Tappeh Emamzadeh Jafar	Ancient hill	Area of Ghanjigh Shahrak
Tappeh Ghanjigh Shahrak	Ancient hill	Area of Ghanjigh Shahrak
Ajan Shahrak	Historical site	Ajan Shahrak area
Charghar Shirmely	Historical site	Charghar Shirmely area
Dar Abad	Historical site	Dar Abad area
Charghar Besh Ghardash	Historical site	Charghar Besh Ghardash area
Tappeh Pasang	Ancient hill	Vicinity of Pasang Bala village
Emamzadeh Takiyeh Baba	Religious enclosure	Vicinity of Pasang Bala village
Tappeh Pasang Yek, Dou	Ancient hills	Vicinity of Pasang Paein village
Tappeh Kamal Abad	Ancient hill	Vicinity of Kamal Abad village
Tappeh Talustan Yek, Dou	Ancient hills	Talustan area
Tappeh Ali	Ancient hill	Tarajigh area
Turang Tappeh	Ancient hill	Vicinity of Turang Tappeh village

Since the hills could contain historical objects, even soil disturbance is not permitted.

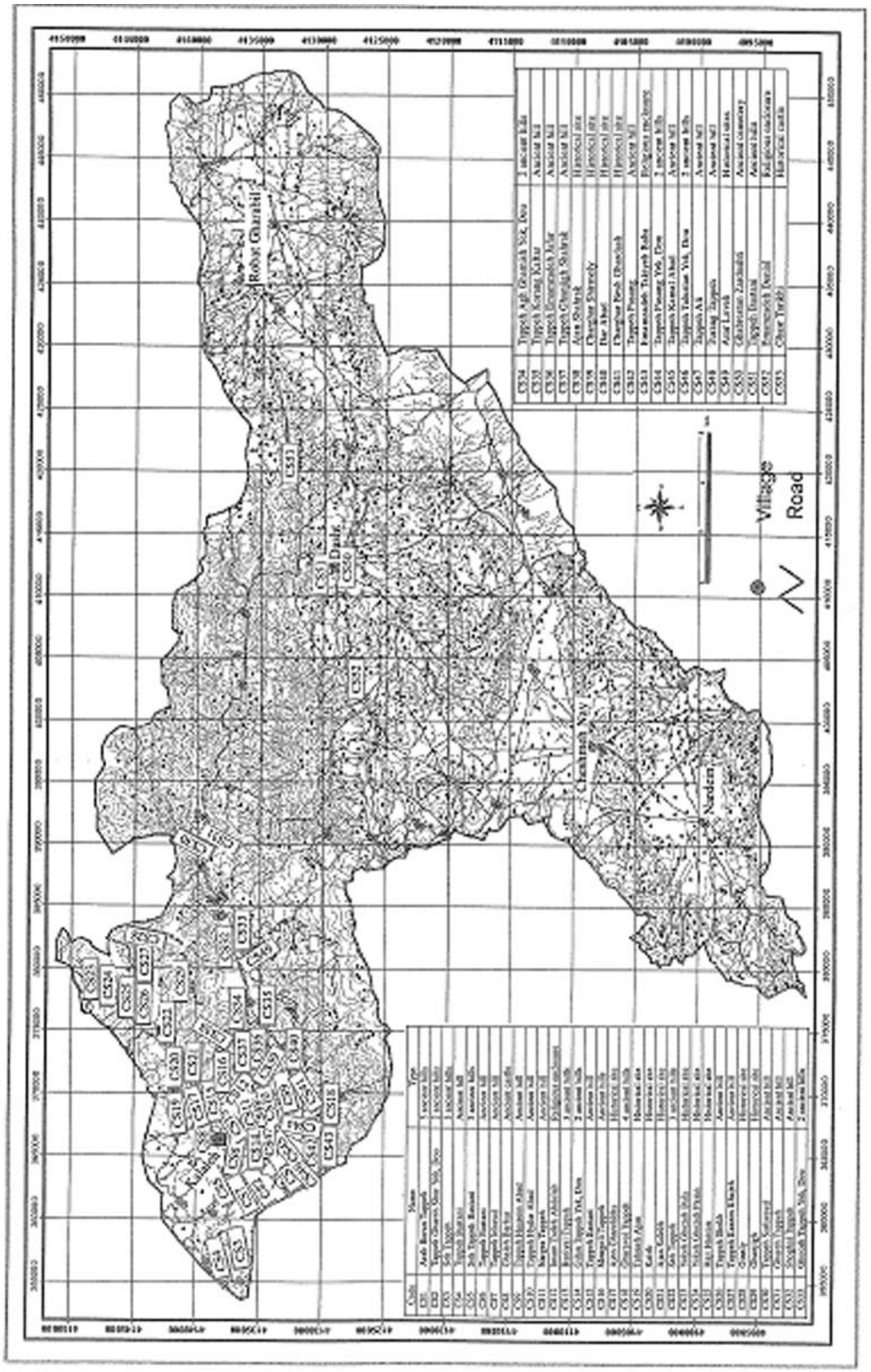


Fig. 2 Historical, Cultural and Religious Sites in the Study Area

Attachment D JICA List of Sensitive Sectors, Characteristics, and Areas

According to Guidelines for Environmental and Social Considerations published by Japan International Cooperation Agency (JICA) in 2004, projects that are in *sensitive sectors*, have *sensitive characteristics*, and/or are in *sensitive areas*, would have significant adverse impact on the environment and society. Therefore are categorized as "Category A", and require full-scale environmental impact assessment prior to implementation.

1. Sensitive Sectors

(1) Mining development
(2) Industrial development
(3) Thermal power, including geothermal power
(4) Hydropower, dams and reservoir
(5) River/erosion control
(6) Power transmission and distribution lines
(7) Roads, railways and bridges
(8) Airport
(9) Ports and harbors
(10) Water supply, sewage and wastewater treatment
(11) Waste management and disposal
(12) Agriculture involving large-scale land-clearing or irrigation
(13) Forestry
(14) Fisheries
(15) Tourism

2. Sensitive Characteristics

(1) Large scale involuntary resettlement
(2) Large scale groundwater pumping
(3) Large scale land reclamation, land development and land-clearing
(4) Large scale logging

3. Sensitive Areas

(1) National parks, nationally-designated protected area, and areas for ethnic minorities or indigenous peoples and cultural heritage
(2) Areas that national or local governments believe to require careful considerations.

Natural Environment

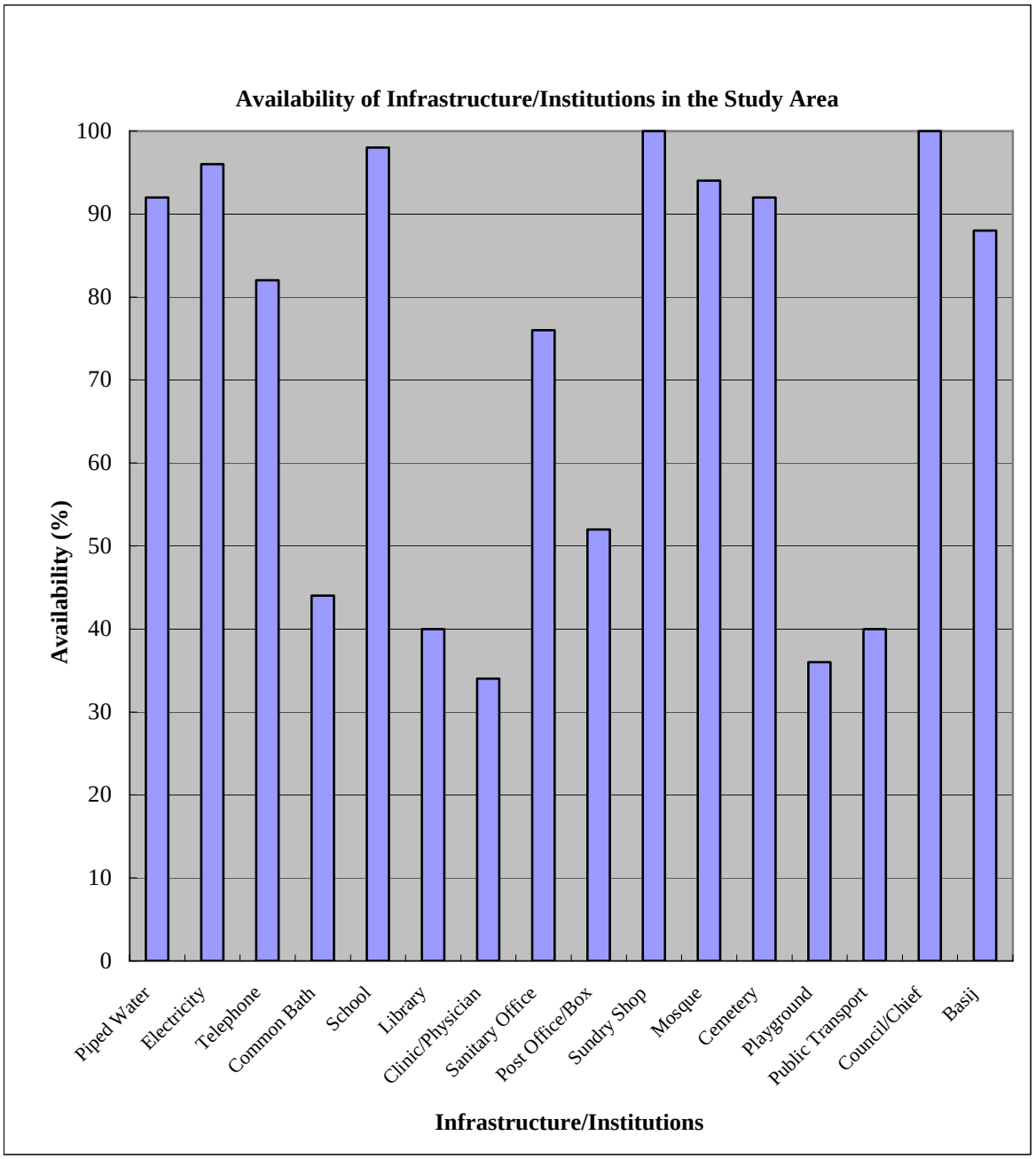
- Primary forests or natural forests in tropical areas
- Habitats with important ecological value, such as coral reefs, mangrove wetland and tidal flats

- Habitats of rare species requiring protection under domestic legislation, international treaties
- Areas in danger of large-scale salt accumulation or soil erosion
- Areas with a remarkable tendency towards desertification

Social Environment

- Areas with unique archeological, historical or cultural value
- Area inhabited by ethnic minorities, indigenous or nomadic peoples with traditional ways of life, and other areas with special social value.

Attachment E



Notes

1) In some village water is of poor quality and turbid
2) Primary and Secondary school widely exist, but high school is limited
3) In some villages library exist, while in others books (religious) are kept in the Mosque
4) In few large villages resident physician exist, while for small villages a physician come to village once a week and provide medical services
5) Most of villages are beside Tehran-Mashhad main road, and depend on passing vehicles for transport
6) Council/Chief = Rural Islamic Council/Village Chief
7) Basij = Voluntary units, which undertake social and relief works
8) In general fuel (kerosene/capsule gas) is supplied to villages through dealers by tanker/pickup cars.

Attachment F Damages Caused by Floods occurred in the Study Area

Type of Damage	*Casualty in 2001*	*Casualty in 2002*
Road demolished	194 km	182 km
Farms and orchards demolished	15000 ha	400 ha
People wounded	200 persons	5 persons
People killed and missing	254 persons	54 persons
Livestock lost	6000 heads	1000 heads
Forest demolished	5500 ha	-
Rangeland demolished	10000 ha	10000 ha
Vehicles destroyed	130 units	9 units
Residential/business building demolished	3000 units	1810 units
Telephone office demolished	7 units	5 units
Estimated Economic Damages	580 billion Rials	213 billion Rials

It should be noted that the above Table indicate only physical/economic loses, but not deal with psychological damages imposed on people by the floods.

Results of intensive surveys conducted on environmental and social conditions of villages by JICA Study Team (October 2004～February 2005) indicate that many people are suffering from psychological/emotional stress, which is a consequence of floods.

Attachment G

Checklist for Proving Environmental Impact (1/2)

1) Applicable development activities: for example, Rural development
2) Applicable development type: for example, New project
3) Applicable environmentally sensitive area: for example, Tropical rain forest

I. Social Environment

Category of Environmental Impact	Evaluation of SEI				Evaluation Base
	A	B	C	D	
1. Socio-economic Issues					
(1) Social Issues					
1. Planned residential settlement					
2. Involuntary resettlement					
3. Substantial changes in way of life					
4. Conflicts on among communities and peoples					
5. Impacts on native peoples					
(2) Demographic Issues					
1. Population increase					
2. Drastic change in population composition					
(3) Economic activities					
1. Change in bases of economic activities					
2. Occupational change and loss of job opportunity					
3. Increase in income disparities					
(4) Institutional and Custom Related Issues					
1. Adjustment and regulation of water or fishing rights					
2. Changes in social and institutional structure					
3. Changes in existing institution and customs					
2. Health and Sanitary Issues					
1. Increased use of agrochemicals					
2. Outbreak of endemic diseases					
3. Spreading of endemic diseases					
4. Residual toxicity of agrochemicals					
5. Increase in domestic and other human wastes					
3. Cultural Asset Issues					
1. Impairment of historic remains and cultural assets					
2. Damage to aesthetic sites					

Note: Applicable columns with the following impact degree are marked with "X"
SEI: Significant Environmental Impact
A: The subject SEI is unquestionably induced by the Project
B: The subject SEI is likely to be induced by the Project
C: There is no possibility of the subject SEI being induced by the Project
D: The SEI is not fully known

Checklist for Proving Environmental Impact (2/2)

II. Natural Environment

Category of Environmental Impact	Evaluation of SEI				Evaluation Base
	A	B	C	D	
4. Biological and Ecological Issues					
1. Changes in vegetation					
2. Negative impacts on important or indigenous fauna and flora					
3. Degradation of ecosystems with biological diversity					
4. Proliferation of exotic and/or hazardous species					
5. Destruction of wetlands and peatlands					
6. Encroachment into tropical rain forests and wildlands					
7. Destruction or degradation of mangrove forests					
8. Degradation of coral reefs					
5. Soil and Land Resources					
(1) Soil Resources					
1. Soil erosion					
2. Soil salinization					
3. Degradation of soil fertility					
4. Soil contamination by agrochemicals and others					
(2) Land Resources					
1. Devastation or desertification of land					
2. Devastation of hinterland					
3. Ground subsidence					
6. Hydrology and Air and Water Quality					
(1) Hydrology					
1. Changes in surface water hydrology					
2. Changes in groundwater hydrology					
3. Inundation and flooding					
4. Sedimentation					
5. Riverbed degradation					
6. Impediment of inland navigation					
(2) Water Quality and Temperature					
1. Water contamination and deterioration of water quality					
2. Water eutrophication					
3. Salt water intrusion					
4. Change in temperature of water					
(3) Atmosphere					
1. Air pollution					
7. Landscape and Mining Resources					
1. Damage to landscape					
2. Impediment of mining resources exploitation					

ANNEX II

Study on Flood/Debris Flow in Caspian Coastal Area

STUDY ON FLOOD/DEBRIS FLOW IN CASPIAN COASTAL AREA

1. GENERAL

Coastal area along the Caspian Sea was composed of some provinces; Golestan, Mazandaran, and Gilan. Among the provinces, some of rivers were selected based on the previous flood or debris flow occurrence. Selected were Neka River ranging from Mazandaran to Golestan, Neiran River in Mazandaran, Masuleh River in Gilan, and Golidagh in Golestan. The result of the study was evaluated on the respect of applicability of the result of the Study and Technical Guideline prepared by the Study.

Fig. 1 Location of Study Area

2. ENCOUNTERED SITUATION

Situations encountered through observation were described as follows.

2.1 Neka River

(1) Flood in Neka City

- Neka City had suffered flood damages in 1999 with death toll more than 30. One of the major causes of the flood was congested residence narrowing the river course. The authority concerned promulgated the regulation to prohibit building within 30 meters as flood plain in the both of banks form the river.
- Narrow bridge in the city blocked flood flow and surged up the flood water level higher.

(2) Basin Feature

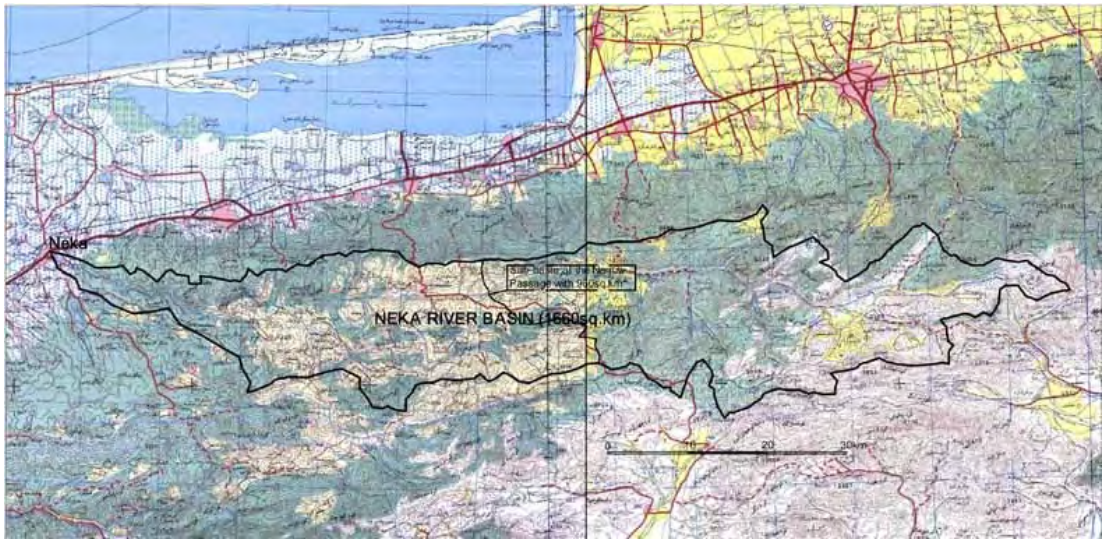


Fig 2 Neka River Basin

- Neka River Basin had 1660 sq.km in basin area ranging from west to east, headwater of which originated from mountain with el.3000s m.
- There were narrow portions; some of which had natural retarding function to floods. One of them, especially, was the narrowest, which had 960 sq.km in basin area, more than half of the total area shown in the photo.
- The narrowest passage was a high potential for flood control with dam construction increasing natural function.
- Geological feature of the dam potential site had many cracks, one of them was developed widely open forming the narrow passage. Therefore, geological investigation should be closely carried out if high dam was adopted at the site.
- There was a landslide, which was treated with drainage works by MOJA. The villagers appreciated the works effecting to settle the land-movement.
- According to the information of the authority concerned, there was a problem on driftwood in the southern part of the river basin that had clogged bridges and destroyed them.
- MOJA Mazandaran had constructed a slit dam to capture driftwoods in one of the tributary, which was fully filled up by the captured driftwoods and sediment. In addition to this, spillway had too small capacity of discharge and little allowance of height to the left side bank so floodwater should spill over it, resulting inducing washout of the bank.
- Upstream of the slit dam, still driftwoods were left in the riverbed, which should be removed.

1. Neka City; housing was restricted to the flood plain

2. Neka City; bridge section narrowed the river course

3. Neka R.Upstream; the narrowest passage with natural flood control function & potential of dam

4. Land-slide; villagers appreciated the drain works for countermeasures.

5. Darvishan Slit Dam; allowance between dam crest and bank was too small in case of excess flow

6. Reservoir; filled up with driftwoods and debris

7. Upstream of the Slit Dam; still fallen trees were left in the riverbed

Fig. 3 Some of Projects in Neka River Basin in Mazandaran

2.2 Neirang River Basin

- Neirang River Basin was 20.5 sq.km in area and had brought about floods to Nowshar town so MoJA Mazandaran had been constructing some flood control dams in the basin as a part of watershed management works.
- One of them was an existing flood control dam in one of the tributaries, which had been functioning well through the holes to control discharge, inlets of which were covered by iron cages to prevent clogging against driftwoods. Preparation for next flood had been made with removing driftwoods caught on the cages during flood when the Team visited there.
  - There was an existing gabion dam in one of the tributaries. Bottom of the dam at downstream side was loosened and some of units of gabion were washed away. The dam was located at the narrow valley with steep slope at both sides of bank with 9 m in height. Topography and a figure of the hollow part of the gabion suggested on a possible mechanism of loosening gabion that;
    - Inter-locking between stones in gabions formed arch action and thrust force to the abutments at both sides of bank.
    - Weights of dam body were diverted from vertical direction to the thrust direction against gravity that reduced vertical load or friction force between stones, resulting a part at the bottom of the dam body became loose.
    - Planar arc form of the dam axis possibly intensified such a phenomenon.

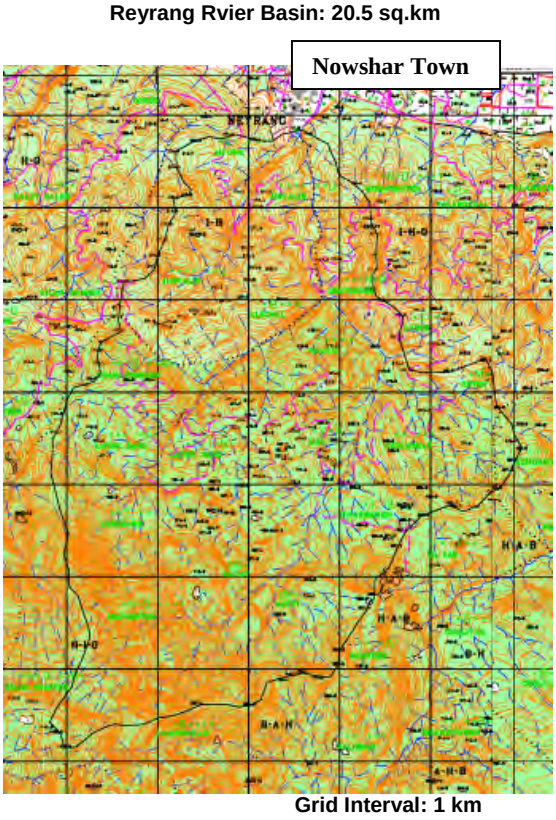


Fig. 4 Reyrang River Basin

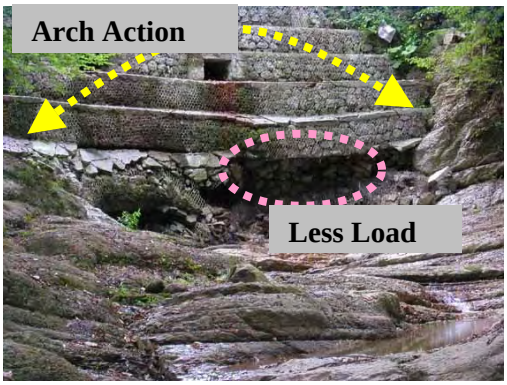
1. Neirang; flood control dam

2. Driftwoods caught in the cages

Fig. 5 (1/2) Some of Projects in Neyrang River Basin in Mazandaran

3. After clearing driftwood ready to next flood

4. gabion dam with 9 m in height



5. Arch action reducing vertical load in the gabion dam

6. View from the crest of the gabion dam

Fig. 5 (2/2) Some of Projects in Neyrang River Basin in Mazandaran

2.3 Masuleh River Basin

- Masuleh was located on the hillside along the Masuleh River, and one of the popular towns for tourism in this country because of the old town registered to the World Heritage. Many tourists had been visiting there with cars through narrow passage of valley reaching to the town.
- Masuleh River Basin was 38.3 sq.km in area with two tributaries meeting at the tourism spot in narrow valley.
- Mostly every year they suffered floods with debris. Tourists were confined in the narrow valley when sudden flash flood came in case they had been already there. The event in August, 1998 caused 60 death tolls and 20 missing.
- There were a few rainfall gauges at the town area, but upstream sites. In

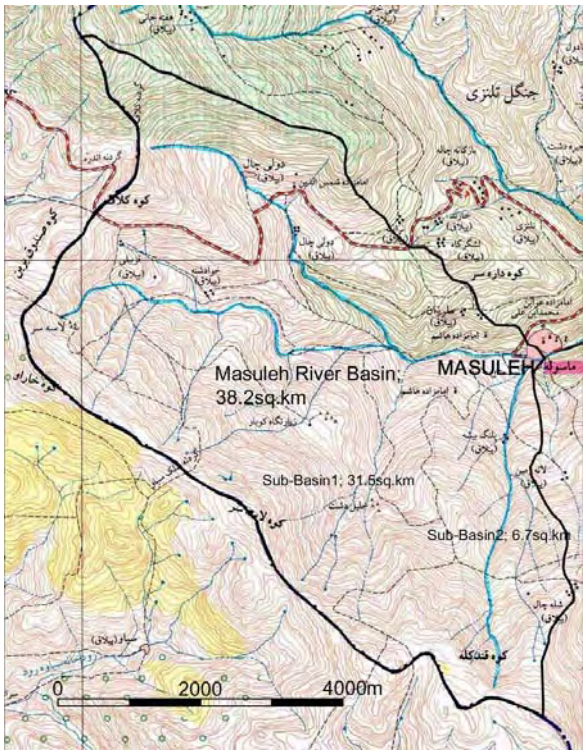
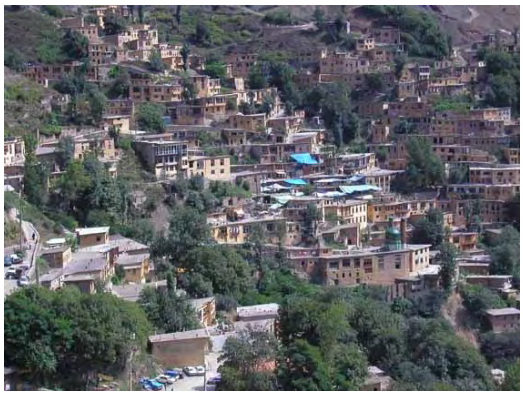


Fig.6 Masuleh River Basin

addition, the gauges had not been online system yet.

- A landslide was located just at the tourist parking lots, and was still under active condition. Streamlines at the crest of the landslide was treated to divert from the sliding area to others but not well treated. In addition, they still excavated the soil at toe of the slide mass, which works as counter-weight to halt sliding movement.



1. Masuleh; World Heritage

2. Tourists crowded in narrow valley

3. Valley at upper end of tourist zone where flash floods coming from

4. Land slide area in Masuleh

5. Parking lots at toe of the landslide; still excavating?

6. Upstream area of Masuleh River; sediment produced

Fig. 7 Masuleh River Basin in Gilan

2.4 Golidagh River Basin

- Golidagh River Basin was one of the tributaries of Gorgan River with 126.4 sq.km in basin area while Gorgan River was with 483.5 sq.km at Poshoy Village.
- Golidagh River Basin including a part of the Gorgan River Basin suffered floods damages twice this year, 2005; the first occurred 30 to 31 July and the second 9 to 10 August.

Death toll was 27 persons and 33 persons respectively. The first flood brought about in the Golidagh River Basin and the second did in the area downstream of the Golidagh River along the Gorgan River.

- According to one of the villager of Poshoy, one of the villages suffered by the second flood located along the Gorgan River around 600 m down stream of the conjunction of the Gorgan River and Golidagh River, some of people heard about flood coming so escaped and survived and others not; no official information or warning was given to the residents while the road was closed by the authority.

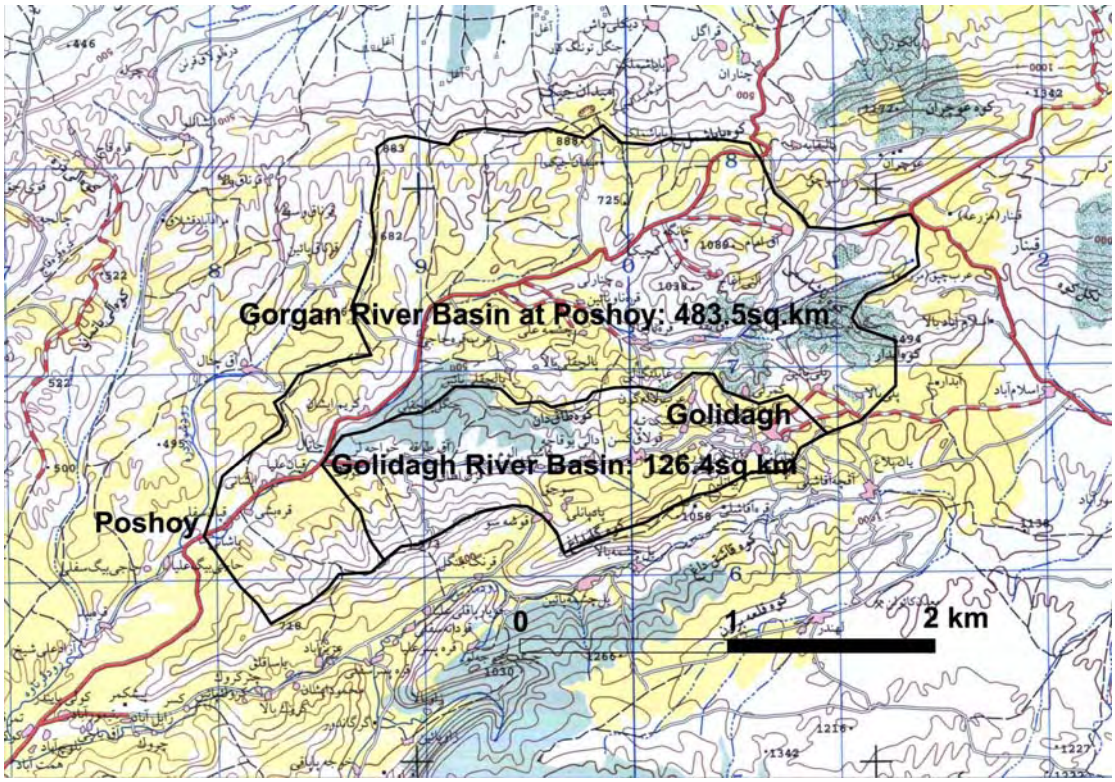


Fig. 8 Golidagh River Basin

- Two of earth dams in the Golidagh River Basin had suffered overflows during 2005-flood, but fortunately they still existed with downstream surface erosion.
- One of them had serious problem on piping through dam body from the upstream face to the downstream. The piping hole was 1 or 2 m in diameter.
- Possible causes of such a piping were as follows
- Wrong quality control on embankment, like dry material, less compaction, mixture of coarse material and so on.
- Hydraulic fracturing due to reduction of vertical force in dam body under arch action caused by angulation of foundation surface or it might suggest that soil material in this area was so fine and physically weak that piping in the dam showed limitation of dam height using this kind of soil for dam construction.
- Therefore, characteristics of soil on physical feature and compactablity for density and permeability should be closely studied.
- Restoration of the piping should be made with cut and replacement by adequate soil material with well compaction.
-

1. Flood area in Ghapon

2. Flood area in Poshoy

3. Flood refugees' camp in Poshoy provided by Red Crescendo & Golestan Government

4. One of dams; flood flew over the crest

5. Damaged by piping

6. Piping hole at upstream face

7. Piping hole at downstream face

Fig. 9 Golidaha River Basin in Golestan

3. LESSONS LEARNT

3.1 Slit Dam

- Interval between slits in slit dam should be determined taking into account size of driftwood to be trapped.
- Keep an enough flow capacity for the spillway providing the trapped driftwoods and debris had filled up the reservoir.
- Empty the reservoir behind slit dam immediately after driftwoods were trapped.
- Remove fallen trees from the riverbed that was the primary countermeasure against driftwoods hazard.
- Provide access road to the reservoir to collect trapped driftwoods.

3.2 Gabion Dam

- Avoid interlocking effect and arch action in design in case gabion dam was applied to narrow gorge; modify the angulations with excavation or replacement by concrete, limit the height or adopt concrete or wet masonry type.

3.3 Earth Dam

- No allow earth dam for flood to flow over the dam surface with enough capacity of the spillway; usually a design discharge for spillway of fill type dam was taken with 1.2 times of that of concrete type for safety.
- Revise the design discharge in case existing earth dam had experienced overflowing and improve the spillway capacity.
- Scrutinize the construction materials on their characteristics of compactiblity in both of laboratory level and site level.

3.4 Land Slide

- Drain works was one of the most fundamental methods for landslide prevention.
- Maintain the drain capacity.
- Provided integrating several countermeasures; cut off to reduce driving force of sliding, counter weight to increase resistant force, anchoring to tighten the sliding body increasing resistant force, and well to drain the groundwater reducing driving force of sliding.

3.5 Forecasting & Warning System

- Improve the existing flood forecasting and warning system.
- The Forecasting & Warning System proposed in the Study was applicable, useful method to mitigate flood damages for the Masuleh River Area and Golidagh Area.

3.6 River Engineering

- Take into account river engineering viewpoint to road and bridge design.
- Land use regulation was useful method as long as it was applied with a guideline provided based on river engineering practices.
- Data collection and hydrological analysis, especially with hourly rainfall, were required because that was fundamental information for river engineering; planning, design and construction works.