2.7 Flood Disaster

2.7.1 Flood Damage and Causes of Casualty

Caspian Sea region in northern part of the Islamic Republic of Iran includes provinces of Gillan, Mazandaran and Golestan, is subjected to frequent disasters of flood and debris flow. Madarsoo River basin is one of the disaster-prone basins in this region, which suffered huge damages as consequences of two big floods occurred in the years of 2001 and 2002. Some of these damages are tabulated below to reflect the severity of flood damages. It should be noted that the figures in this table indicate only physical/economic loses, but not deal with psychological and emotional stresses imposed on people by the floods.

Table 2.45 Flood Damage in 2001 and 2002

Type of Damage	Damage in 2001	Damage in 2002
Road demolished	194 km	182 km
Farms and orchards demolished	15,000 ha	400 ha
People wounded	200 people	5 people
People killed and missing	254 people	54 people
Livestock lost	6,000 heads	1,000 heads
Forest demolished	5,500 ha	-
Rangeland demolished	10,000 ha	10,000 ha
Vehicles destroyed	130 units	9 units
Residential/business building demolished	3,000 units	1,810 units
Telephone office demolished	7 units	5 units
Estimated Economic Damages	580 billion Rials	213 billion Rials

The historical floods always occurred in August, when it is summer tourism season in Iran, and numerous visitors and campers visit to the Golestan Forest Park along the mainstream of the Madarsoo. The floods and debris flow, suddenly occurred due to intensive downpour, had carried off lots of visitors and campers as well as residents in the villages along the Madarsoo River.

As presented in the following table, more than 70 % of casualties were visitors and campers in the Golestan Forest in the 2001 Flood. Similarly more than 80 % of casualties were the visitors and campers in the 2002 Flood. In contrast, although various infrastructures of roads, bridges and riverbank walls, which were rehabilitated or under rehabilitation, were completely destroyed in the 2005 Flood, there were no casualties. This might be a good learning effect by the government officials and residents living nearby the river course after the above-mentioned two floods. Before the flood coming, the visitors and campers were evacuated out of the Forest Park area, based on the weather forecast warned by the Met-Golestan Office.

Table 2.46 Causal Relationship of Flood Casualty

Cases of Casualty/Places	Casualties		
	2001 Flood	2002 Flood	2005 Flood
Rolling-down incident to the mainstream in Dasht village	26	-	-
Camping sites in the Golestan Forest	194	44	-
Debris avalanche in Terjenly village	3	-	-
Bank erosion in Loveh village	24	-	-
Rolling-down incident to the mainstream in the middle stretch	7	6	-
Others (workers for road rehabilitation)	-	4	-
Total	254	54	0

The above table implies the following useful information to deliberate upon the effective direction of the flood mitigation and management. These are facts experiencing in the 2001 Flood.

- 26 villagers had been evacuating from Dasht village along the river course by tractor, and rolled down to the turbulent floodwater of the mainstream. If some proper information on necessary action and appropriate evacuation route had been given to the villagers, the incident would not happened.
- Since narrow and steep gorge with 60 to 200 m wide is formed along the mainstream in the Golestan Forest, the visitors and campers cannot escape from the riverside to some safer places while the swollen floodwater passed in the Forest accompanying with upsurge of water level. They had no other choice of being washed out by the turbulent floodwater.
- Camping sites in the Golestan Forest were located on the previous debris flow deposits due to flat topography, so that the debris avalanche occurring in the mountain stream washed out the campers staying the sites.
- In Terjenly village, two children climbed a tree alongside a mountain stream for evacuation, and their mother ran after them. Finally the tree fell down into the debris flow with three people. This process also reveals the incident to be avoided if the necessary information was provided to the villagers beforehand.
- In Loveh village, turbulent floodwater eroded the riverbank where the residential houses were situated, and the villagers sleeping deeply died due to collapse of their houses into the floodwater.
- In contrast, in Beshoily village located 5 km upstream of Loveh village, some villager got a scent of impending danger due to approaching extraordinary sound like jet plain, and announced warning message to the villagers. Immediately after receiving his warning, all villagers evacuated to the backside mountain, and finally there were no casualties in the village although most of the residential houses were completely destroyed by the floodwater.
- A few residents in the middle reaches died in both floods in 2001 and 2002. They were farmers, shepherds and housewife who went to the riverside and incidentally rolled down into the turbulent floodwater. If some proper information on danger of floodwater had been given to the residents, these incidents would not happened.

These facts on causes of casualty imply that most of the casualties in the 2001 and 2002 Floods could be saved from their death if early warning and proper evacuation order were disseminated beforehand and knowledge building on disaster management had been made as a routine basis to the residents.

2.7.2 Causes of Flood Disaster

Regarding the causes of flood disaster in 2001, various discussions were made after the 2001 flood disaster. Major issues raised are deterioration of watershed and illegal or excessive logging in the mountainous areas. Through data collection and hydrological analysis, however, the major causes of 2001 flood disaster are clarified as 1) occurrence of historical heavy rainfall and 2) occurrence of debris flow in various mountain streams in parallel with large flood in the mainstream. These are briefly described below, using related data in both floods, 2001 and 2005.

Rainfall

Rainfall started on 10 August 2001, and reached to the peak on the next day, 11 August. Daily rainfall aggregated to 150 to 180 mm in the Golestan Forest Park as already presented in Fig. 2.46.

On the other hand, the 2005 Flood was the first flood that hourly rainfall could be observed in the Madarsoo River basin. After the 2001 Flood, Met-Golestan and MOE each installed online rainfall stations. Among four stations, Tangrah station, where most intensive rainfall always occurred, only recorded hourly rainfall. Another stations could not recorded hourly rainfall due to malfunctioning of recorder or data logger.

In the 2005 Flood, the peak of rainfall appears on 10 August, and daily rainfall aggregated to 100 to 130 mm centering on the Golestan Forest as already shown in Fig. 2.63. Tangrah station recorded hourly rainfall of 80 mm/hr so that it verified occurrence of intensive downpour in a short duration.

Furthermore statistical evaluation on the historical floods is presented in the previous sub-clause 2.6.5, and probable rainfall is tabulated in Table 2.39.

Flood Discharge

Flood hydrographs observed or estimated for the 2001 and 2005 Floods are discussed in the previous sub-clauses 2.6.2 and 2.6.3. Furthermore hydrological modeling is made as described in 2.6.8. Based on the simulation results, the peak discharges in both floods are illustrated in the following figure.

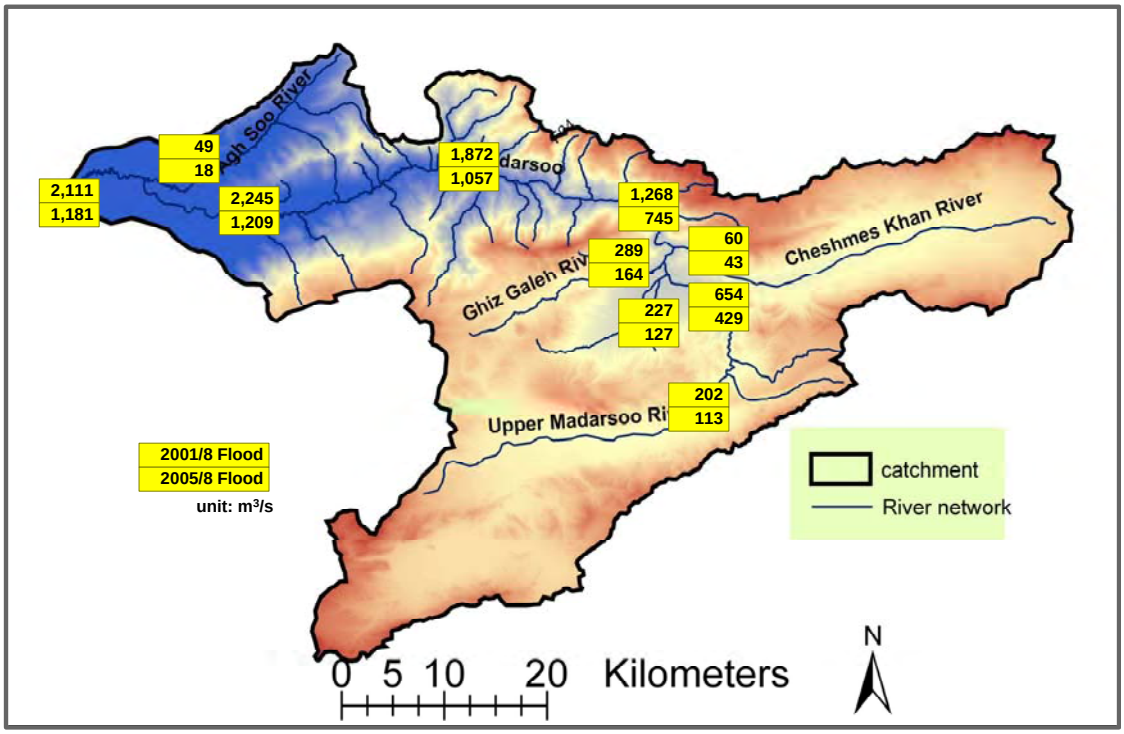


Fig. 2.82 Flood Peak Discharges in the 2001 and 2005 Floods from Hydrological Simulation

One of the major traces or scars of the 2001 Flood is a breached earth dam in the Ghiz Galeh River. As presented in the above figure, however, the large flood always came from the upper part of mainstream, the Gelman Darreh River. The simulation results reveal that the major cause of recent disasters was a large amount of floodflow rushing to the Golestan Forest Park from the upper reaches.

As increasing the floodwater through adding floodwater of the tributaries, flood peak discharge of 1,270 m^3/s rushed to the gorge of the Golestan Forest where the numerous visitors and campers took rest in August 2001. This fact was verified through interview survey to the village chief of Dasht and farmers cultivating in the lower part of the Gelman Darreh.

After arriving at the entrance of the Golestan Forest, the floodwater further increased its discharge through adding floodwater from mountain streams in the forest and middle reaches, and finally the peak discharge reached to 2,250 m^3/s in the Gorgan plain.

2.7.3 Sediment and River Morphologic Changes

Debris Avalanche

In the 2001 Flood, debris flow occurred in several mountain streams as shown in the following map. The figure shows that debris avalanche occurred in several mountain streams at the center of Tangrah where the most intensive rainfall core appeared in the 2001 Flood. Debris avalanche carried off lots of camper's lives, and increased energy of the floodwater in the sequential process of avalanche, damming-up of floodwater, collapse of the dam and occurrence of flood surge.

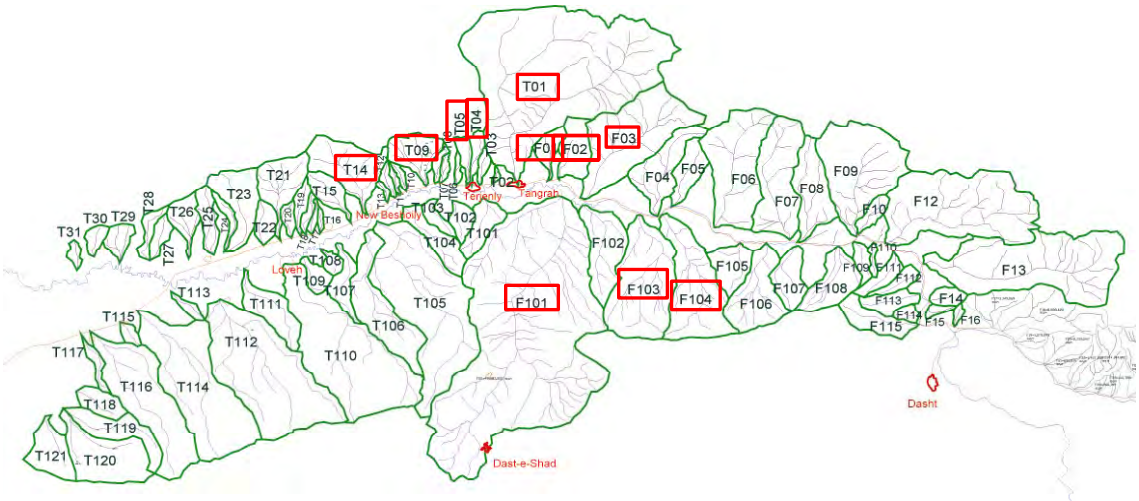


Fig. 2.83 Mountain Streams of Debris Flow Occurrence in the 2001 Flood in the Middle Reaches of the Madarsoo River Basin

Note: Red boxes indicate mountain streams in which debris flow occurred in the 2001 Flood.

Sediment Transport

Sediment transport in the mainstream in the 2001 Flood could be briefly described below, based on the field survey and hydrological simulation.

- Sediment transported from the upper part of the Madarsoo River was deposited around Dasht area due to flat topography and decrease of floodwater velocity. These were not only the sediment stored in the basin of the breached earth dam, but also the sediment transported from the Gelman Darreh and Dasht-e-Sheikh rivers. The trace of the deposits could be seen around the polder dike of Dasht village and in the farmland along the Gelman Darreh (See Fig. 2.84).
- After dispersing on the Dasht plain, floodwater converged at the outlet of Dasht plain, and strongly eroded right bank around the confluence with the Cheshmeh Khan River. Simultaneously sudden hydraulic change due to collapse of natural dam might cause valley-head erosion with some 5 m gap at the exit of Dasht village.
- After entering the Golestan Forest, floodwater alternated erosion and deposition in the river channel accompanying with washing out the trees beside the river course. According to DOE, the riparian forest of 500 ha (200 m wide and 25 km long) was washed out so that 35 thousand trees were lost in the 2001 Flood.

- Serious bank erosion occurred along the concave bank at bend and along the protruding edge of tributary's alluvial fan. In this area not only sediment but also trees were significantly washed out.
- Furthermore bank erosion also occurred at many bends downstream of the Golestan Forest. Floodwater flowed down toward the Golestan reservoir alternating erosion and deposition in the river channel.

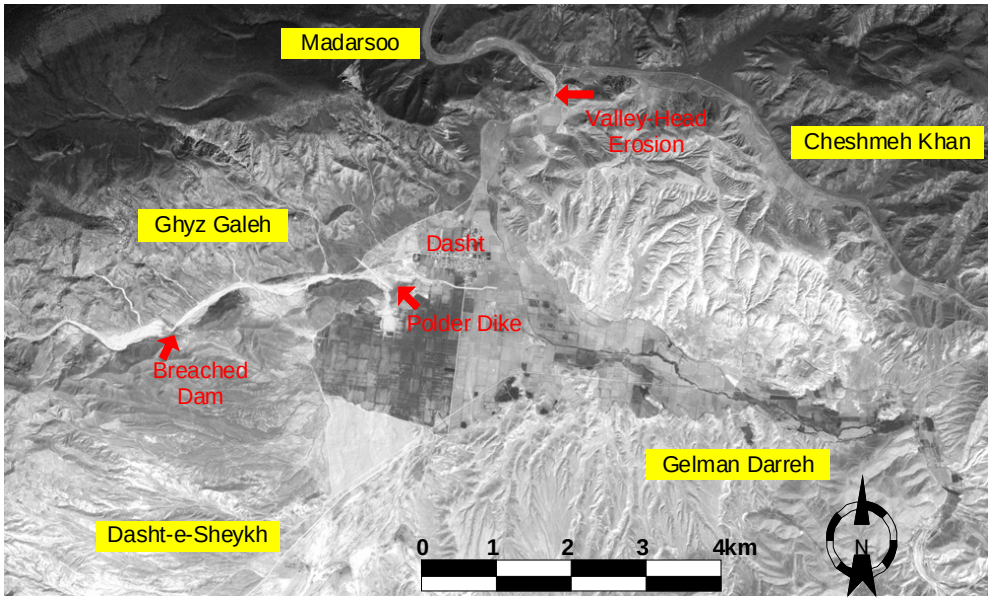


Fig. 2.84 Satellite Imagery around Dasht Village

The following figure shows historical changes of river cross-section at Tangrah station of MOE. Although the elevation of data is not so reliable, it is clearly understood that the 2001 Flood significantly widened river channel. The river channel changed from 20 m wide before 2001, to 100 m wide after the flood.

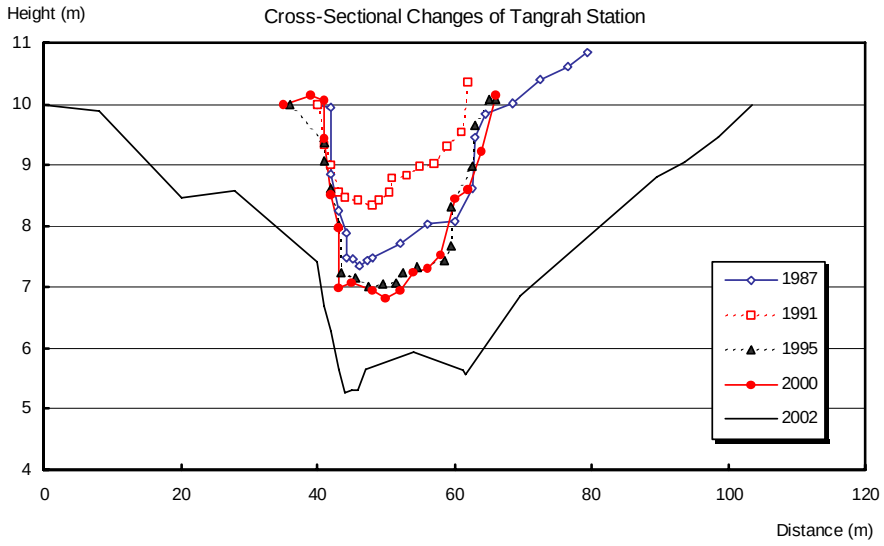


Fig. 2.85 River Cross-sectional Changes at Tangrah Station

2.8 Urgent Restoration Projects after the 2001 and 2002 Floods and Future Improvement Program

2.8.1 Summary on Damages of Infrastructure

Many kinds of infrastructure in the Madarsoo River basin have been devastated caused by the two times huge flooding in 2001 and 2002. Its main damages in view of river engineering are itemized as follows.

(1) Loss and collapse of roads and bridges

(2) Bank erosion along the river courses

(3) Debris deposition in farmlands, villages and roads

(4) Breach of five existing dams in the Ghiz Galeh and the Dasht-e-Sheikh rivers

2.8.2 Required Countermeasures of Governmental Organizations

The plan and implementation of projects for restoration of damaged infrastructure and prevention of recurrence have been conducted by the governmental organizations concerned from the huge flood damages occurrence. Mainly three (3) governmental organizations, which are Ministry of Jihad-e-Agriculture, Ministry of Energy and Ministry of Road & Transportation (hereinafter referred to as MOJA, MOE and MORT, respectively), have coordinated with the said projects in accordance with their jurisdictions.

The projects of MOE and MORT have been mainly aimed for rehabilitation of the damaged infrastructures and restoration of the least original function while that of MOJA for mitigation of damages in recurrence.

The principle of the jurisdiction of the projects is:

(1) MOJA is responsible for flood, erosion and debris/sediment control in watershed management;

(2) MOE is responsible for flood and erosion control in river improvement; and

(3) MORT is responsible for restoration of damaged roads and bridges.

Implementation of the projects has been carried out by the organization of the province, which the location of the project belonged to, except for some MOJA projects.

2.8.3 MOJA Urgent Projects

MOJA has a conceptual master plan on the Golestan Dam basin including the Madarsoo River basin according to the principle based on the general policy, which follows the third National Five-Year Plan. Scope of the master plan consists of the followings as watershed management in the Golestan Dam basin.

(1) To preserve/restore natural condition

(2) To promote sustainable development on social-economical activity

(3) To protect natural environment and human activities from water-related destruction

(4) To reduce and control flood peak discharge

Based on the said master plan, MOJA has determined to implement the urgent projects to reduce physical damages caused by the probable flood and debris flow in five (5) sub-basins of the Madarsoo River basin.

Those projects aim to 1) to reduce the probable flood peak discharge with the water storage function of the proposed countermeasures, 2) to accelerate the infiltration of flooding water stored by the proposed countermeasures and 3) to control the erosion in the hillsides with the proposed countermeasures.

The urgent projects have been formulated concretely in 2002 after the 2001 Flood and a part of its implementation has been completed as of September 2005.

The overall location map of those projects in the Madarsoo River basin is shown in Fig. 2.86.

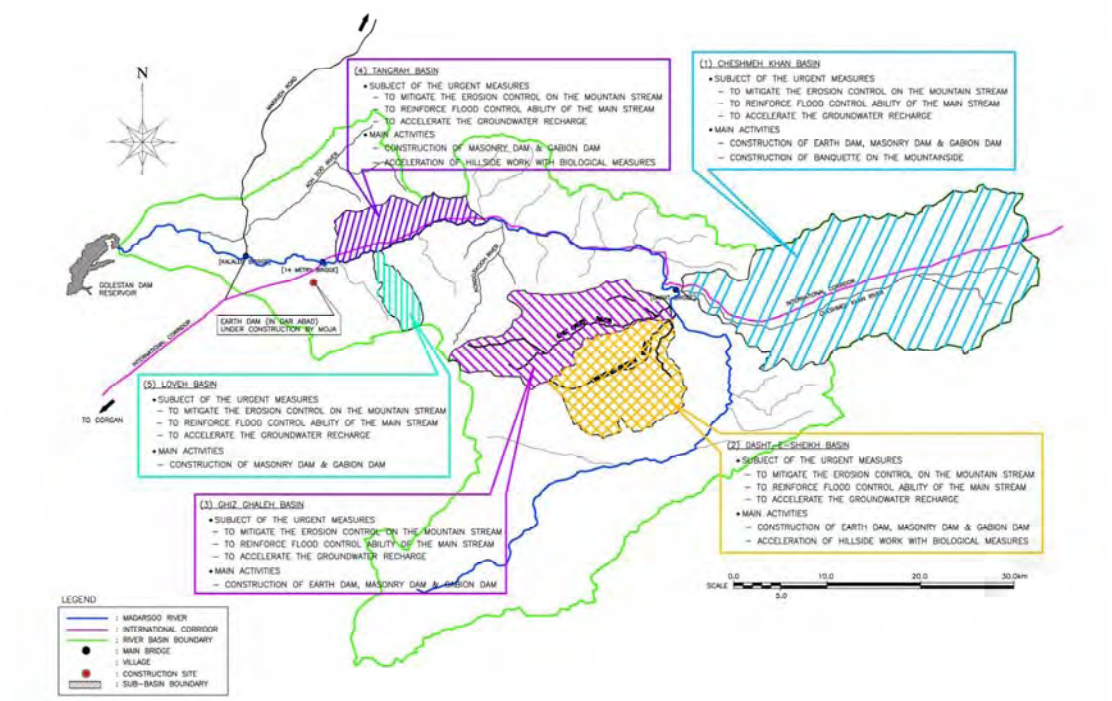


Fig. 2.86 Location of the Overall Urgent Measures Proposed by MOJA

The project features in the urgent projects are described as follows.

(1) Cheshmeh Khan Sub-Basin

This sub-basin has a catchment area of 452 km^2 and the Cheshmeh Khan River runs from west to east side in the muddle of this sub-basin. This project is planned to implement for prevention of existing farmlands from sediment deposition caused by floods and erosion in the hillsides.

The project objective and main structural measures are mentioned as follows.

Project Objectives

- To mitigate the erosion control in the mountain streams
- To reinforce flood control ability of the mainstream

Major Activities

- Construction of earth dams, a series of masonry or gabion dams
- Execution of hillside works with biological measures such as changing dry farming, fertilizing and seeding in rangeland, mass seeding and planting trees in the forest area

Further, MOJA will expect this project to accelerate the groundwater recharge for the irrigated farmlands and to reduce the flood peak discharge with the proposed earth dams.

The project features are tabulated in Table 2.47.

Table 2.47 Project Features for Cheshmeh Khan Sub-Basin

Countermeasures	Quantity	Implementation Schedule	Estimated Cost (Million Rials)
Earth Dam	5 nos.	N/A	N/A
Masonry Dam	21 nos.	2 years	383.8
Gabion Dam	36 nos.	2 years	324.8
Banquetting	145 ha	2 years	45.3
Mass Seeding	2,939 ha	8 years	882.4
Planting	2,630 ha	7 years	2,439.0
Total			4,075.3

Source: MOJA Golestan Office

(2) Dasht-e-Sheikh Sub-Basin

This sub-basin has a catchment area of 125 km^2. The Dasht-e-Sheikh River runs from southeast to northwest side in the muddle of this sub-basin and the downstream end of this river meets the Gelman Darreh River nearby the Dasht village. This project is planned to implement the prevention of existing farmlands from sediment deposition and erosion in the hillsides.

The project objective and main structural measures are mentioned as follows.

Project Objectives

- To mitigate the erosion control on the mountain stream
- To reinforce flood control ability of the main stream

Main Activities

- Construction of earth dams, a series of masonry or gabion dams
- Acceleration of hillside works with biological measures such as changing dry farming, fertilizing and seeding in rangeland, mass seeding and planting trees in the forest area

Further, this project is expected to accelerate the groundwater recharge for the irrigated farmlands, to promote the biological measures, which are like fertilizing, tree planting, seeding and terracing, and to reduce the flood peak discharge by MOJA.

The project features are shown as follows.

Table 2.48 Project Features for Dasht-e-Sheikh Sub-Basin

Countermeasures	Quantity	Implementation Schedule	Estimated Cost (Million Rials)
Earth Dam	7 nos.	1 year	4,514.1
Masonry Dam	35 nos.	6 years	6,944.0
Gabion Dam	36 nos.	1 year	789.3
Terracing	120 ha	5 years	3,373.1
Banquetting	1,740 ha	5 years	1,305.0
Furrow	2,850 ha	6 years	712.5
Changing dry farming	140 ha	5 years	2,824.0
Fertilizing in rangeland	6,000 ha	8 years	541.4
Seeding in rangeland	4,200 ha	6 years	655.2
Mass Seeding	240 ha	3 years	72.0
Planting (Forest)		6 years	6,078.2
Supporting of drinking water for seep	32 nos.	4 years	160.0
Total			27,968.8

Source: MOJA Golestan Office

The arrangement of structural measures including dam construction and farmland improvement is shown in Fig. 2.87. This arrangement map is obtained from the Watershed Management Division of MOJA-Golestan Office.

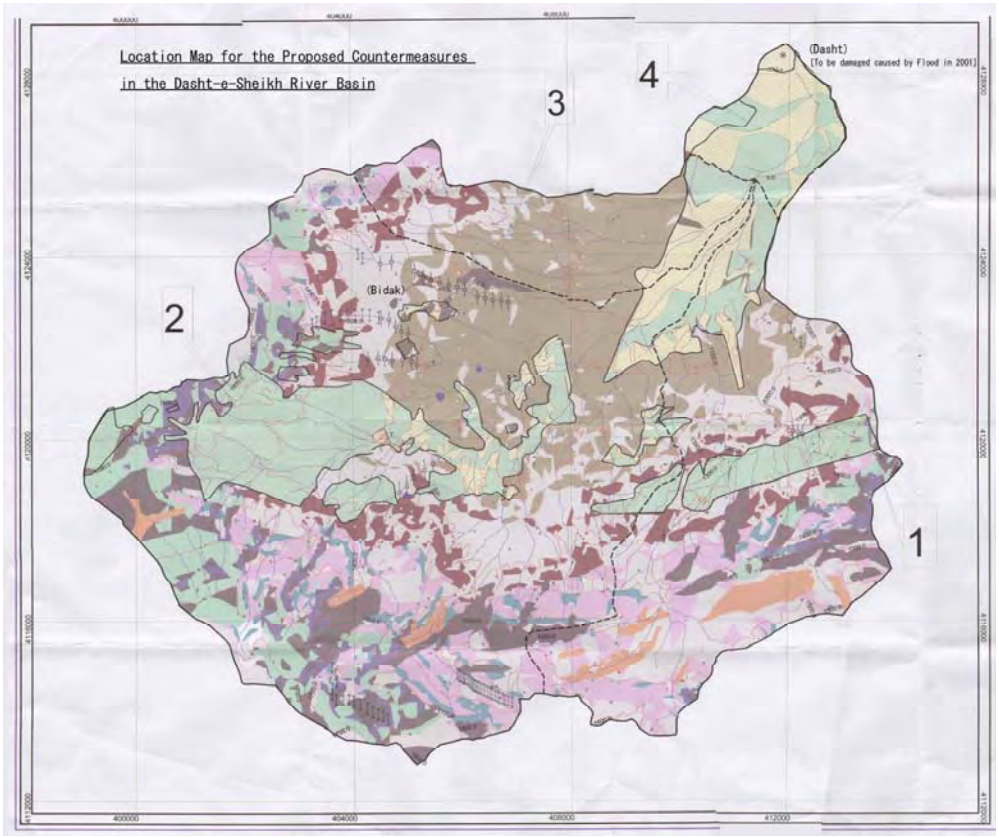


Fig. 2.87 Urgent Measures in the Dasht-e-Sheikh Sub-Basin

(3) Ghiz Galeh Sub-Basin

This sub-basin has a catchment area of 126 km^2. The Ghyz Ghaleh River runs from east to west side in the muddle of this sub-basin and the downstream end of this river meets the Madarsoo River nearby the Dasht village.

This project is planned to implement the prevention of existing farmlands from sediment deposition caused by floods and erosion in the hillsides.

The project objectives and major structural measures are mentioned below.

Project Objectives

- To mitigate the erosion control on the mountain streams
- To reinforce flood control ability of the mainstream

Major Activities

- Construction of earth dams, a series of masonry or gabion dams
- Execution of hillside works with biological measures such as changing dry farming, fertilizing and seeding in rangeland, mass seeding and planting trees in the forest area

Further, this project is expected to accelerate the groundwater recharge for the irrigated farmlands and to reduce the flood peak discharge by MOJA.

In addition, a part of the northern riverbank of the Ghyz Ghaleh River is corresponding with the boundary for the Golestan National Park (hereinafter referred to as G.N.P). Therefore, this project also has the essential objective for the environmental conservation to G.N.P.

The project features are tabulated in Table 2.49.

Table 2.49 Project Features for Ghyz Ghaleh Sub-Basin

Countermeasures	Quantity	Implementation Schedule	Estimated Cost (Million Rials)
Earth Dam	18 nos.	N/A	N/A
Masonry Dam	49 nos.	3 years	11,134.0
Gabion Dam	25 nos.	2 years	546.2
Terracing	125 ha	5 years	3,013.3
Banquetting	180 ha	5 years	135.0
Changing dry farming	500 ha	5 years	10,000.0
Fertilizing in rangeland	2,700 ha	4 years	243.7
Seeding in rangeland	2,700 ha	4 years	421.4
Mass seeding	70 ha	2 years	21.0
Supporting of drinking water for seep	9 nos.	2 years	45.0
Miscellaneous			1,142.5
Total			26,702.1

Source: MOJA Golestan Office

The arrangement of structural measures including the dam construction and farmland improvement is shown in Fig. 2.88. This arrangement map is obtained from the Watershed Management Division of MOJA- Golestan Office.

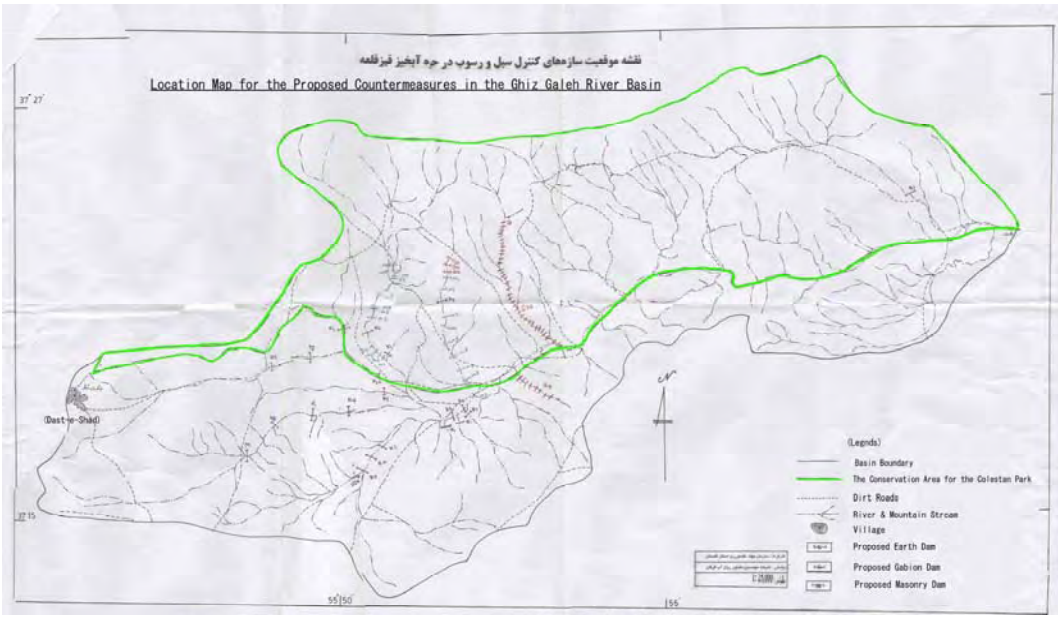


Fig. 2.88 Urgent Measures in the Ghyz Ghaleh Sub-Basin

(4) Tangrah Sub-Basin

The Tangrarh sub-basin has a catchment area of 362 km^2. This proposed plan is limited to implement in a part of the sub-basin, which is located in the northern part of the Madarsoo River. The debris flow caused by 2001 Flood had damaged the

Terjenly village directly and several residential houses have been broken and/or buried by the debris flow.

This project is planned to implement the prevention of existing farmlands from sediment deposition and erosion in the hillsides.

Project Objectives

- To mitigate the erosion control in the mountain streams
- To reinforce flood control ability of the mainstream

Main Activities

- Construction of a series of masonry or gabion dams
- Construction of new waterway in the Terjenly village to protect the human life and properties from flood flow discharging into the Madarsoo River
- Execution of hillside works with biological measures such as changing dry farming, fertilizing and seeding in rangeland, mass seeding and planting tree in the forest area

Further, this project is expected to accelerate the groundwater recharge for the irrigated farmlands, to promote the biological measures, which are like fertilizing, tree planting, seeding and terracing, and to reduce the flood peak discharge by MOJA.

The project features are shown as follows.

Table 2.50 Project Features for Tangrah Sub-Basin

Countermeasures	Quantity	Implementation Schedule	Estimated Cost (Million Rials)
Masonry Dam	9 nos.	1 year	1,641.9
Gabion Dam	42 nos.	1 year	672.8
Channel Works	900 m	1 year	5,000.0
Terracing	200 ha	8 years	5,620.0
Banquetting	1,740 ha	5 years	1,170.0
Furrow	2,650 ha	6 years	712.5
Mass Seeding	180 ha	7 years	51.0
Planting	180 ha	1 year	750.0
Tending Forest	767 ha	5 years	767.0
Cleaning Forest	42 ha	5 years	16.8
Seeding Forest	35 ha	1 year	17.5
Planting Forest	150 ha	1 year	375.0
Miscellaneous			1,134.1
Total			17,928.6

Source: MOJA Golestan Office

In addition to the channel works in the above table, the proposed channel works is located in Terjenly village and the waterway, which is connected with the Madarsoo River, will be designed to prevent the flood and/or debris flow from spreading over the conservation area.

The arrangement of structural measures including the dam construction and farmland improvement is shown in Fig. 2.89. This arrangement map is obtained from the Watershed Management Division of MOJA- Golestan Office.

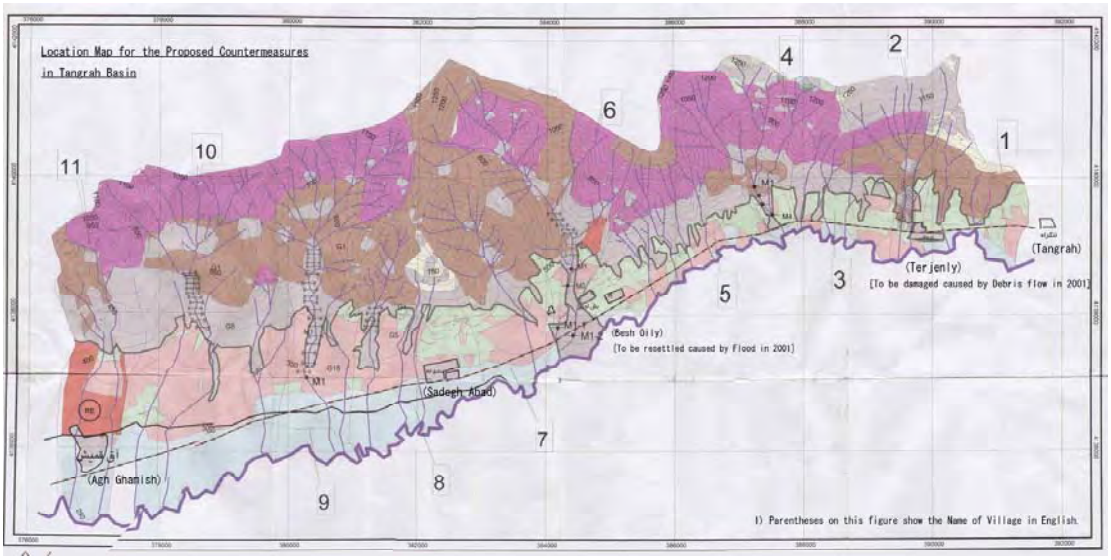


Fig. 2.89 Urgent Measures in the Tangrah Sub-Basin

(5) Loveh Sub-Basin

This project is planned to implement the prevention of existing farmlands from sediment deposition caused by floods and erosion in the hillsides. Further, this project is expected to accelerate the groundwater recharge for the irrigated farmlands and to reduce the flood peak discharge.

The project features are tabulated in Table 2.51.

Table 2.51 Project Features for Loveh Sub-Basin

Countermeasures	Quantity	Implementation Schedule	Estimated Cost (Million Rials)
Masonry Dam	6 nos.	One year	816.0
Gabion Dam	21 nos.	One year	236.0
Total			1,052.0

Source: MOJA Golestan

The arrangement of structural measures including dam construction and farmland improvement is shown in the following figure. This arrangement map is obtained from the Watershed Management Division of MOJA- Golestan Office.

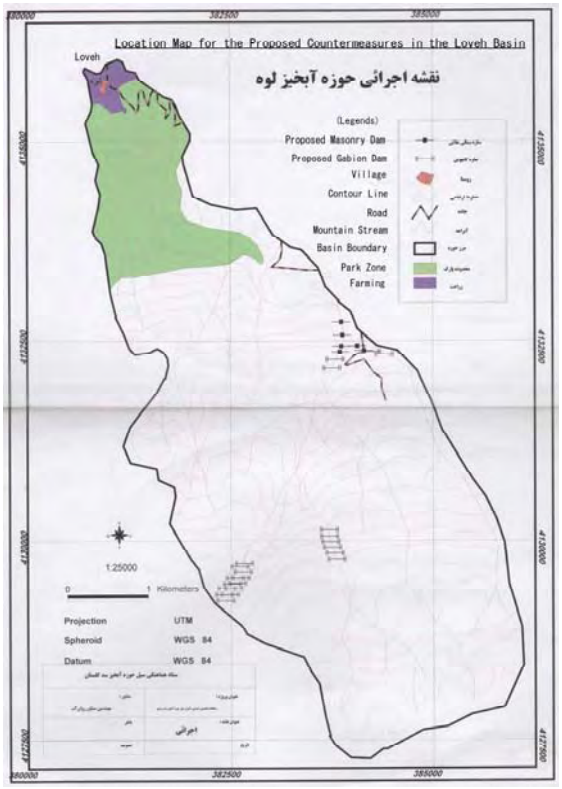


Fig. 2.90 Urgent Measures in the Loveh Sub-Basin

2.8.4 MOE Urgent Projects

MOE has conducted the river improvement plan with the Urgent Measures in the Madarsoo River basin since the flood occurrence in 2001 because the roads, bridges and river banks along the river course has been seriously damaged. The river improvement stretch proposed by MOE is approximately 65 km from Kalaleh Bridge to Dasht Bridge along the river. The design discharge in the plan is ranged between 250 m^3/s of the upstream (nearby Golestan National Park) and 400 m^3/s of the downstream (nearby the Kalaleh Bridge) in accordance with a 50-year return period.

In order to protect the essential infrastructures along the Madarsoo River from the further probable flood damages, MOE has determined to implement the river urgent improvements of the nine locations. The improvement plans include the protection of the existing road system against flood and/or debris flow in association with MORT as well as river widening to accommodate the probable flood.

In addition, MOE has simultaneously conducted to formulate the Master Plan in accordance with a 100-year return period over the Golestan Dam Basin. However, as of January 2005, the Master Plan has not been finalized yet due to the continuation of the study by MOE staff.

Unfortunately, the flood has been occurred in August 2005. The flood seriously damaged the riverbank protections, which are composed of the MOE urgent measures, along the Madarsoo River. Consequently, MOE Golestan Office is carrying out the overall review for the Master Plan and urgent measures in terms of hydraulic conditions, riparian structures strengthening and structural arrangements.

The following information is described for the urgent measures undertaken by MOE before the 2005 Flood occurrence.

Fig. 2.91 shows the location of the respective scheme conducted by MOE and the said features are tabulated below.

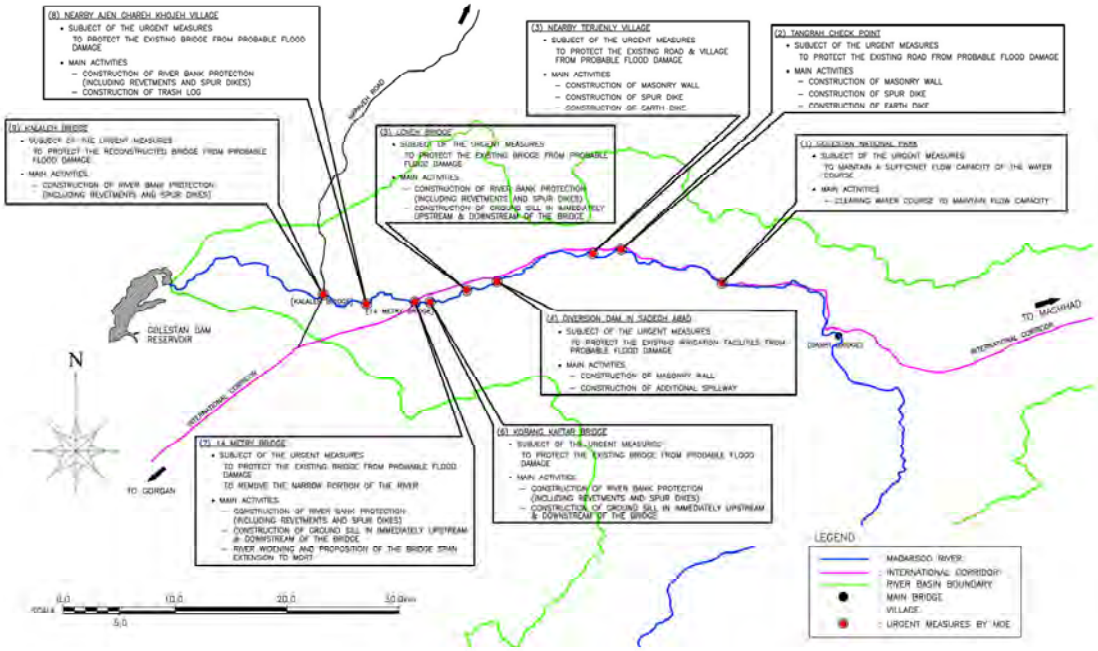


Fig. 2.91 Location of the Urgent Measures Proposed by MOE

Location	Features of the Proposed Structures		Current Status (As of Jan. 2005)
	Structural Type	Work Volume	
(1) Golestan National Park	Riverbed Clearing		To be reviewed caused by the damage of August 2005 Flood

The subject is to maintain the existing watercourse.

Location	Features of the Proposed Structures		Current Status (As of Jan. 2005)
	Structural Type	Work Volume	
(2) Tangrah Check Point (Right Bank)	Masonry Wall	L=700m, H=3.5 to 4.0m	To be reviewed caused by the damage of August 2005 Flood
	Groin (Riprap type)	L=10m, 69nos.@10m	
	Earth Dike with/without slope protection	Slope Gradient =1:2.0 Dike Crest Width =4.0m	

The subject is to protect the existing roads from probable flood.

Location	Features of the Proposed Structures		Current Status (As of Jan. 2005)
	Structural Type	Work Volume	
(3) Terjenly (Right Bank)	Masonry Wall	L=400m, H=3.5 to 5.5m	To be reviewed caused by the damage of August 2005 Flood
	Groin (Riprap type)	L=10m, 69nos.@10m	
	Earth Dike with/without slope protection	L=550m Slope Gradient =1:2.0 Dike Crest Width =4.0m	

The subject is to protect the existing roads and village properties from probable flood.

Location	Features of the Proposed Structures		Current Status (As of Jan. 2005)
	Structural Type	Work Volume	
(4) Diversion Dam in Sadegh Abad	Masonry Wall (Right Side)		To be reviewed caused by the damage of August 2005 Flood
	Diversion Weir (Addition to existing weir)	L=20m, W=60m, h=2m (Gabion Mattress type= 1.0mX1.0mX2.0m)	

The subject is to protect the existing irrigation facilities from probable flood.

Location	Features of the Proposed Structures		Current Status (As of Jan. 2005)
	Structural Type	Work Volume	
(5) Loveh Bridge	Masonry Wall		To be reviewed caused by the damage of August 2005 Flood
	Groin (Riprap type)		
	Earth Dike with/without slope protection	L=600m Slope Gradient =1:2.0 Dike Crest Width =4.0m	
	Ground Sill	H=2.0m	

The subject is to protect the existing bridges from probable flood.

Location	Features of the Proposed Structures		Current Status (As of Jan. 2005)
	Structural Type	Work Volume	
(6) Korang Kaftar Bridge	Groin (Riprap type)		To be reviewed caused by the damage of August 2005 Flood
	Earth Dike with/without slope protection	Slope Gradient =1:2.0 Dike Crest Width =4.0m	
	Ground Sill	H=2.0m	

The subject is to protect the existing bridge from probable flood.

Location	Features of the Proposed Structures		Current Status (As of Jan. 2005)
	Structural Type	Work Volume	
(7) 14 Metry Bridge	Masonry Pitching	L=650m, Slope Gradient = 1:2.0 Dike Crest Width =4.0m	To be reviewed caused by the damage of August 2005 Flood
	Masonry Wall		
	Ground Sill	H=2.0m	

The subject is to protect the existing bridge from probable flood and to remove the narrow portion of the river.

Location	Features of the Proposed Structures		Current Status (As of Jan. 2005)
	Structural Type	Work Volume	
(8) Ajen Ghareh Khojeh	Earth Dike with/without slope protection (Right Bank)	L=1,200m Slope Gradient =1:2.0 Dike Crest Width =4.0m	To be reviewed caused by the damage of August 2005 Flood
	Groin (Riprap type)		
	Masonry Wall (Left Bank)	L=250m	
	Trash Log	1 nos.	

The subject is to protect the existing bridge from probable flood.

Location	Features of the Proposed Structures		Current Status (As of Jan. 2005)
	Structural Type	Work Volume	
(9) Kalaleh Bridge	Masonry Wall		To be reviewed caused by the damage of August 2005 Flood
	Groin (Riprap type)		

The subject is to protect the reconstructed bridge and natural levee in the bending portion of the watercourse from probable flood.

2.9 Road Network Improvement

2.9.1 Current Status of Road Network in Golestan Province

Since the 1990s, the traffic density in this province increased year by year as well as the evolution of motorization. Before 1998 Golestan Province had a poor road network with 2-lane way and the traffic density much exceeded the capacity of this road network.

Therefore National Road Improvement Program was started by widening the roads and bridges to extend the highway network such as Sari-Gorgan Highway and Gorgan-Ali Abad Highway in 1998.

Fig. 2.92 shows current status of the road network. In this Figure, all highlighted highway was constructed in recent 5 years.

Fig. 2.92 Current Status of Road Network in Golestan Province (2004)

Table 2.52 Road Classification

Class	No. of Lane	Width
Highway	4 lanes	21.6–25.6 m
Main Road	2 lanes	about 11 m
Sub-main Road	2 lanes	7–8 m
Boundary Road	2 lanes	6.5 m

<u>On-going Road Project in Golestan Province</u>

Following the above-mentioned completed highway project (widening), National Road Improvement Project is continuously conducted in the stretches between Gorgan and Ali Abad, etc. as shown in Fig. 2.93.

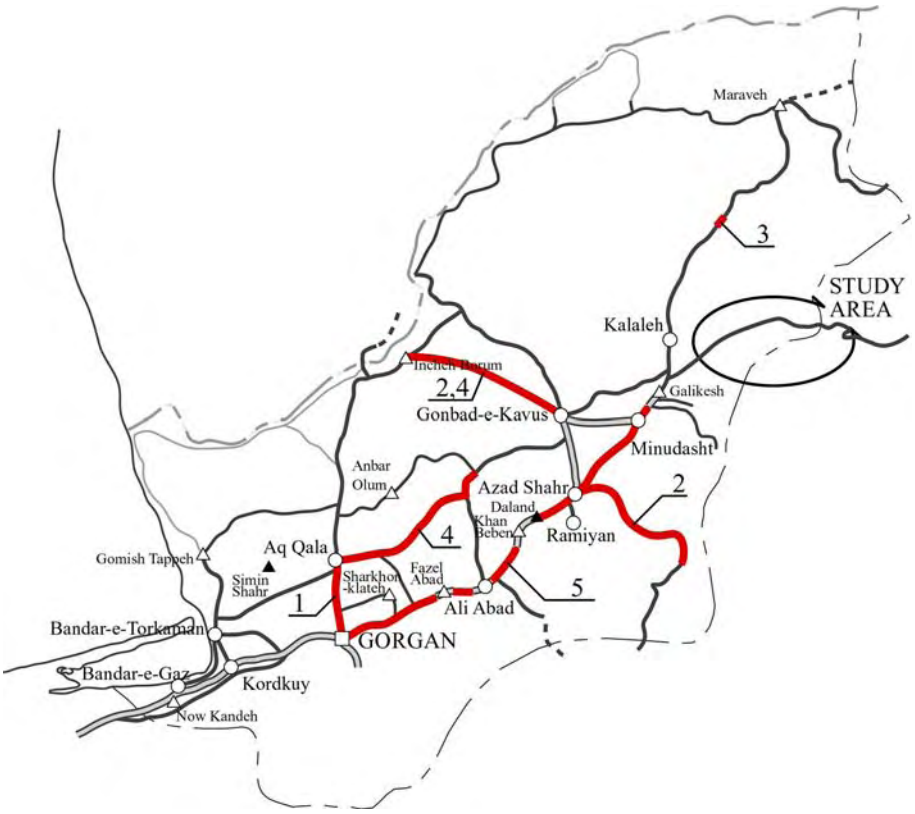


Fig. 2.93 On-going Road Projects in Golestan Province (2004–2005)

(1) Road Improvement Project (Gorgan - Aq Qala)

(2) Road Improvement Project (Azad Shahr – Khosh Yeylagh, Inche Borun – Gonbad)

(3) Goggeh Bridge Reconstruction Project

(4) Intersection Improvement (Aq Qala – Imer, Inche Borun - Gonbad)

(5) Highway Network Project (Gorgan – Aliabad – Azad Shahr – Minudasht - Galikesh)

The Highway Network Project (Gorgan–Aliabad–Azad Shahr–Minudasht-Galikesh) has been almost completed in March 2005.

Extension of Highway Network

In addition to the above-mentioned process, MORT formulated the Master Plan to widen the existing main road in the Madarsoo River basin (Galikesh–Kallaleh Junction–Tangrah–Golestan Park–Golestan Tunnel).

This was an extension of the Highway Network Project. The final target was to connect Gorgan, Golestan Provincial Capital City, with Mashad, Khorasan Provincial Capital City in 4-lane road for regional development and traffic demands. However, the existed road was much damaged by the consecutive floods, in 2001 and 2002.

After the floods MORT constructed temporary road in the Golestan Park, while MORT, MOE, DOE, MPO and the relevant governmental agencies discussed on reconstruction plan of road in the Golestan Park. Then through the discussion an agreement was made in January 2005. The agreement includes the following points.

(1) Road reconstruction in the Golestan Park must be completed within a couple of years to reduce any losses in connection with traffic safety and traffic limitation and also the environmental damages which are given by reconstruction activities must be minimized.

(2) Highway between Golestan Province and North-Khorasan Province must be constructed in the north side of the Golestan Park, to pass Kalaleh, Golidagh and Ashkhane, not inside of the Golestan Park. MORT shall conduct the feasibility study on the mentioned highway project and implement this construction by widening the existing road after completion of the study.

(3) Road inside of the Golestan Park shall be reconstructed as a park road for natural habitats, tourists, campers and regional capacities.

(4) Hydrological and hydraulic study for flood control and the feasibility study on river control project in the Madarsoo River must be completed at same time of road reconstruction.

The highway passing Kalaleh, Golidagh and Ashkhane, mentioned in the agreement, is shown as Plan-3 in Fig. 2.94. This route is mostly located along the existing rural road (about 8 m wide).

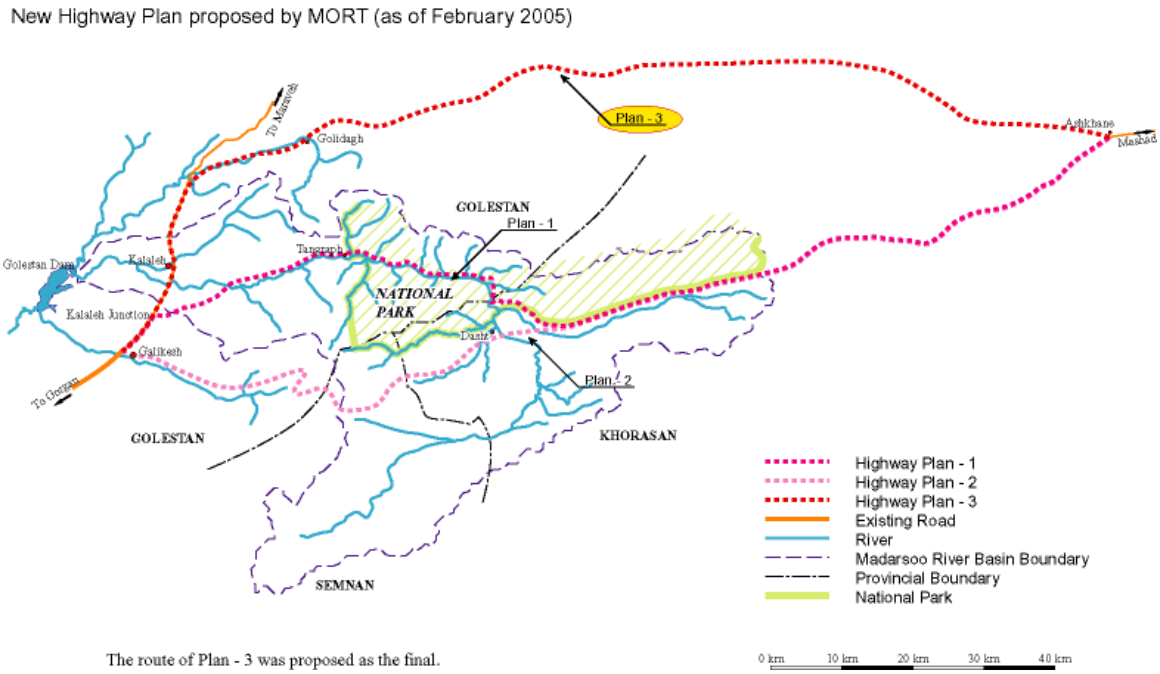


Fig. 2.94 New Highway Plan proposed by MORT (Feb. 2005)

Other Issues on Road and Bridge Management in Golestan Province

MORT provincial unit stresses that the road in the Madarsoo River basin needs urgent improvement project. They reported many critical points, which need urgent improvement projects.

As the result of consideration on the current flood condition, the numerous constructed bridges should be replaced with the longer spanned bridges, and the road embankments along rivers should be reinforced.

They also pointed that one of reasons is speed and volume of the natural stream increased by the development and the forest-degradation on the northern slope of the Elborz Mountains.

2.9.2 Accomplished MORT Urgent Projects

MORT Golestan provincial unit conducted and completed the construction of a temporary road in the Golestan Park and road reconstruction in 2002 and 2003 as the urgent project in

order to restore the connection between cities and rural communities in the northern part of Golestan Province and Khorasan Province.

The connection, or the road between Kalaleh Junction and Golestan Tunnel, which was constructed in the 1960s passing the Madarsoo River Basin with about 75 km long, was destroyed by the huge flood occurrence in 2001 and 2002.

At the time of the 2001 Flood, MORT Golestan provincial unit had immediately conducted the construction of emergency temporary road with cooperation of the other MORT provincial units; Tehran, Mazandaran, Gilan, Esfahan, Kordestan, Kermanshah, Birjand, Zanjan, Hamedan and so on.

Then MORT Golestan provincial unit conducted the construction of temporary road after the 2002 Flood as the above-mentioned.

Urgent projects accomplished after the 2002 Flood are listed below.

(1) Goggeh bridge reconstruction (16 m spanned bridge/Kalaleh-Maraveh)

(2) Kouseh bridge reconstruction (4x20 m spanned bridge/entrance of Kalaleh)

(3) Revetment work in Tergenly village (250 m length/Kalaleh Junction-Tangrah)

(4) Road reconstruction

(4)-a: Approach road of 14-Metry bridge

(4)-b: Road in front of Tergenly village

(4)-c: Road inside the Golestan Forest Park

(5) Construction of submerged bridges (18 bridges in and out of the Madarsoo River basin)

(6) River treatment and excavation work (200,000 m^3/Madarsoo River)

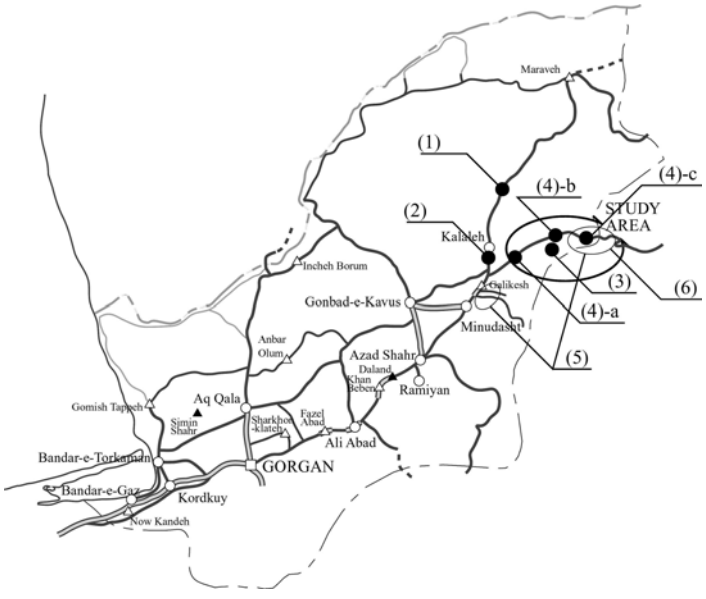


Fig. 2.95 Location of MORT Urgent Projects

2.9.3 Current Status of Road and Bridges between Golestan Dam and Tangrah

There are 7 bridges crossing Madarsoo River in the section between Golestan Dam and Tangraph as shown in Table 2.53 and Fig. 2.96. This information is based on the situation before the 2005 Flood, in July 2005.

Table 2.53 Existing Bridges between Golestan Dam and Tangrah

No	Name	Width (m)	Length (m)	Span (m)	Use	Description
1	Kalaleh Bridge	9 (18)	84	20	Main road	This bridge was existed with shorter length before the 2001 Flood, but it was washed away. Then it was reconstructed in 2003 and 2004, as shown in Fig. 2.96. However this bridge doesn't have enough flow capacity. MORT is planning to widen this bridge with 4-lane road.
2	unknown	5	45	11	Agricultural road	This has a structural style like a submerged bridge.
3	14-Metry Bridge	9	14	12.5	Main road	Approach embankment was damaged in the 2001 Flood, because this bridge has a poor flow capacity. This should be improved as soon as possible with enough flow capacity.
4	unknown	8	30	30	Agricultural road	This bridge functioned as a submerged bridge.
5	Loveh	8	28 + about 20 m	28	Agricultural road/ entrance of village	Existed bridge was washed away in the 2001 Flood, and it was reconstructed as shown in Fig. 2.96 with 28 m long steel bridge and about 20 m long spillway.
6	unknown	5	16	8	Agricultural road / entrance of village	This has a structural style like a submerged bridge.
7	unknown	8	10	10	Agricultural road	This has a structural style like a submerged bridge.

( ) is future plan

In these seven bridges, Kalaleh bridge, 14-Metry bridge and Loveh bridge were seriously damaged by the 2001 Flood, such as collapse and washed away. Although other bridges also were affected, damages were still limited and they remained.

The difference between the former three bridges and latter bridges is that the three bridges were significant obstacles against strong flood flow but other bridges were not significant, because these had structural styles such as a submerged type.

Bridge No.1 (Kalaleh bridge)

Bridge No.2

Bridge No.3 (14 Metry bridge)

Bridge No.4

Bridge No.5

Bridge No.6

Bridge No.7

Fig. 2.96 Satellite Imagery of Existing Bridges

Kalaleh bridge was reconstructed in 2003 as shown in Fig. 2.97. Its flow capacity might be about 1,400–1,800 m^3/s. According to hydraulic model simulation, about 2,200 m^3/s of peak discharge is estimated in the 2001 Flood. This bridge doesn't have enough flow capacity yet for it.

Furthermore, sharp river bend near the bridge is shown in Fig. 2.96, and embankment around bridge is not protected. Therefore, this bridge will be affected again if large flood such as the 2001 flood occurs.

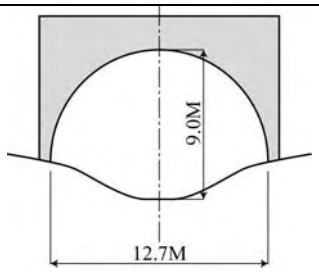
This road belongs to class “main road” and is one of the most important lifelines in this region, so that the bridge should be reconstructed with enough flow capacity. River channel should be improved with smooth line and embankment protection.

Fig. 2.97 Reconstructed Kalaleh Bridge (L=84 m) (Bridge No.1)

14 Metry bridge

Left Photo shows the existing 14 Metry bridge. This was not lost at the time of the floods. But approach road of this bridge was eroded and washed away. Generally the structural weakest point is damaged when the flood hits road and bridges.
At the time of the 2001 Flood, the weakest point, approach bank, was damaged. If this bridge had enough flow capacity, approach bank would be saved.

Right figure shows rough sketch of 14 Metry bridge and that the opening area of the bridge has about 60 m^2.
If flow velocity is 4 m/s, the flow capacity of the bridge is only 240 m^3/s.
At the time of the 2001 Flood, it is reported that the maximum water discharge was about 2,200 m^3/s in this section of the Madarsoo River.



Flow area of 14 Metry bridge

Fig. 2.98 Current Situation of 14 Metry Bridge (Bridge No.3)

Since the bridge did not have an enough flow capacity, the water level increased more than the road level, and the floodwater overtopped the road or bridge with strong current in the 2001 Flood as illustrated in Fig. 2.99.

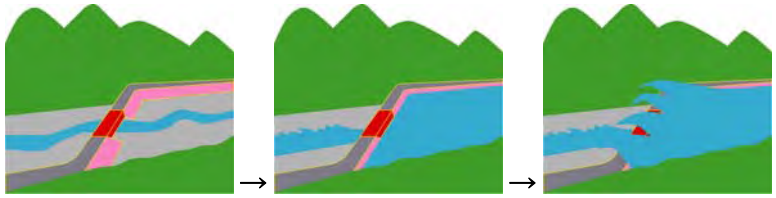


Fig. 2.99 Mechanism of Road Destruction by the 2001 Flood along the 14 Metry Bridge

Left photo shows Loveh bridge, which was reconstructed in 2003, because the former bridge was washed away at the time of the 2001 Flood. Any documents on the former bridge were not found, and shorter concrete bridge might be located.
Although Loveh bridge was reconstructed with steel girder bridge, its length is only 28 m. Flow capacity of the bridge is not enough to carry the floodwater. That is why about 20 m width of spillway was constructed beside of the bridge.

Fig. 2.100 Reconstructed Loveh Bridge (Bridge No. 5)

It's understandable that such bridge was constructed because of financial shortage for construction cost, but it is not able to understand why such design decision was given.

If enough budget was not allocated, it was much better that the submerged bridge was constructed completely. Furthermore, as Fig. 2.96 shows, satellite imagery, river meanders intensely. Unprotected embankment will be easily affected by floodwater under such condition. River embankment should be improved before bridge reconstruction.

Bridge No. 6

Bridge No.7

Fig. 2.101 Existing Bridges No. 6 and No. 7

Fig. 2.101 shows existing bridges that were affected by the floods but still remain. These bridges are small and functioned like submerged bridges in the flood time. They may not significant obstacles against floodwater and may not impede passage of the floodwater. That is why they could remain.

However, they were not complete submerged bridges, so that some damages were given. They should be replaced with complete submerged bridges at the same time of river improvement project. The complete submerged bridge means entirely not to resist floodwater

as conceptually illustrated in Fig. 2.102. Safety fence and unnecessary structures should not be attached on the top of submerged bridges.

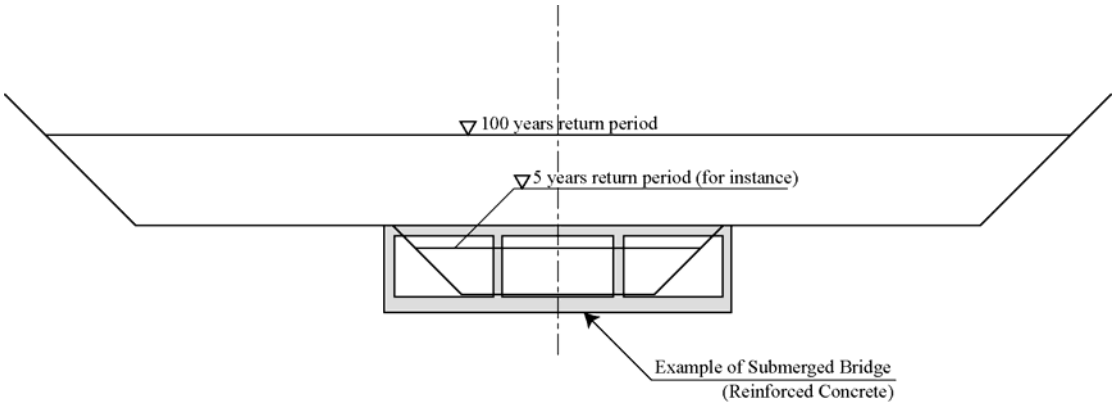


Fig. 2.102 Example of Submerged Bridge

In addition to bridge damages, three types of road damage by the flood, as shown below, were clarified in a stretch of Golestan Dam to Tangrah.

(1) Bank erosion

(2) Road closing by sediment and debris flooding from tributaries

(3) Flooding over road

2.9.4 Current Status of Road and Bridges between Tangrah and Dasht

After the 2001 Flood, MORT provincial unit tried to construct bridges in the Golestan Park. However, those works were unfortunately affected and damaged again by the 2002 Flood. The construction site offices, equipment and workers also were washed away in the 2002 Flood.

For the time being, only temporary road was constructed with submerged bridges in pipe culvert type. The temporary road and submerged bridges will be used until the Park Road Project will be accomplished in this area. The differences of elevation between top of temporary road and riverbed are 2 to 4 m. It cannot be used under rainy conditions. Furthermore their structures might be easily washed away in the flood time.

From the above-mentioned situation at present, traffic officers are checking and controlling the traffic at the entrances of the temporary road, Tangrah (west side) and Cheshme Khan (east side) and patrolling on a 24-hour basis. The speed in the temporary road is limited under 40 km/hr. Moreover MORT provincial unit also always conduct monitoring on the road with cooperation of traffic officers to take prompt countermeasures in the flood time, if flood occurs.

Table 2.54 shows information found through investigation on the submerged bridges in pipe culvert type. The diameter of concrete pipe culvert used in submerged bridge is 1.0 m. 8 or 10 pipes are arranged for each submerged bridges. The flow capacities of bridges are estimated about 20 to 25 m^3/s as shown in the table.

Table 2.54 Submerged Bridges between Tangrah and Dasht

No	Width (m)	Length (m)	Num. of pipe	Dia. of pipe (m)	Flow Capacity (m^3/s)
1	10	16	10	1.0	25
2	10	20	10	1.0	25
3	10	21	8	1.0	20
4	10	23	8	1.0	20
5	10	25	10	1.0	25
6	10	25	8	1.0	20
7	10	30	8	1.0	20
8	10	23	8	1.0	20

Fig. 2.103 shows submerged bridges in the Golestan Forest (Bridge No.1 to No.8). The last photo shows a remaining bridge, but approach road around the bridge were washed away. That is why the bridge remained.

Bridge No.1

Bridge No.2

Bridge No.3

Fig. 2.103(1/2) Submerged Bridges in the Golestan Forest

Bridge No.4

Bridge No.5

Bridge No.6

Bridge No.7

Bridge No.8

Remaining Bridge

Fig. 2.103(2/2) Submerged Bridges in the Golestan Forest

2.9.5 On-going Road Construction in the Golestan Park

MORT had already ordered the road reconstruction work to a construction company in order to follow the agreement made with DOE. In the agreement, the work must be completed within a couple of years. As of July 2005, the work was carried out partially limited on retaining walls as shown in Fig. 2.104.

Moreover the relation between their working plan and hydraulic analysis was not cleared. It seemed to carry out construction work without hydraulic analysis. They were conducting under MORT with the consultant, Pasilou Consultant, located in Tehran.

Completed retaining wall upstream of Golestan tunnel (1)

Completed retaining wall work upstream of Golestan tunnel (2)

On-going retaining wall work downstream of Golestan tunnel (1) (Concrete Wall)
(photo taken on 20 June 2005)

On-going retaining wall work downstream of Golestan tunnel (2) (Limestone Masonry)
(photo taken on 20 June 2005)

Fig. 2.104 On-going Road Construction Work in the Golestan Forest

On other hand, road planning and designing, conducted by a consultant company, are not finalized yet and they are still under evaluation of MORT as of June 2005. Although the latest plan made by the Consultant can be checked in MORT office, its documents and drawings were not provided the JICA study team, from the reason that those are still under evaluation. The JICA study team requested to provide design data and drawing through MOJA, but it was not granted.

2.10 Environment

2.10.1 Environmental Scoping

Environmental Guidelines and Laws

Revised version of JICA Guidelines for Environmental and Social Considerations published in April 2004, provides the following definitions "environmental and social considerations" means considering environmental impacts on air, water, soil, ecosystem, fauna and flora as well as social impacts including involuntary resettlement and respect for human rights of indigenous people and so on. The guidelines Categorizes the projects as shown below:

Table 2.55 Project Categorization in 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 the JICA Environmental Guidelines (categorization, list of sensitive sectors) see Scoping for the Study attached to this Report.

Main objectives of JICA Guidelines are the followings:

(1) To encourage recipient governments to take appropriate considerations of environmental and social factors as well as to ensure that JICA's support for and examination of environmental and social consideration are conducted accordingly.

(2) To outline JICA's responsibility and procedures, and requirements for the recipient governments to facilitate achievement of the objectives.

Disclosure of information (transparency), consultation with local stakeholders, and participation of people in projects are emphasized in the guidelines. However JICA refers to international standards, treaties/declarations and good practices which Japan, international and regional organizations have, it urges the recipient government to conduct environmental assessment (evaluation) in accordance with laws, regulations and guidelines of the country.

DOE (Department of the Environment) of Iran published its revised version of Environmental Guidelines and Standards in the autumn of 2003. The guidelines provide information and guidance on conduction of environmental studies and preparation of environmental impact assessment report. According to the guidelines, 18 kinds of projects are expected to have significant adverse impacts on the environment and society, thus requiring environmental impact assessment (EIA) prior to their implementation. For long list of projects and organization chart of DOE see Scoping for the Study attached to this report.

Laws of all Five-Year Socio-economic and Cultural Development Plans of Islamic Republic of Iran address the environmental issues and emphasize wised utilization of natural resources through sustainable development.

Islamic Punishment Law (Taazirat) 2004 edition, discusses the environmental issues, and forbids the people from damaging the natural environment and destroying historical/cultural heritages, through warning and punishment.

For detail on environmental laws, regulations and standards prevailing in Iran see Scoping for the Study Annexed to this report.

Field Survey

To reveal present condition of natural, socio-economic, and cultural/historical environments of the study area, field survey was conducted with the collaboration of Jihad-e-Agriculture Organization, General Directorate of Environment, General Directorate of Cultural Heritage and Tourism Organization, and Natural Resources General Office of relevant Provinces, by using questionnaires. Draft of questionnaires was prepared by the JICA study team and finalized after consultation with counterparts in Ministry of Jihad-e-Agriculture (MOJA). To fill the questionnaires members of Rural Islamic Council, Village Chief, public servants (schoolteachers, personnel in sanitary office), farmers, and other informed sources were contacted and requested to answer the questions as precisely possible.

Since there were two questionnaires, one for Environmental and Social Considerations and another for Land use (agriculture), totally it took about four hours to complete a set of questionnaire. Some points from survey output are tabulated below and details presented in Annex of this report.

Table 2.56 Summery of Village Interview Survey on Environmental and Social Considerations

Item	Description
Total population	93,141 person
Population density	0.39 person/ha
Average household size	6.5 person
Major occupation	Agriculture, livestock breeding and laboring (mostly outside village)
Main source of income	Agriculture, livestock breeding and laboring
Major source of fuel	Gas and petrol
Major expenditure	Food/cloth, fuel/transport and education
Widely available infrastructure/institution	Piped water, electricity, telephone, school, sundry shop, mosque, cemetery, rural Islamic council and village chief
Main mass media	Radio and television
Major crop	Wheat, barley and sunflower
Major fruit	Plum, pear and olive
Major vegetable	Cucumber, tomatoes and watermelon
Main livestock	Sheep, goat and cow
Means of feeding livestock	Rangeland, farm residue and commercial materials
Major social nuisance and agricultural problem	Unemployment, lack of medical/sanitary, education, recreational and sport facilities. Threat of farmlands by flood/debris flow, water shortage for irrigation, infestation of weed/pest, lack of storage and marketing facilities. Difficulty in getting agriculture/livestock loan.

Source: JICA Study Team, Survey for Environmental and Social Considerations/Land use- October 2004～June 2005.

It should be noted that in some villages people were anxious about spread of drug, sexy video and smuggling, which threat the health and progress of society. It seems that most of people have last their confidence on authorities responsible for improvement of rural areas. Because while answering the questionnaires they mentioned that: “till now about 50 persons like you have came to village, completed their questionnaires and return to their institution, but we have not seen any action by them for removing the villager’s problems. And we do not thing that you will do any thing for us, anyhow fill up your questionnaires and go-away”.

To identify the sites with historical, cultural and religious importance, and indicate them on map of the study area, investigation was carried out with cooperation of Cultural Heritage and Tourism Organization of relevant provinces. Relevant document/materials were collected, carefully examined, thence confirmed in the field to accomplish the task. Totally 53 of such

site fall in boundary of the Madarsoo river basins, which are outlined in Scoping for the Study being provided in Annex of this report.

Preparation of Scoping for the Study

"Scoping" means deciding alternatives to be analyzed, a range of significant and likely significant impacts, and study methods.

Document of environmental Scoping for the Study was prepared based on the collected data/ information, field survey, discussing with counterparts in MOJA and consultation with relevant institutions such as DOE. Key point of the document prepared in JICA format is given below, and its text is provided in the Annex.

Conduction of Scoping revealed that the captioned project falls in category B of JICA environmental categorization, with following justification:

(1) The proposed project is of disaster mitigation and management in nature and sprit, aiming at reducing flood/debris flow damages, preventing soil erosion/land degradation, thereby 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. Thus inserting no significant adverse impact on the environment or society.

(2) Structural measures being established in hazardous localities are so designed to counter deterioration of physical and biological environments, and safeguard the society.

(3) However part of Golestan National Park occurs in study area, but no structural measure is recommended for this park. Instead, flood forecasting and warning systems are installed to alarm the visitors/campers about occurrence of flood on time and accelerate evacuation.

(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 referred when selecting sites for establishment of structures. Thus 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 (corresponding to category A of JICA), require environmental impact assessment, while captioned project is of small scale and for disaster mitigation and management.

(6) The project neither plans involuntary resettlement, nor proposes any change in existing institution and customs, thus its smooth execution is expected.

(7) Disaster mitigation and management tasks have been undertaken for a long time in Iran, and are quite familiar/acceptable to inhabitants, hence 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, thus no complicated formalities or sophisticated countermeasures are required. Adverse impacts (if any) of the project can be avoided/reversed through simple and common countermeasures.

2.10.2 Environmental Situation in Iran

Social, Economic and Political Situation

(1) Administrative Division and Population

Covering an area of about 1.64 million km^2, Iran is located in southwestern Asia, and in heart of Middle East. Caspian sea, Turkmenistan, Azerbaijan and Armenia in north; Afghanistan and Pakistan in east; Turkey and Iraq in west surround the country. On

the south Iran borders Persian Gulf and the Sea of Oman. It is divided into 30 Ostan (province), 314 Shahrestan (district), 928 Shahr (city), 842 Bakhsh (county), and 2,350 Dehestan (rural district). A governor-general, a governor and a lieutenant governor administer each province, township and district, respectively. A governor-general is appointed by, and works under guidance of the Ministry of Interior (MOI).

According to the recent estimation (2003) population of Iran is about 68.8 million, of which 45.9 million (66.8%) live in urban, and 22.8 million (33.2 %) live in rural areas. About 39% is under 15 year, and population growth rate is 1.8% (long term basis), with a decreasing trend. Life expectancy is 69 years, and population density is 42 persons/km^2. It is said that about 11 million of population live below the "absolute poverty line", and 25 % of Iranians suffer from malnutrition.

(2) Religion and Tribe

According to Article 12 of constitution of the Islamic Republic, the official religion of Iran is Islam (Shiite). Although about 99.5 % of population is Muslim, other religions such as Zoroastrian, Christian, and Judaism are also officially recognized (article 13 of constitution) and their disciples have equal political, social and economical rights as Muslims.

Though about 65% of population is Persian (Farsis), many tribes are dispersed throughout the country, such as Turkeman in Golestan and Khorasan provinces, Azaris, (Azarbayejan), Kurds (Kurdestan and Kermanshah), Baluch (Sistan and Baluchestan), Lors (Lorestan and Khuzestan), Bakhtiyari (Chaharmahal-Bakhtiyari) and Arabs in Khuzestan provinces. According to article 19 of the Constitution, all tribes have equal rights and by no means one is superior to another. Official language of Iran is Persian (Farsi) but tribes are free to use their own language beside Farsi.

According to Article 44 of Constitution, economy of Iran is composed of three sectors: State, cooperative, and private. Large industries and mines, foreign trade, large dams and water/energy supply networks are incorporated in state sector. Predominant ownership is concentrated in state and private sectors, and cooperatives own only a small portion (2.5 %) of country's economy. It should be noted that the Iran economy largely depends on oil exportation, thus fluctuation of oil price in international market seriously affects its economic performance. Gross Domestic Product (GDP) is composed of 4 major sectors: agriculture, industry and mine, services, oil and gas. Share of economic activities in GDP in the year 2000 was as follows:

Table 2.57 Share of Economic Activities in GDP, 2000

Agriculture	Mining	Manufacturing	Oil/ Gas	Water and Electricity	Construction	Trade/ Tourism	Transport/ Communication	Services
12.9%	0.6%	12.9%	22.4%	0.9%	3.5%	14.5%	6.3	26.0

Source: Statistical Yearbook of Iran- 2001.

Government of Iran is Islamic Republic, established as the result of Islamic Revolution in 1979, which ousted the king (Shah) and abolished the Monarchy system. In accordance with the Constitution of the Islamic Republic of Iran (article 62) members of the Islamic Consultative Assembly (Parliament), the President (article 114) and members of different Councils (Article 100) are directly elected by the people for a 4-year term to administer the country. The three powers in Iran are Legislative, Executive, and Judiciary that independent, but coordinated by the president and supervised by Supreme Spiritual Leader (*Valiyeh Fagih*). Supreme leader is the highest authority in the country with enormous power such as selection of commander of Armed Forces, declaration of war/peace and dismissal of president.

Judiciary power is supportive of individual and social rights of people, directed by Head of Judiciary, who is selected by supreme leader for a 5-year term.

Natural Environment and Ecology

Iran lies in northern part of temperate zone, between latitudes 25° 03' and 39° 47' north and longitudes 44° 14' and 63° 20' east. Alborz Mountain Range in north, Zagross Mountain Range in west and some other mountain chains extending from Khorasan to Baluchestan in east, surround plateau of Iran which is mostly desert in the middle. There are many summits in Iran, of which Damavand with 5,671 m from sea level, in northeast of Tehran is the highest one. Two major deserts namely Dasht Loot and Dasht Kavir, covering an area of 360,000 km^2, occur in central part. These are among the hottest and driest places in the world. Average altitude of the country is about 1,200 m.

Topographically Iran can be roughly divided into followings:

Table 2.58 Topographic Divide in Iran

Topography Condition	Area (km^2)	% of Country Area
Land with elevation >2000 m above seas level	260,000	15.7
Land with elevation between 1000 to 2000 m	879,000	53.3
Land with elevation between 500 to 1000 m	154,000	9.3
Land with elevation between 0 to 500 m	332,000	20.1
Land below mean sea level (Caspian coastal area)	11,000	0.7
Inland lakes and water bodies	14,000	0.9
Total	1,648,000	100.0

Source: Soil Institute of Iran, 1981

Iran is in northern moderate dry region of the earth mean latitude close to the equator, and has three main climatic regions:

- Arid and semi-arid regions of interior and far south, being characterized by long, warm and dry periods, low annual precipitation (30 to 250 mm) and cover 85 % of the country.
- Mediterranean climate (Alborz, Zagros mountains), characterized by warm, dry summers and cool, damp winters, with annual precipitation between 250 to 600 mm, and covering about 5 % of the land surface.
- Humid and semi-humid regions (Caspian area), with annual precipitation of about 600 to 2000 mm, and cover 10 % of the land surface.

In Iran precipitation comes in form of rain, snow and sleet, with an annual average of 240 mm, corresponding to 392 billion cubic meters.

Iran hosts about 8,200 species of flora, of which 2,500 species are endemic. Forests in north of Iran are comprised of beech, walnut, and fig tree, while oak is the main tree in forests of Zagros Mountains. Desert forests are composed of small trees and shrubs, mainly of spinach family (Tagh, Shureh), being enables to grow in salty soil. Many wild medicinal plants and herbs grow all over Iran, being used domestically or exported for gaining hard currency. Among such plants, gum tragacanth, saffron, henna, indigo, borage, madder, and jasmine play significant economic role.

A vast variety of animal species have their habitat in Iran, and so far about 160 species of mammals, 164 species of reptiles, and 500 species of birds have been identified, of which some are endemic species. Most of species live in Alborz and Zagros Mountains, and on the coasts of Caspian Sea. Mammals include wild ram/goat, deer, bear, gazelles, boar and wolves. The most famous birds are partridge, pheasant, quails, vulture, golden eagle and falcon.

Rivers of Iran are of 3 categories:

- Rivers which originate in Alborz Mountains and flow into Caspian Sea,
- Rivers which originate in Zagros Mountains and flow into Persian gulf, and
- Low yielding rivers, flowing across the country and pouring into swamps and lakes.

From hydrological point of view, Iran has been divided into 6 main watersheds, receiving an annual average (for last 33 years) precipitation of 411 billion m^3. Characteristics of watersheds are tabulated below:

Table 2.59 Major Watersheds in Iran

Watershed	Area (1,000 km^2)	Precipitation (BCM)*
Caspian Sea	177	72.365
Persian Gulf and Oman Sea	430	166.045
Orumiyeh Lake	53	18.544
Markazi	831	143.879
Hamum	106	7.731
Sarakhs	44	10.012
Total	1,641	418.576

* Volume of precipitation (billion cubic meters) for water year 2002～2003.
Sources: Ministry of Energy, Iran Statistical Yearbook-2003.

Natural Reserves

Degradation of natural environment as a consequence of human activity and overexploitation of natural resources has resulted in destruction of some of valuable flora and fauna species. To prevent further degradation of the environment some localities in the country have been declared as natural reserves by DOE. Total area of these reserves is about 11.7 million ha, corresponding to 7.2 % of total area of the country.

Table 2.60 Type, Number and Area of Natural Reserves in Iran

Type	Number	Area (ha)	% of Reserve Area	% of Country
National Park	16	1,741,528	14.84	1.05
Wildlife Habitat	33	3,607,000	30.75	2.18
Protected Area	90	6,363,621	54.25	3.86
Natural Monument	13	16,337	0.13	0.00
Total	152	11,728,486	100.00	7.11

Source: JICA Study Team- 2005, based on documents of Department of the Environment (DOE), Iran.

There are more than 100 sizable wetlands in Iran, 21 of which are of international importance, and registered by Ramsar Convention. Moreover numerous natural attractions exist in Iran, being visited by foreign and domestic tourists and nature lovers throughout the year. Some of these attractions are listed in table below.

Table 2.61 List of Significant Natural Attractions in Iran

Name	Type	City/Area	Province
Alisadr Cave	Cave	Kabutarahang	Hamadan
Alvand Summit	Summit	Hamadan	Hamadan
Amir Kabir Dam Lake	Dam lake	Tehran	Tehran
Anzali Lagoon	Lagoon	Anzali	Gilan
Aras River	River	Maku	East Azarbayjan
Avan Lake	Lake	Qazvin	Qazvin
Caspian Sea Shore	Sea shore	Mazandaran	Mazandaran
Choqakhor Lagoon	Lagoon	Gandoman	Chaharmahal
Damavand Summit	Summit	Damavand	Tehran
Dena Mountain	Mountain	Hafshejan	Chaharmahal
Desert Attraction	Desert	Yazd	Yazd
Eil Goli Pool	Pool	Tabriz	Tabriz
Eram Garden	Garden	Shiraz	Shiraz
Gahr Lake(Gol Gahar)	Lake	Aligudarz	Lorestan
Gavkhoony Lagoons	Lagoons	Esfahan	Esfahan
Genoo Hot Spring	Hot spring	Bandar Abbas	Hormozgan
Golestan National Park	Natural park	Gorgan	Golestan
Golshan Garden	Garden	Shiraz	Shiraz
Hamoon Lake	Lake	Zabol	Sistan Baluchestan
Karkheh River	River	Shush	Khuzestan
Karoon River	River	Ahvaz	Khuzestan
Kavir National Park	Natural park	Varamin	Tehran
Kish Island	Island	Bandar Abbas	Hormozgan
Lar Protected Zone	Natural area	Damavand	Tehran
Loot Plain	Plain	Zahedan	Sistan Baluchestan
Mahan Place	Place	Kerman	Kerman
Maharloo Lake	Lake	Shiraz	Shiraz
Moorzard Zilaei Lake	Lake	Yasuj	Boyer Ahmad
Neor Lake	Lake	Ardabil	Ardabil
Orumieh Lake	Lake	Orumieh	West Azarbayjan
Oshtoran Mountain	Mountain	Aligudarz	Lorestan
Parishan Lake	Lake	Kazeron	Fars
Persian Gulf Coasts	Sea coasts	Chabahar	Sistan Baluchestan
Qeshm Island	Island	Qeshm	Sistan Baluchestan
Qoori Qaleh Cave	Cave	Paveh	Kordestan
Sabalan Mountain	Mountain	Tabriz	East Azarbayjan
Salt Lake	Lake	Qom	Qom
Sefidrud River	River	Gilan	Gilan
Tochal Run	Run	Tehran	Tehran
Valasht Lake	Lake	Chaloos	Mazandaran
Zerivar Lake	Lake	Marivan	
Zayandehrud River Banks	River Banks	Esfahan	Esfahan

Source: Iran Caravan Documents

Historical, Cultural and Religious Heritages

Plateau of Iran is among the oldest civilization centers in the history of humanity and has an important place in archeological studies. The Achaemenidae established first great Persian Empire after defeating the Medes and conquest of their capital. Achaemenian territory during reign of Dariush I (522-485 BC) extended from plains of Sand River in east to the borders of Greece in west. Pasargadae and Persepolis are among important historical sites belonging to this period. The Sassanides, after defeating the last Parthian king in 224 AD, founded a new empire, which lasted until mid 7th century AD. Introduction of Islam in Iran began in early 7th century AD, and caused fundamental changes in social, political, religious, and governmental

system of the country, which ultimately led to Islamic Revolution under leadership of Imam Khomeini in 1979 and establishment of Islamic governing system- Islamic Republic of Iran.

Table 2.62 Historiography of Iran

Era/Period	Duration	Era/Period	Duration
Achaemenian	533-330 BC	Mongol Invasion to Iran	1220 AD
Selecuidian	330-247 BC	Elkhanian	1256-1353 AD
Parthian	247 BC-224 AD	Mozaffarian	1314-1393 AD
Sassanide	224-651 AD	Teymurids	1370-1506 AD
Arab Attack	645 AD	Turkmens	1380-1468 AD
Omavian and Abbasian	749-932 AD	Safavid	1501-1732 AD
Saffarian	866-903	Afsharian	1734-1796 AD
Samanian	819-999 AD	Zandian	1750-1794 AD
Al Bouyeh	945-1055 AD	Qajar	1779-1924 AD
Qaznavian	977-1186 AD	Pahlavi	1924-1979 AD
Seljukian	1038-1194	The Islamic Revolution	1979 AD
Kharazmshahian	1077-1231 AD		

Source: Iran Caravan Documents. BC, Before Christ; AD, Anno Domini in the year of the Lord.

Cultural Heritage and Tourism Organization of Iran has registered more than 100,000 sites of historical, cultural and religious importance. Seven of these sites, are registered by UNESCO (United Nations Educational, Scientific and Cultural Organization) as "world cultural heritage" as shown below:

Table 2.63 World Cultural Heritage in Iran

Name	Type	Location	Registration Date
Chogha Zanbil	Temple	Vicinity of Such city, Khuzestan province	1979
Persepolis	Palace	Vicinity of Shiraz city, Fars province	1979
Meidan Imam	Cultural site	Inside the Esfahan city, Esfahan province	1979
Takht Soleyman	Castle	Vicinity of Takab (Chaloos) city	2003
Pasargadae	Tomb	Marvdasht	2004
Bam and its Cultural Landscape	Citadel, Bam old city	Bam city and its vicinity	2004

Source: UNESCO World Heritage Center, World Heritage List.

With expansion of Islam in Iran, tombs of the Imams (descendants of the prophet of Islam and Shiite religious leaders) were gradually changed to places of pilgrimage and shrines, some with international fame like shrine of Imam Reza in Khorasan province and shrine of Hazrat Masomeh in Qom province. Shrines of Shah Cheraq in Fars province, Hazrat Abdol Azim in Tehran province, and Mausoleum of Danial Nabi in Khuzestan province are also well known in the country and visited by millions of people throughout the years.

In addition to Muslims, there live in Iran other religious minorities such as Zoroastrian, Assyrians, Armenian, and Jews who have their own sacred religious places. Zoroastrians usually go to Persepolis, Naghsh Rostam, Taq Bostan, and Bistoon Inscription for religious ceremonies and rituals. Old Azargoshasb fire-temple in Takht Solaiman, Kashmar Tower in Khorasan, and Orumieh Lake in Azarbayejan are also sacred sites for Zoroastrians. It should be noted that Iran is birthplace of Zoroaster, founder of Zoroastrian religion, one of the oldest religions of the world. Tatavoos and Stepanous churches in Azarbayejan province, as well as

13 churches in Jolfa area (Esfahan province) are among sacred places for Armenians. The most important place of pilgrimage for Jews is the tomb of Esteroo Mord Khay in Hamadan.

Environmental Laws, Regulations and Standards

Islamic Republic of Iran has established comprehensive environmental legislations, which are rooted in the Constitution and Islamic culture and wisdom. Article 50 of Constitution, and Articles 684 to 688, 560, 558 of the Islamic Punishment Law (*Taazirat*) provide foundation and strength to all environmental laws, regulations and standards prevailing in the country. Legislations relevant to the captioned project are tabulated below with brief content.

It should be noted that Department of the Environment (DOE) is principal organization for administrating the environmental status in Iran. DOE is attached to Office of President of the country, and president appoints its head. DOE has a General Directorate in each province, which monitors status of environment as well as implementation of environmental programs at provincial level. For details of legislations and organization chart of DOE see Scoping for the Study in Annex of this report.

Table 2.64 Environmental Laws, Regulations and Standards in 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, published by DOE in the year 2003	Itemization of projects requiring EIA, and guidelines for 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)- 2005.	Punishment for causing environmental pollution, damaging public facilities (dam, canal), and destroying cultural/historical heritages.

2.10.3 Environmental Situation in Golestan, Semnan and Khorasan Provinces

Golestan Province

Golestan province lies between longitudes 53° 57' and 56° 22' east, and latitudes 36° 30' and 38° 08' north, in northern part of Iran. Turkmenistan in the north, Semnan province in south, Khorasan province in east, and Caspian Sea and Mazandaran province in west surround this province. Golestan is divided into 11 Shahrestan (district), 23 Shahr (city), 21 Bakhsh

(county), and 50 Dehestan (rural district) and 1,064 Rusta (village). Total area of the province is 20,438 km^2, with a population density of 81 persons/km^2. Golestan is one of important and strategic provinces having marine and overland connecting routes to Central Asia.

Golestan province has two distinguished features: mountainous and plains with slope reducing from heights to plains towards Caspian Sea. The most important mountain is Abar Kuh, with Shavar peak of 3,945 m in elevation.

According to the recent estimation (2005) by Management and Planning Organization of Golestan province, population of Golestan is about 1.7 million, of which 0.8 million (46.8 %) live in urban, and 0.9 million (53.2 %) live in rural areas. About 30.4 % of total population is under 15 year, and 6.1 % is over 60 year. Life expectancy is 66.9 years, and average annual population growth rate (on long term basis) is 1.72 % (urban area 2.30 %, rural area 1.14 %).

Parts of project area occur in Kalaleh and Minu Dasht districts, which their population status is tabulated below:

Table 2.65 Population of Kalaleh and Minu Dasht Districts

District	Total population	Urban population	Rural Population
Kalaleh	163,579 (100 %)	40,370 (24.7 %)	123,209 (75.3 %)
Minu Dasht	157,270 (100 %)	53,193 (33.8 %)	104,077 (66.2 %)

In Golestan literacy rate of population more 15 years old is 85.0 % for male and 70.8 % for female. Most of population is Farsis (Persian), but other communities such as Turkeman, Baluch, and Armenians also live in this province, preserving their traditions and rituals.

In 2003, employment and unemployment rates were 86.3 % and 13.7 %, respectively, and distribution of employed population in major economic activities was as below:

- Agriculture: 34.3 %
- Industry: 24.8 %
- Services: 40.9 %

Agriculture is an important sector in Golestan, and more than 92 kinds of field and orchard crops are produced here, of which cotton, oilseeds, wheat, rice, potato, tobacco, and barley can be mentioned. Livestock raising and fishery are also widely practiced and contribute to economy of the province.

Area of rangeland is 1,126,000 ha, and area of forest is 430,000 ha. Total area for farmland and orchard is 580,000 ha. Annual rainfall varies from 200 to 700 mm, in accordance with topography and localities.

Golestan National Park, the first Iranian national park registered by UNESCO, and some other natural reserves occur in this province, which their status is given table below:

Table 2.66 Type, Number and Area of Natural Reserves in Golestan Province

Type	Number	Area (ha)	% of Reserve Area	% of Province
National Park	1	88,576	61.1	4.3
Wildlife Habitat	3	56,318	38.9	2.7
Protected Area	0	0	0	0
Natural Monument	0	0	0	0
Total	4	144,894	100.0	7.0

Source: JICA Study Team- 2005, based on documents of Department of the Environment (DOE), Iran.

History of human settlements in territory of Gorgan dates to a millennium BC (before Christ). Evidences of the ancient city of Jorjan are near the current city of Goragn. This was one of the important cities on Iran located on Silk Road, which was destroyed by Mongol's attack.

Semnan Province

The province Semnan covers an area of 95,815 km^2, to the east of which is Khorasan province, to the north are provinces of Golestan and Mazandaran, to the west stand the provinces of Tehran and Qom, and to its south are Esfahan and Yazd provinces. This province is located in southern part of Alborz Mountains and has two distinguished regions: mountainous, and plains which ends in desert of Kavir Namak in central part of Iran. Climate of mountainous region is cold/temperate, while that of plain region is warm. The province is attractive area from aspect of natural beauty, since it possess rivers, springs, forests, mountains with high peaks and large caves. To conserve natural of the province, some localities have designated as natural reserves as shown in the table below:

Table 2.67 Type, Number and Area of Natural Reserves in Semnan Province

Type	Number	Area (ha)	% of Reserve Area	% of Province
National Park	2	674,017	28.5	7.03
Wildlife Habitat	2	506,111	21.4	5.28
Protected Area	3	1,183,418	50.1	12.35
Natural Monument	0	0	0	0
Total	7	2,363,546	100.0	24.67

Source: JICA Study Team- 2005, based on documents of Department of the Environment (DOE), Iran.

According to recent estimation (2003), population of Semnan province is 568,310, of which 421,486 (74 %) live in urban area and 146,824 (26 %) live in rural area. Population density in the province is 5.9 persons/km^2. The province is comprised of 4 districts, namely Semnan, Shahrud, Garmsar and Damghan. Part of the study area occurs in Shahrud district. Population of Shahrud district is 229,816 inhabitants, of which 150,346 (65.5 %) live in urban area, and 79,469 (34.5 %) live in rural area. Population density in Shahrud district is 4.5 persons/km^2. Northern sector of Shahrud has cold climate, while its central and southern sectors are temperate and warm respectively. Highest elevation in Shahrud district is about 1,970 m above sea level.

Literacy rate in Semnan province is very high (87.7 %), and large number female inhabitants attend higher education. In 2003, total number of students enrolled in higher education was 20,985, of which 9,633 (46 %) were male and 11,352 (54 %) were female. (Excluding figures for Azad University, which is a private educational network).

The territory of Semnan province is an ancient area dating back to the time of Avesta. During Medes and Achaemenia periods this area was one of the largest provinces of the Parthians, as well it held its importance in Sassanide period and the Islamic era. Silk Road paved its way from midst of this territory. Semnan province now is rich in historical relics such as palaces, castles, and ancient inns/Caravansaries, of which palaces of Agha Mohammad Shah and fathali Shah in Damghan district, and castles of Saroo, Kushmoghan and Pachenar in Semnan district could be mentioned. Among the religious site, Soltani mosque, Jaame mosque, and Tarikhaneh mosque are important ones.

Khorasan Province

Khorasan province with a total area of 247,618.3 km^2 is divided into 25 Shahrestan (district), 85 Shahr (city), 88 Bakhsh (county), and 318 Dehestan (rural district). Total population is 6,571,466 inhabitants, of which 3,958,328 (60 %) are in urban area and 2,613,138 (40 %) in rural area. Population density in the province is 26.5 persons/km^2. Part of the study area is in Jajarm district. Mashhad, the capital of Khorasan, is the country's second largest city, and the third most favorite tourist spot in Iran after Isfahan and Shiraz, and is known as a center of

Shiite pilgrims from all over the world, due to presence of the Shrine of Imam Reza. Imam refers to descendants of the prophet of Islam and religious leaders. Imam Reza is the 8th Imam of Shiite, and the only Imam buried in Iran.

In 2003 total number of students enrolled in primary, secondary and high schools was 1,749,946, of which 908,385 (52 %) was male and 841561 (48 %) was female. In same year total number of students enrolled in university was 67,231, of which 29,016 (43 %) were male, and 38,215 (57 %) was female, indicating high desire of female for education/social activities.

Aggregates of tombs or mausoleums consist of construction of buildings, which are regarded as pilgrimage sites or tombs of prominent or religious personalities and the resting abode of persons of reputes. Many of such establishments exist in Khorasan province, adding to its historical/cultural value, of which mausoleums of Imamzadeh Tabas, Sheikh Abu Nasr Iravehei, Sheikh Rashidudin Mohammad, Imamzadeh Shahzadeh Zeid, and Imamzadeh Shahzadeh Jaffar, Sheikh Bahei and Sheikh Ameli's tombs can be mentioned. Gowharshad Mosque, one of the most famous buildings from the 7th century, stands near Iman Reza shrine.

To conserve natural beauty and wildlife of Khorasan, parts of high natural importance/value have been designated as natural reserves by DOE. These sites also contribute in research and preservation of genetics resources as well play an important role in production of medicinal plant and progress of pharmaceutical industry (table below).

Table 2.68 Type, Number and Area of Natural Reserves in Khorasan Province

Type	Number	Area (ha)	% of Reserve Area	% of Province
National Park	3	50,717	11.0	0.20
Wildlife Habitat	3	150,356	32.5	0.61
Protected Area	7	261,833	56.6	1.06
Natural Monument	0	0	0	0
Total	13	462,906	100.0	1.87

Source: JICA Study Team- 2005, based on documents of Department of the Environment (DOE), Iran.

It should be noted that in 2004 Khorasan has been divided into three separate provinces: namely Northern Khorasan, Southern Khorasan and Razavi Khorasan. But map and statistics for separated provinces are not available yet, therefore data/information for entire (single) former Khorasan province have been considered and used in this report.

2.10.4 Environmental and Social Considerations in the Study Area

The study area covers entire watershed of the Madarsoo River, one of tributaries of Gorgan River emptying into the Caspian Sea. Part of the Golestan National Park occurs in this watershed. The Madarsoo River originates in mountain range (vicinity of Nardein village) in Semnan province, passes through Dasht village in Khorasan province, then enters into Golestan province via the Golestan National Park, joins to the Gorgan River in vicinity of Garkaz village, thereafter empties into the Caspian Sea. The river is 142 km in length, having an average slope of 1.4 %, and a catchments area of 2364 km^2.

Total present population (2005) in the study area is 93,141 inhabitants, with a population density of 0.39 persons/ha, and average family size of 6.5 persons, as attained by JICA study team through filed survey and data collection activities.

2.11 Watershed and Forest Management

The watershed and Forest management condition was surveyed to learn the outline of the watershed and forest management in entire Iran and Golestan province. This paper also describes about the watershed management plan for flood control in the Madarsoo River basin and village opinion clarifying through the data collection, interview and field reconnaissance.

2.11.1 Policy of Watershed Management in Iran

General

Water has continued to be a critical component in agriculture, industrial and urban development in Iran. Land and water, most precious natural resources, are interrelated elements in different regions and are major components in catchments integrated planning that cannot be managed in isolation.

To evaluate the present condition of catchments in Iran, it is necessary to consider some information related to flood and its trend water shortage and drought, erosion and sedimentation, and some others.

The first step in organizing the water and soil conservation system in Iran was the establishment of Soil Research Department and Agricultural Resource Conservation Department in the Ministry of Agriculture in 1949. After that, the organization of water and soil conservation has been reconstructed to improve and strengthen the watershed management works several times. At present under Ministry of Jihad-e-Agriculture, Deputy for Watershed Management is reorganized in 2001 as a responsible organization.

Issues

The main issues identified in Iranian catchments are as follows.

- Heavy soil erosion
- Deforestation and decline and loss of native vegetation
- Increase in the peak and frequency of floods
- Occurrence of flood and debris flow and increasing damage
- Reservoir sedimentation
- Land degradation, e.g., soil erosion and acidification

Solution and Strategy

The land and water resource management strategy is the first step to sustain the natural resource and overcome land degradation. The strategy, which should be developed over period of time, involved a significant consultation phase with government agencies and the wider community groups.

The established work aims should be followed by further executive work to develop an integrated approach to natural resource management. Third National Five–Year Plan Strategies on water resource development that was proposed by the Deputy for Watershed Management are as follows.

- To legalize the intra-sectoral and inter-organization planning of water resources management and observing considerations concerning natural, economic and social balance in order to increase soil and water resources productivity and stabilize and revitalize production
- To plan and manage production resources (water and land) based on watershed basins
- To legalize and systematize land use and the implementation of development projects on sediment and water shortage in watershed basins intra-sectorally and inter-organizationally

- To explain and develop regulation and principle for public and local management of water resources as a sub-system of national water resources management and redistribution of responsibilities aimed at decentralization
- To establish the system as a measure of social justice, processing and dissemination system and water and soil data studies
- To prioritize planning and investment on mountain areas with regards to their natural advantages in controlling precipitation
- To develop regulation on methods of public participation in planning, investment, implementation and operation of water facilities and other effective measures in water resources management

2.11.2 Watershed Management in Golestan Province

Watershed in the Region of Gorgan and Gonbad

The region of Gorgan and Gonbad in Mazandaran province (after 1997 divided to Golestan province) has 5 watersheds including Atrak, Gorgan, West Gorgan, Gharesoo, West Gharesoo. The Madarsoo River basin of 2,300 km^2 belongs to Gorgan River watershed.

Aims of the Watershed Management in Golestan Province

Golestan province has formulated the following aims to realize the rehabilitation, conservation and regular exploitation of natural resources in watershed and to prevent the damage due to soil erosion, crop yield decreasing, forest destruction, floods, drought, sedimentation in dam.

- Decreasing risk of natural and human disasters (flood and earthquake)
- Protection and strengthening of production potential capacities with performance of soil protection
- Increasing of national yield of capitals with performance of improving farming and preventing from decrease of dam storage
- Strengthening of groundwater (aquifer) with distribution of flood application
- Establishing of occupation for rural and preventing migration from the villages to towns
- Ratifying and legitimating of kind of exploitation sources in basins
- Coordinating of plans in the whole projects and reconstructive activities in watershed

Performed Activity

These activities can be divided into 4 groups to include rehabilitative manner of vegetation canopy, to establish reformation of the controlled reconstructions, to improve groundwater, to control flood and to conduct watershed management.

(1) Mechanical project

Reduction of the destructive power of flood and to prevent the towns, villages and farmland from the damages of flood and sedimentation

(2) Biological project

Rehabilitation of the canopy covers, reformation of the land use, increase of crop yield, and decrease of runoff and increase of soil fertility

(3) Complete management

Coordination between different activities that are available in watershed

(4) Participatory application for people:

Reformation of the life condition

The accomplished activities about protecting watershed in Golestan province are shown bellow. The area of accomplished activities after in 2001 and 2002 floods is bigger than the area of other activities. The accomplished activities in 2004 would be conducted in Sub-basin of Dar Abad (Earth dam) and in Sub-basin of Pa Sang (Sabo dam, Flood credit, Masonry dam).

Plan

The plan to accomplish the performed activity shows below. It should be noticed that this plan has not prepared the concrete numbers, costs and schedule.

Table 2.69 Plan Components to Accomplish the Performed Activity

Component	Contents
Decreasing of damage due to flood and sedimentation	Explorative study in whole watershed Explanative study in 50% of whole watershed Administrative study in 300,000ha of watershed Study of land use plan Foundation of areas that damaged by flood
Decreasing of soil erosion	Changing of dry land to place for planting forage Changing of slope land to orchard of nut, mulberry, olive with helping of extension manners Plugging to shape of slope land with helping of extension and education manners Rehabilitation of forest and rangeland
Comprehensive management	Conservation of recycle and non recycle resources by best use City management of watershed to landscape and recreation area

2.11.3 Watershed Management Plan for Flood Control in the Madarsoo River Basin

Outline of the Plan

The plan has been formulated in 2003 by a local consultant (Ravanabup Company) on the basis of the following reports prepared by MOJA. The titles of the reports are as follows.

- The report on flood control through the project of watershed management and restoration of forest-rangeland in Golestan province in September 2002
- The report on the plan of the watershed management and prevention of the forest-rangeland degradation to conduct the flood control in Golestan dam basin

The plan has been conducted the fundamental study which consisted of geology, topography, soil, vegetation focusing on the Madarsoo sub-watershed in Golestan dam basin. On the basis of this study implementation plan has been formulated including the goal of plan, contents of plan, method of countermeasure, and prioritization among the project.

The following sub-watershed has been given high priority among the nine sub-watersheds in the Madarsoo River basin and the plan has been formulated in each sub-watershed.

- Cheshmeh Kahn sub-basin
- Dasht-e-Sheikh sub-basin
- Ghiz Ghaleh sub-basin
- Tangrah sub-basin
- Loveh sub-basin

The main contents of the plan are as follows.

- Check dam construction to mitigate the flood intensity
- Terracing to protect the soil surface erosion
- Restoration and improvement of forest and rangeland
- Countermeasure of overgrazing
- Extension and training to implement the project smoothly
- Cost estimate

Biological Countermeasure

Among the above five sub-watersheds, the biological countermeasures have been introduced mainly in two sub-watersheds: Dasht-e-Sheikh and Tangrah sub-basins. The biological countermeasures to be conducted in two sub-watersheds are enumerated in the following table.

Table 2.70 Biological Countermeasures

Dasht-e-Sheikh sub-basin	1) Planting+fertilizing 2) Planting Banqquet +Seeding +Fertilizing 3) Planting banqquet +Fertilizing 4) Terracing 5) Hill planting + Fertilizing 6) Seeding + Fertilizing 7) Fertilizing
Tangrah sub-basin	1) Irrigated farmland-strip sodding 2) Irrigated & non-irrigated farmland, strip sodding 3) Terraced farmland not to be Irrigated 4) Forestation on the terraced farmland 5) Planting on the grassland 6) Planting on the mountainside 7) Recovery planting with seeding on the mountain side 8) Available rangeland to be fertilized

2.11.4 Interview Results from Villagers

Interview survey was conducted with village chief in Dasht village to study the damage of disaster to the forest, rangeland and farmland in and around the village. The result of interview is as follows.

Forest Land Flora

- The forest in Dasht village was destroyed by the floods and debris flow.
- The damage is enormous: for example, many species of plant were destroyed by the floods and numerous debris deposits.
- The forest surrounding the village has decreased in recent years, especially after drought and fire in 1995.
- People in the village do not use forest resources because various activities like hunting and cutting trees are forbidden in the Golestan National Park.
- People in the village eager to conduct reforestation if the government give credit or loan to the people.

Grazing Land

- The damages were very severe and included soil erosion, accumulation of sediment.
- There are two kinds of grazing in the village: (1) villagers send their livestock to rangeland, and (2) villagers use the straw and farm residue for their livestock for five month in year.

- Villagers move in 1 to 8 km for grazing, and a person and many dogs are necessary for controlling the livestock.
- Villagers didn't protect their farmland from the livestock.

Agricultural Land

- The damages were very severe including soil erosion, accumulation of sediment.
- Floods and debris flow destroyed 21 ha of agricultural land. After the floods new weeds grew in the farmland and most of the pesticide can't effect on them.
- Villagers sell the wheat and barley to cooperative shop and sunflower to oil company, and other crops like vegetable and fruit consumed by themselves

Vision for Village Development

- Establishment of facilities for fish, honey bee, flower culture and consequently provide job opportunity for people, especially juvenile generation, introduction of sprinkler irrigation system for efficient irrigation and saving the additional water.

2.11.5 Policy of Forestry in Iran

History of Iranian Forestry

The economic role of forests had become important in the 19th century when the exploitation of the northern forest of the country, mainly for timber for export, was transferred to foreign contractors. In addition, before the nationalization of the forests in 1962 some landowners exploited their own forestland. Although the High Council for Forest, Range and Soil was established in 1951 and forest management regulations were ratified in 1958, forest area continued to be exploited by foreign owners.

In 1959, the first management plan was prepared and implemented in the Caspian area. Forestry plans covered only limited areas until 1963, when nationalization of forests led to the preparation of forestry and exploitation plans on a large scale. Multiple-use forestry plan are now on non-wood products with wood production exclusively to cover local needs for fuel wood and fine wood industry. Fisheries, apiculture, animal husbandry and fodder production are integrated in forestry planning in suitable areas.

Policies

In Iran, forestry is in the hands of the forestry and range organization, under Ministry of Jihad-e-Agriculture. The forestry and range organization gives special importance to rural development and people involvement in harvesting and afforestation activities. The main object of forest policy relate to this study are:

- Preparing integrated plans for all natural resources of the country and applying proper exploitation systems based on modern technology suitable for the sustainability of natural resources and increasing timber and fodder production for economical exploitation
- Establishing forest cooperative societies to manage, preserve, rehabilitate, develop and exploit the forest in collaboration with local people and within the conditions and limitations prescribed in the developed plans
- Industrializing the traditional animal husbandry systems in the northern forests by creating income generating possibilities and procuring animal husbandry facilities in marginal areas outside forests lands
- Preserving rare forest communities and species as national reserves
- Promoting training and extension programs and awareness raising about the importance of natural resources preservation and rehabilitation

Forest Area

Forest with an area of nearly 12.4 million ha (60.4 % of the total area of the country) has various geographic conditions producing different forest of various tree and shrub and production capacity in different edaphic-climatic condition. Man-made forest area is being developed through intensive seeding in order to complete the natural regeneration or establishment of forest. Until 1978, the man-made forest was established about 42,000 ha.

Natural forest area in Hyrcanian forest is estimated to 1,925,000 ha, but before was 3.4 million ha in 1945. In recent years, forest enterprises have been managed under conservation, rehabilitation, development and exploitation activities.

Issues on Forest Management

The issues on forestry could be divided into management and technical issues.

(1) Management Issues

- Lack of preparation of suitable land use plan
- Deficiency of funding for executing organization to management forest
- Necessary funding for afforestation and providing sufficient fund to the provinces
- Necessity of the research, education and training

(2) Technical Issues

- High cost of seedling production in the nursery
- Timing of seedling year and cleaning the forest floor for the natural regeneration
- Controlling the weeds (paliurus spina, fern, robus spp.) for growth of seedling and young tree
- Combating the damage by mammal (porcupine, mouse)
- Compaction of soil surface by existence of livestock

2.11.6 Forest and Forestry in Golestan Province

Area of forest, pasture and desert in Golestan province is 3,792,000 ha, 1,126,000 ha, 0 ha respectively. The natural forest and plantation exist along and in the Hilucanian Mountains.

Plantation and Nursery

The plantation area has increased from 1,002 ha in 1986 to 6,023 ha in 2001, and the plantation of the private sector has been increased rather than the governmental one. Seedling production in nursery has decreased from 13,550 seedlings in 1991 to 7,500 seedlings in 2000, but seedling production has increased in 2001.

Forest Production

Area for cutting tree in forestland of private enterprise given the right as a concession has increased from 107,489 ha in 1986 to 145,981 ha in 2001 slightly.

Production of wood includes the sleeper and timber, tunnel and bar, fuel wood and charcoal. Whole production of wood has more or less decreased from 1991 to 2001.

Forest Protection from Fire

Forest fire occurred by human activities in every year. Maximum figure of forest fire was recorded at 70 cases and 744 ha in 1996, while minimum figure of it was recorded at 27 cases and 47 ha in 1997. From the environmental and ecological aspect, these figures cannot be neglected.

2.11.7 Forest Management in the Study Area

Loveh Forestry Plan Area

Loveh forestry plan area is located in the northern part of the study area managed by NRGO (Natural Resource General Organization). Now one concession holder has conducted the management in the forest area. The production aims of Loveh forestry plan area are to product forest by introducing natural regeneration system in oak forest.

The forest consists of oak, hornbeam, alder, plum tree, elm, maple and so on. Undergrowth in the forest is rare. This situation is good for the seedling after germination. But succeeding seedlings seldom remain in this forest.

Defoliation and fallen branches accumulate on the ground and the soil is getting deep and soft. It is considered that those cycles contribute to prevent the soil surface run-off.

Management System

The harvesting activities have been continued in this area for 40 years and management plan has been revised every 20 years. Loveh forestry plan is one of the "management units" in the Golestan province. The management unit was divided into "serie", and one "serie" consists of several "parser". The areas of management unit, serie, and parser are 10,683 ha, 1,800 to 3,200 ha, 30 to 70 ha respectively.

According to the harvesting standard in this area (4 m^3/year), the volume of forest is estimated at 8,000 m^3 (2,000 ha x 4 m^3/year) per one serie.

That shelter cutting system that is one of the reforestation methods has been conducted in this area as management system and cutting period is adopted at 150 years at the viewpoint of inclination of trees (oak).

The flow of shelter cutting system is as follows.

- Selecting the site for the harvesting
- Harvesting without mother trees
- Land preparation in nursery
- Regeneration (20,000 to 30,000 seedlings/ha)
- Increment of young trees
- Pruning and thinning
- Final cutting (250 trees /ha)

Forest management plan consists of the outline of the planning area, site condition (forest, soil, topography), volume table, growing stock, and thematic maps (site, road, management).

NRGO in Golestan province

NRGO is one of the government organizations under the MOJA, established 1929. NRGO in Golestan province was established in 1950s, and has branch office in district level and village level. NRGO consists of general affair department, technical affair department, and land conservation department, and there are several responsible sections under each department. There are forest management section, reforestation section and rangeland management section under technical affair department.

For the formulating the forestry plan and its implementation, NRGO selects the consultant to conduct feasibility study (F/S). On the basis of F/S, NRGO makes the specification of work and selects some contractors to be concession holder. Contractors have been given the period of concession for 20 to 30 years. Contractors implement the project under inspection of NRGO.

Issues for Forest Management

According to the stuff of NRGO, there are some issues for forest management in this area.

- Exploitation of the forest for construction of pipeline of natural oil/gas
- Reduction of forest land by development of farmland
- Illegal activities in the forest land by grazing

2.12 Disaster Management in Village

2.12.1 Social Structure

(1) Village Structure

Total population of the surveyed 30 villages in the Madarsoo River basin amounts to 6,894 families equivalent to 32,449 persons. The average household members are 4.7 persons. The population level differs considerably, from minimum 193 to maximum 3,200. The average village population is 1,082, which is the manageable size as unit.

Population ratio by age groups is as follows: 0 to 14 years is 34 %, 15 to 64 years is 60.5 %, and over 65 years is 5.5 %. Children under 15 years old, considered as a vulnerable group, form one third of the population.

(2) Household Characteristics

The following table illustrates the general characteristics of the households in the villages.

Table 2.71 General Household Characteristics

Category	Characteristics
Family type	Nuclear of Children 4 plus (50%)
Housing unit	235 m^2 (average) Single-floor (90 %)
Land ownership	Self-own (96 %)
Monthly Income	500,000-1,500,000 Rials
Ethnic group	Turkmen (47 %) Fars (23.5 %) Kurd (13.0 %)
Occupation	Farming Animal husbandry

Majority of families are nuclear family, and nearly half of the family has more than 4 children, among them 28 % of the family has more than 6 children. The size of housing unit is mostly above 100 m^2, and the average is 235 m^2. Most (more than 90 %) housing units are single floor. Majority of people (96%) own their land. Monthly income is between 500,000 to 1,500,000 Rials. Turkmen families account for nearly half, followed by Fars (one-forth) and Kurds (one-eighth).

(3) Occupation

Majority (one-third) of the villagers are farmers. Animal husbandry of sheep and cow accounts for 8 %. Public officials including teachers are 6 %. Nearly 5 % is unemployed. Others are workers and clerks.

(4) Lifestyle

Comparative numbers of villagers in the study area were once nomads and started to settle down after the land reform in 1962 and the Islamic Revolution in 1979. Most people work within the village but have urban behavioral pattern. It is probably because the area is not far from city. The mode of life varies throughout the year. Spring, summer, and autumn are basically the season for cultivation and harvesting, while winter is the time of vacation. More labor is concentrated in the dry and warm season.

2.12.2 Local Organization and Cohesion

(1) Organization

Village based organizations that can be commonly found are agricultural cooperation, Basij, Imam Khomeini's foundation and Red Crescent Society. They have not only locally based, but also nationwide networks. These organizations played an important role of rescue and relief operations.

(2) Meeting Place

Common meeting place for villagers are mosques. For small private gathering, houses of white-beard council members are occasionally used by local people. For holding workshops for villagers, mosques provide screens, audio system, and comfortable atmospheres.

(3) Mutual Cooperation

Bond of family, bond of neighborhoods is tight. People know each other about who lives where and where the elderly and handicapped lives. People help each other and share information on regular basis. At the time of flood, evacuated people took shelter at houses on the high elevation in the villages, and helped each other. Before flood season, information of possible flood should be informed to those who may not access to such information by local initiatives.

(4) Village Actors

Village actors related to decision-making are primary three village councilors. Within the council, dehiyar who is elected by the council is responsible for financial administrations. Whereas, white-beard elderly, Imam of the mosque, teachers, and young educated villagers are also influential figures in villages.

(5) Decision-making System

Village council is the final authority to decide village matters. The white-beard of elderly and respected, Imam, teachers are also respective figures for consulting various matters. Nowadays, white-beard sometimes gets opinions from young educated people in the village. Villagers elect village councilors. Annual council meeting are held for council members.

2.12.3 Disaster Experience and Knowledge

(1) Flood Situation

In severely damaged villages, most people evacuated to elevated site being wet. Electricity went off due to heavy rainfall, sooner, their houses are inundated more than 1 m or even washed away. Some farmlands were damaged of itself or of its irrigation pipelines. Nearby civil structures and public facilities, such as bridge, school, police station were damaged. Falling rubles due to debris flow injured some people. Electric devises like TVs, refrigerators and furniture were damaged. Some villages incurred casualties. Most victims were women and children.

(2) Past Disaster Response

Many people got information from the regular TV news program. Some conveyed this information to villagers by motorbikes. Some village councilors could inform villagers about the possible flood before critical situation. Due to power failure, mosque speakers could not work to inform. Nobody instructed the evacuation beforehand, thus most people evacuated by their own decision, facing dangers of inundation of their houses, to the elevated site. Most village councilors informed the related public authorities but they could not reach villages because of the

inaccessibility of roads and bridges. Official relief by helicopter was failed because of the heavy rain; the relief could reach the next morning.

(3) Information Distribution System

The common way of distributing information is through the mosque speaker. No bulletin board was used. Mouth to mouth informal communication is commonly used and useful. In case of flood in the past, some council members utilized firing guns for information of extraordinary situation.

(4) Risk Perception of Flood and Debris flow

Majority of people in the flood experienced villages think the hazard of flood and debris flow is dangerous and that it is hard to cope with them. Thus, the awareness for such disaster is very high. The risk perception of flood is higher than debris flow.

(5) Analytical Capacity for Evacuation

Majority of people (90 %) know where they should evacuate, but several percents of the respondents do not know the evacuation place. Some people went to see the floodwater of the river to inform the villagers. Accurate flood monitoring system that can inform early warnings is very much expected by the villagers.

2.12.4 Participation

(1) Interest to Disaster Risk Management

Nearly 80 % of the respondents want to attend the disaster risk management activities. Type of activities they want to participate is active one; to become a member of the rescue team counted most, and to receive rescue and evacuation training, to become a member of disaster management committee.

In most villages, there are unwritten social and moral rules and obligations to participation. Those who refuse to participate are sometimes isolated from others.

(2) Self-help Attitude

Villagers have notion that public facilities are provided by the public sectors. Actually the system has been as such. Survey shows that the villagers have motivation of flood risk management. The past disaster made them motivated to react by their own of what they can do. Through workshops of disaster risk management in villages, the role of villagers, public sectors and local organizations can be delineated, and self-help attitude can be enhanced.

(3) Consideration to Women

Workshops for villagers need to be conducted separately for women. Village organizations like Basij have separate body for women. Red Crescent society can hold joint workshops. Based on the village survey, 5 % answered that the decision were left for the head of the family. However, women usually have complete decision-making power regarding their personal life.

2.13 Flood Monitoring and Warning System

2.13.1 General Condition

Telecommunication Conditions in the Study Area

(1) Fixed Telephone Service

The Iranian Telecommunication Company handles fixed telephone service. The diffusion rate of the nation is 18,497,653 lines against 60,055,488 population according to 1996-7 Censes), equivalent to 30 lines/100 persons. Golestan Telephone Company gives telephone service in Golestan province having 378,715 lines against 1,426,288 population, equivalent to 26 lines /100 persons. There are 1,055 villages within Golestan Telephone Company responsible area. Telephone lines already installed at 977 villages, and remaining 98 villages is under expansion of telephone lines using WLL (Wireless Local Loop) technology. Fixed telephone service in the Madarsoo River basin is well installed and ordinarily 56 kbs quality is guaranteed. Telecommunication Company has basic standard to install the public telephone exchange those village living inhabitants over the 100 populations. Village telephone exchange has Microwave network or fiber optical cable network to connect nearest bigger telephone exchange and distribute to village subscribers through electronics switch. However, small villages, such as Hagholikhajeh, Kahrizli, do not have telephone exchange.

(2) Mobile Telephone Service

There is only one service provider for mobile telephone. Mobile Telephone Company belongs to the Iranian Telephone Company that is one of government enterprise. 6,681,554 sets of hand terminal are operational in Iran that is equivalent 36 sets/100 persons. About 64,670 sets hand terminal are operational in the Golestan province that is equivalent 4.5 sets/100 persons and 116 mobile base stations were installed in the area. Semens GSM model 900 is installed. There is no service coverage map provided by the company. Installation of mobile base station in urban area is employed micro cellular that has many base stations in short distance. However, mountainous area dose not have such plural base station. It has installed on the top of mountain to keep wide propagation. It can cover huge service area. But mobile telephone service does not cover all area due to obstruction of the mountain. Therefore, this service does not cover the entire basin.

(3) Radio Communications

Radio Communication Regulatory of Iran (RCRI) is implementing agency for the management and control of the telecommunication in Iran. RCRI shall apply frequency allocation to the radiotelephone network.

Electrical Conditions

(1) Power Distribution Conditions

The power distribution system among the river basin has two types of power line. One is middle 4,400 V with 3 phases, and the other one is 220 low 220 V with 3 or 5 phases. 4,400 V is installed with the transformer depending on demand of the customers. Voltage fluctuation is quite huge.

(2) Power Failure in the Madarsoo Basin

Normally, power supply within the basin is stable. Planed power-down is announced to the public prior to the installation. According to the previous disaster management survey, power failure occurred in the early stage of the 2001 Flood. Power failure started at 30 minutes after the flood occurred in the middle basin. Even in the lower basin, power failure started at one hour after the flood occurred. During that time

mosque loudspeaker could not work. Therefore, power back-up system for the flood warning equipment is essentially necessary.

2.13.2 Organizational Conditions for Existing Flood Warning System

Organization for Flood Disaster Management in Golestan Province

For flood disaster management in the province, the responsible organization is Provincial Disaster Management Committee. General Governor of Golestan province organizes the Golestan Disaster Management Committee among the governmental agencies concerned. 27 provincial and governmental agencies are committee members. Table 2.72 tabulates major acting members during flood.

Table 2.72 Members of Provincial Disaster Management Committee

Organization in Province
Governor General (Chairman)
Managing Director of the Red Crescent in Province
General Manager of Road and Transportation in Province
General Manager of MOE in Province
General Manager of Meteorological Organization in Province
Commander of the Disciplinary Region in Province
Managing Director of Water and Sewage Company in Province
Managing Director of Telecommunication Company
Managing Director of Regional Power Company in Province
Chairman of Managing and Planning Organization in Province
Senior Commander of Islamic Revolutionary Guard Crops in Region (or in Province.)
Senior Commander of Army in Region
Commander of Besiege Resistance Forces in Province
Chairman of Commercial Organization in Province
General Manager of Voice and Vision of the Islamic Republic of Iran (Radio &TV)
Chairman of House and Urban Making Organization in Province
Chairman of MOJA in Province
Chairman of Islamic Assembly (Council) in Province
General Manager of State Welfare Organization in Province
General Manager of Economic and Financial Affairs in Province
General Manager of Culture and Islamic Guide in Province
General Manager of House Court (Administration of Justice)
Chairman of Education Organization in Province
Mayor of City Center in Province
Chairman of Islamic Republic House Foundation in Province
Chairman of the Municipals Organization in Province

Present Flood Information Flow

Fig. 2.105 illustrates present flood information flow. All flood information is concentrated into the Provincial Disaster Management Center (PDMC). PDMC will issue necessary instruction and order to related agencies as well as inhabitants in disaster-occurring area. Meteorological Office sends initial information on floods to PDMC in a form of weather bulletin or flood warning notice. PDMC issues an order to take action against floods to all agencies concerned.

Major organizations concerning the flood disaster management are described below. They are PDMC, Meteorological Organization and Red Crescent.

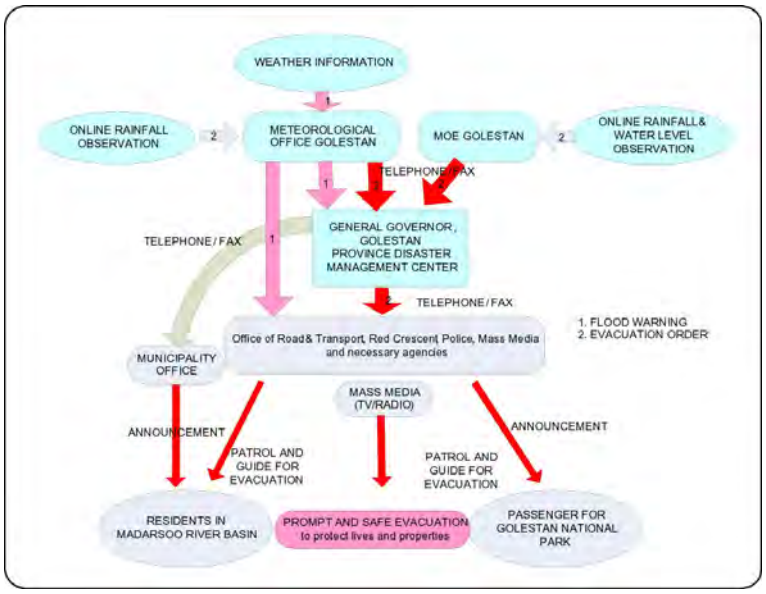


Fig. 2.105 Present Flood Information Flow

Provincial Disaster Management Committee (PDMC)

The core organization of the disaster prevention and fighting is Provincial Disaster Management Committee (PDMC) under General Governor of the Golestan Province. PDMC is decision-making organization for the disaster mitigation and necessary action to be taken by the committee members based on their disaster prevention and fighting action program. PDMC has only four staffs and no actual flood-fighting materials. Especially, PDMC takes an active part for coordination of flood warning and fighting, and recovery of damages by floods. PDMC staffs always are being ready for preparedness to the disaster occurrence.

Telephone including mobile and facsimile are used for communication between PDMC and Meteorological Organization (MET). Once PDMC instructs flood prevention/mitigation measures to the related agencies, the agencies shall obey such instruction. At the same time flood information is conveyed to the Ministry of Interior for preparation of flood in adjacent river basins. If flood situation becomes serious, PDMC establishes flood disaster task force in Gorgan city or disaster site, and calls necessary committee members to discuss proper countermeasures. During 9 to 10 August Flood in 2005, PDMC conducted such action especially to Red Crescent, police and office of road and traffic. They closed the road and conducted patrol activities in the Golestan National Park to make the visitors/campers evacuate out of the park. As the result, there were no casualties in the Madarsoo River basin in the 2005 Flood.

Meteorological Organization Golestan (MET)

MET issues two (2) kinds of weather information to PMDC as well as related government agencies and the public. Flood Notice is closely related to the flood forecasting and warning system. However, reliability of such information is not so high enough for flood forecasting since it is based on global weather information. For increase of reliability in spot weather forecasting, rainfall forecast for next three hours and the Radar Rain gauge system will be at least required.

(1) Weather Bulletin

MET shall issue the weather bulletin address to related governmental agencies when stormy weather and heavy rainfall can be foreseen. The general weather situation will be described on the bulletin for at least next 48 hours to one week ahead.

(2) Flood Warning Notice

After weather bulletin is issued, if probability of flood occurrence increases in a short period through their weather forecasting, MET shall disseminate flood warning notice to the General Governor Office and Provincial Disaster Management Committee for preparation of flood warning, evacuation and fighting.

Red Crescent Golestan

Red Crescent is the most organized and powerful organization for disaster prevention/ mitigation operation. It has enough experienced staffs and relief goods. Red Crescent Golestan has responsibility to act necessary prevention, evacuation and rescue before, during and after disaster. There is Red Crescent Road Center in Gorgan city and major towns have branch offices in the Golestan province that mainly work rescue activities for traffic accidents. At the same time, road center has also a function of local disaster rescue center. At first, Red Crescent receives weather bulletin and flood notice from MET, and then Red Crescent receives dispatch order to the disaster site through PDMC. Staffs of Red Crescent at the nearest branch office, including flood specialist and volunteers, will be dispatched to the disaster site for flood evacuation and fighting to coordinate with village chief. In this action, young volunteers play major roles of the actions. Therefore, Red Crescent promotes one-from-one-family program to increase numbers of volunteers.

2.13.3 Present Flood Warning System

MET Data Collection System

MET-Golestan, under IRIMO (Islamic Republic Iran Meteorological Organization), installed three climatologic and rain gauge stations connecting to public telephone line. Out of three stations, two stations are located in the Madarsoo River basin. Furthermore, MET plans to expand monitoring network, installing four more rain gauge stations as enumerated in the following table.

Table 2.73 Existing Online Observation Stations of MET-Golestan

Station	Class	Location (Deg. Min)		Elevation (m)	River Basin	Remarks
		Long. E	Lat. N			
Golestan Park	Climatologic	55.47	37.24	460	Madarsoo	Existing
Dasht	Climatologic	56.00	37.18	1,005	Madarsoo	Existing
Farsian Farang	Rain gauge	55.37	37.13	670	Oghan	Existing
Hossein Abad Kalposh	Climatologic	55.45	37.13	1,540	Oghan	Planning
Ghaleh Ghafeh	Rain gauge	55.29	37.03	1,200	Chehl Chay	Planning
Bidak	Rain gauge				Madarsoo	Planning
Dasht Shad	Rain gauge				Madarsoo	Planning

There are the following three kinds of observation station in MET.

(1) Climatologic stations monitor five elements of weather and rainfall data. Commercial power source is used as power supply.

(2) Rain gauge stations are same configuration except power supply as climatologic stations. Power supply has two kinds; AC 220 V for rain and snow gauging and solar panel power supply for only rainfall gauge.

(3) Online stations are connected to the public telephone line. It can provide real time data during stormy weather.

The equipment diagrams of the MET stations are comparatively shown in the following figure.

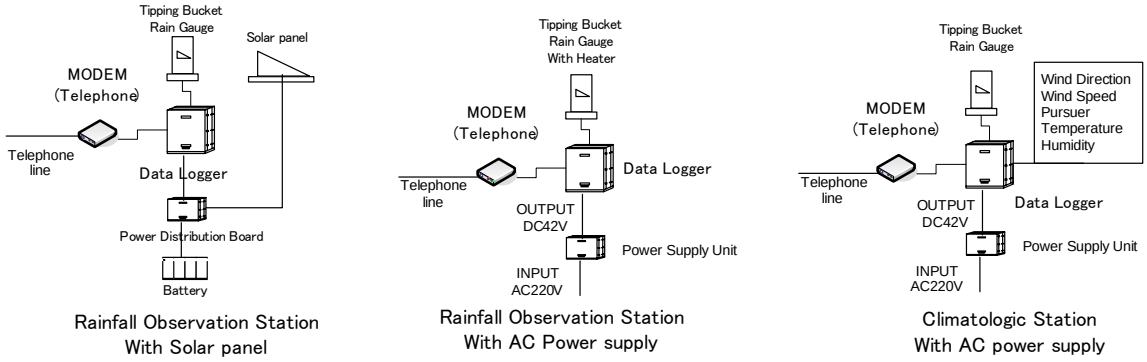


Fig. 2.106 Existing Rain Gauge Equipment Diagrams under MET

MOE Data Collection System

Ministry of Energy, Golestan office installed online observation stations for flood monitoring and warning after the 2001 and 2002 Floods. Four stations out of six are located in the Madarsoo River basin. The following stations are connected to MOE-Golestan office through the telephone network.

Table 2.74 Existing Online Observation Stations of MOE-Golestan

Station	Class	Location (Deg. Min)		Elevation (m)	River Basin	Remarks
		Long. E	Lat. N			
Tangrah	Water level	55.44	37.27	330	Madarsoo	
Dasht	Water level			1,005	Madarsoo	
Galikesh	Rain gauge	55.27	37.15	250	Oghan	
Dasht	Rain gauge				Madarsoo	
Narab	Rain gauge				Tillabad	
Dashy Shad	Rain gauge	55.55	37.16	1540	Madarsoo	

There are the following two kinds of online station in MOE.

(1) The rain gauge stations are same configuration with AC 220 V supply as rain and snow gauge of MET.

(2) Water level station monitors water level and non-charging battery is equipped.

All stations are connected through dial up public telephone line. The equipment diagrams of the MOE stations are shown in the following figure.

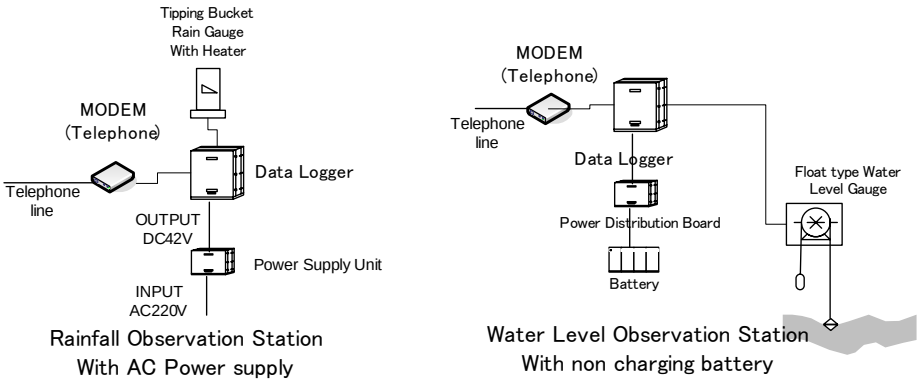


Fig. 2.107 Existing Rain and Water Level Gauge Equipment Diagrams under MOE

Data Transmission System

Data transmission of existing monitoring stations has two different systems; public telephone line and GSM mobile telephone network. Only two stations are connected to GSM mobile telephone network, while the existing online stations in the Madarsoo basin are connected to the public telephone network. GSM mobile telephone network is not utilized so far. MET has a plan to change public telephone line to GSM MODEM to solve interfacing problem between telephone network and data logger.

Data Processing system

Personal-computer-based system is employed for data processing both in MET and MOE.

(1) MET system

MET online data collection system software UMAD, made by German Mevis T version 1.7, has an automatic observation function. One of control functions is polling instant value (ON/OFF) and can be set any time-interval including online mode. This shall be used for automatic observation of every one-hour data collection as an online station. System has two inputs; one is GSM MODEM and the other is public telephone network MODEM. In case of flood event, both lines shall be connected as online bases. Therefore, real time online observation data for two stations can be received. Network connection for PC is shown below.

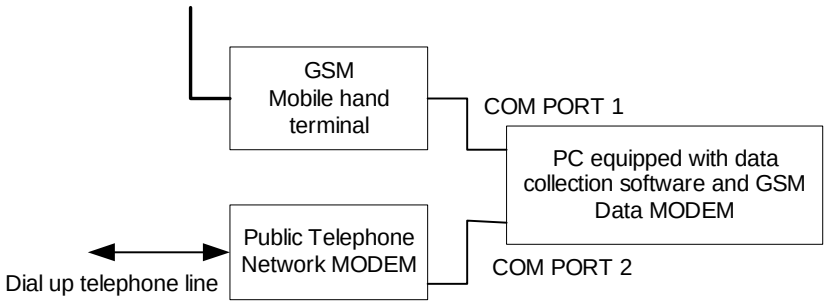


Fig. 2.108 Network Connection Diagram for MET System

(2) MOE System

MOE data collection system software HIDLAS, made by OTT, has a function for automatic data collection. This function has not been used so far, but it can be used for automatic observation of every one-hour data collection. Network connection for PC is shown below.

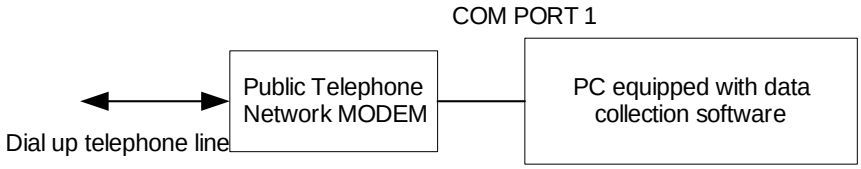


Fig. 2.109 Network Connection Diagram for MOE System

System Operational Condition

(1) MET System

Meteorological data collection rule is based on WMO standard. They have three kinds of time intervals for data collection as shown in the following table.

Table 2.75 Observation Time Interval

Type of station	Data collection interval	Observation time
Synoptic	24 times a day	Every one hour
Climatologic	Three times a day	6:30, 12:00, 18:30
Rain gauge	Once a day	18:30

- Synoptic stations observe meteorological data automatically, memorize in their data logger and send to the data collection computer every one-hour as a real time data collection system.
- Climatologic stations are accessed from data collection PC at MET through the dial-up telephone MODEM at fixed time-interval manually. Climatologic stations send back previous data stored in the data logger. When stormy weather is foreseen, the PC can connect to the stations continuously as online operation. Also, all stations can be accessed through polling mode in fixed time-interval. However, automatic real time polling mode is not equipped so far.
- At non-telephone connected climatologic stations, observers monitor temperature, humidity, wind direction, wind speed, air pressure and rainfall, and record them on the logbook. They inform the latest data to MET through the telephone three times a day.
- Rain gauge stations are accessed from data collection PC at MET through the dial-up telephone MODEM at fixed time-interval manually. The stations send back previous data stored in the data logger. When stormy weather is foreseen, the PC can connect to the stations continuously as online operation. Also, all stations can be accessed through polling mode in fixed time-interval.
- At non-telephone connected rain gauge stations, observers monitor rainfall and record it on the logbook. They inform the latest data to MET through the telephone once a day.
- Hardware of rainfall gauge stations has no significant problems so far, except Hagholkhajeh station. The data logger and battery has been stolen after installation. Small space with low fence caused its problem. Large space and tall fence shall be necessary for keeping security.
- Telecommunication problem still remains due to improper functioning of public telephone network. MET tries to change the network from public telephone line to GSM MODEM. However, GSM mobile telephone service does not cover the entire basin. Therefore, online stations connected to public telephone line have to remain until GSM mobile telephone service expands over the basin.

(2) MOE System

- Basic hydrological data collection is made in one-hour interval. On the other hand, flood forecasting and warning system requires 10-minutes data during heavy rainfall. The time interval of MOE online stations is basically every two-hour, and after office hour (14 o'clock) no observation is made until 8 o'clock in the next morning. In view of flood forecasting and warning system operation, MOE online data collection system cannot properly function.
- Rain gauge and water level stations are accessed from data collection PC at MOE through the dial-up telephone MODEM in fixed time-interval manually. Those stations send back previous data stored in the data logger. Therefore, the present system is not substantially real-time data collection system.

System Maintenance Condition

Normally, meteorological service requires 24-hour operation and maintenance for weather instruments in good condition. Therefore, MET has maintenance teams to repair the weather monitoring instruments including rainfall observation equipment. However, there is no regular and routine maintenance works established. Only maintenance teams will visit the site when some trouble happens.

MOE dose not have any maintenance team. The operator of data collection system will visit the site when some trouble happens. If he cannot repair the equipment troubled in the system, MOE will ask repair work to the system suppliers. There is no regular and routine maintenance works established.

2.13.4 Lessons in the 2005 Flood

Flood Events and Responses

In the evening of August 9 to the morning of August 10, 2005, heavy rain occurred over the Madarsoo River basin. It caused medium scale flood in the basin and caused serious damages on road and bridge in the basin. In the morning August 10, temporally flood survey was conducted along the Madarsoo River. At the same time interview survey was also conducted to the concerning agencies to confirm their activities before and during the flood. The occurrence of flood disaster and actions taken by the concerning agencies are below.

Date		Flood and Action
August 6	08:00	MOE could not collect all online stations' data due to telephone line and equipment problems.
August 7		MET issued weather bulletin to concerning agencies and private sector.
August 8	09:00	MET reported flood forecasting to the General Governor and distributed copy to 14 government agencies and private companies.
August 9	09:00	Red Crescent Golestan National Park Branch prepared for rescue action.
	09:00	Disciplinary region and traffic police prepared for dispatch of the officers.
	17:00	Road through the Golestan National Park was closed at both entrances by Disciplinary region and traffic police.
	19:00	Rainfall started in the Golestan National Park.
	20:00	Water level at Tangrah started rising.
	21:00	Peak hourly rainfall (80 mm/hour) was recorded at Golestan Park rain gauge by online data collection system of MET.
August 10	01:00	Noise originated by rolling stones in the riverbed became maximum level. Estimated water level at Tangrah was 420 cm.
	02:00	Water level of Dasht indicated highest water level 502 cm. (This data was gotten from the data logger later on.)
	02:00	Road at 14 Metery bridge was closed by the traffic police.
	04:00	Floodwater overtopped 14 Metery bridge.
	06:00	Floodwater overtopped the road on the west side from the 14 Metry bridge with about 500 m of width.
	11:30	Road around 14 Metery bridge was open for public.
	13:00	Office of Road and Transport started removal work of debris along the international corridor.
	16:00	There were no casualties in the National Park area, reported by Red Crescent.
	16:00	Staff of MOE visited to Tangrah water level station for data checking. Unfortunately, no data was recorded on the data logger due to equipment trouble.

August 10	18:00	There were no casualties along the Madarsoo River, reported through radio news. However, there are many casualties in the Agh Soo River basin. The flood killed around 36 persons according to radio report.

Lessons

The followings are lessons based on of action taken by related agencies in 2005 Flood in view of early flood warning system.

- MET issued a reliable flood notice having enough lead-time for evacuation.
- Related agencies such as police, MORT, Red Crescent, DOE Park Office stood ready to take necessary actions on 24-hour basis against floods.
- In view of early warning system, MOE monitoring system did not well function before the flood. Furthermore, MET online system also could obtain rainfall data at Golestan National Park only. MET could not receive rainfall data from the other stations due to the telephone line problems.

2.13.5 Major Issues and Possible Solutions for the Existing System

Basically, both MET and MOE data collection systems are not configured for the flood forecasting and warning system. The following issues are clarified throughout the field survey.

Data Collection System

MET system collected the past 1-hour, 3-hour, 6-hour and 24-hour meteorological data for weather forecasting purpose in normal condition. Once rainfall starts, MET will connect to particular station as an online basis to obtain real-time data. However, it is not fully automatic real-time observation mode.

MOE system collected the past 2-hour data for hydrological data collection purpose. The flood forecasting and warning system shall require monitoring real-time rainfall and water level data in at least 1-hour interval.

The data transmission network through the public telephone does not secure high reliability. Disconnection of the lines easily occurs during heavy rain/floods.

Tangrah water level station is not prepared for serious flood situations due to rare experience on big floods in the past. Height of water level gauge container is lower than the previous floodwater level in 2001. Extension of well and support material will be necessary.

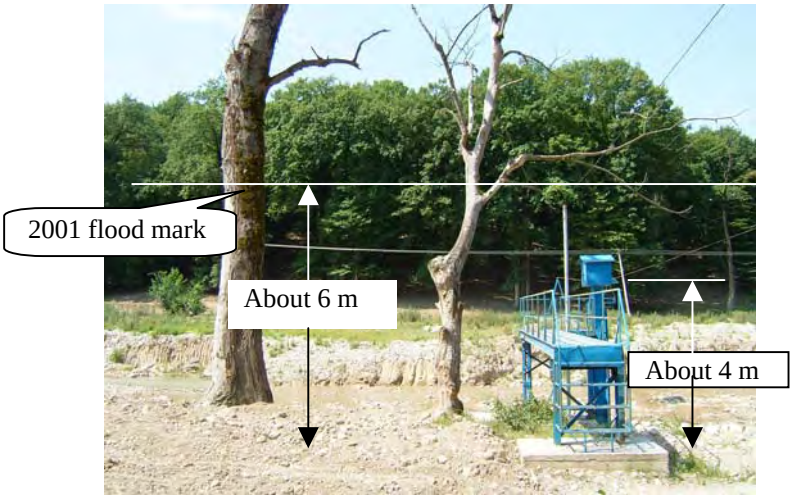


Fig. 2.110 Tangrah Water Level Gauging Station

Regarding Dasht water level station, sediment accumulation clogged the bottom of the steel pipe well as presented below. There are some holes in the middle of the well, but diameter of the hole is too small. It seems to create time delay during high water level.

Fig. 2.111 Dasht Water Level Gauging Station

Before the 2005 Flood, the telephone pole had been installed near the riverbed so that it had been apprehensive for washing-away in flood time. As a result, telephone pole near the station was washed away, and telephone line was broken in the 2005 Flood. Both water level stations of MOE need battery charger with solar panel. Solar system can charge battery all the time instead of battery charging work.

2.14 Institutional and Legal System

2.14.1 Status of Laws in Iran

Important laws in Iran related to flood disaster prevention are selected and translated for the review as listed in Table 2.76. It is noted that laws for environmental management has long history in Iran, as most of them were established in 1960s. Especially, the environment protection is mentioned in the Constitution of Iran, as well as in socio-economic and cultural development plan for a long time in Iran. Environmental policy appeared in Second National Development Plan (1995-2000), attaching special importance to environmental protection, primarily in the areas of air and soil pollution. Later, it is explicitly stated in chapter 12, "Environmental policies" in the third national development plan (2001-2004). Chapter 5 in Part 2 of the Fourth National Development Plan is also dedicated to Environmental Protection.

Laws for resource management such as "fair distribution of water" have been established in 1980s, which defines the responsibility of ministry of energy from the viewpoint of water resource management.

The Law for disaster prevention emerged in 1992, which defines responsible institutions and its coordination for different kind of disasters. Recently, "The Integrated Disaster Plan of Iran" was established in 2003, which states functions of responsible organizations and procedures of disaster prevention.

In the third socio-economic and cultural development plan, the article 181 states that "Government is required to provide in the annual budget bill during the Third Plan period, necessary funds to prevent, provide relief assistance to renovate and rebuild the areas damaged by unpredictable events". This Article is revalidated in fourth plan in Chapter 10 "national security" as well.

However, it is noted that in the definition of terms in Iranian laws, flood is not regarded as disaster. For example, "Flood control" is defined as "storage of water in surface or underground reservoir" in article 29 of "The law of fair distribution water". Similarly, "Watershed management" is defined as "management of environment of watershed that reach best objective of the management for sustainable utilizing" in the "Executable decree for law of the protection and stabilization of the bed and bank of the river that pass from the border of the country".

Table 2.76 List of Important Laws Related to Flood in Iran

Year	Area	Name of Law
1963	Forest	National Forest Law
1967	Environment	Game and Fish Law
1968	Forest	Protection and Utilization of Forest and Range
1975	Environment	Protection and Enhancement of Environment Law
1979	Environment	Constitution, article 45 and 50
1983	Water	Fair Distribution of Water
1984	River	Protection and Stabilization of Riverbed & Banks of River that Pass from Border of Iran Country
1986	Insurance	Agriculture Production Insurance Fund Law
1989	Development	The First Socio-Economic and Cultural Development Plan
1992	Disaster	Organizing National Committee to Decrease Effect of Natural Disaster
1995	Development	The Second Socio-Economic and Cultural Development Plan
2000	Development	The Third Socio-Economic and Cultural Development Plan
2000	Watershed	Establishment of MOJA
2003	Disaster	The Integrated Disaster Plan of Iran
2005	Development	The Fourth Socio-Economic and Cultural Development Plan

2.14.2 Flood Prevention Measures in Iran

Though not specifically mentioned in the law, there are many efforts for flood disaster prevention among different institutions in Iran. In Iran, each ministry has provincial office, and provincial office from each ministry forms provincial government, with a governor appointed by central government as a chief. In this section, key institutions are described. Responsibility and interests among related institutions are summarized in the following table.

Table 2.77 Interests and Responsibilities among Institutions in Iran

	Forest	Water	Road	Disaster
MOJA	Exploitation Forestation	Watershed management		Recovery
MOE		Water Resources, River		Recovery
MORT	Exploitation	Road protection	Road construction	Warning (IRIMO)
DOE	Environmental Protection		Recovery	
MPO	Development		Recovery	
MOI	Prevention		Response	

Watershed Management

Ministry of Jihad-e-Agriculture (MOJA) has two important functions, biological and mechanical measures, related to flood disaster prevention. In provincial level, Natural Resource General Office (NRGO) is responsible for biological measures such as forestation. The development of watershed management in Iran is summarized as shown below. Watershed management department is responsible for mechanical measures such as check dam construction. In Tehran, these sections are merged as Forest, Rangeland and Watershed Organization (FRW).

Table 2.78 Development of Watershed Management in Iran

Period	Activities
1968	Foundation of Ministry of Natural Resources
1968-1971	Four watershed management works started.
1972-1981	Dispatch of Iranian experts to abroad. Foreign consultants studied on master plans. People's participation in watershed management was taken into account.
1982-1988	Sediment problem emerged. Comprehensive definition of watershed management was defined.
1989-1993	Preservation of development, rehabilitation of natural resources in First development plan.

Source: Behbahani, 1994

Agriculture Insurance

In Iran, the history of agriculture insurance dates back to 1970, but the insurance was actually implemented since 1984, as summarized in Table 2.79. The Insurance Fund is administered through a Head Office in Tehran, 29 provincial Directorates and a total of more than 1750 Agricultural Bank branches in the country. The Minister of Agriculture, as the head of the Fund's General Assembly is responsible for the administration of the program through the Board of Directors. Participation to the agricultural insurance is voluntary basis, but governmental support for premium payment gives strong incentive for farmers' participation. The chief perils covered are: flood, hail, storm, windstorm, heavy rainfall, frost, frostbite, and earthquake. So far debt is covered in limited manner.

Premium rating is evaluated by factors such as the rate and the probability of occurrence of perils over a period of at least five years, the weighed average yield, and the production cost per hectare, the loss cost, the loss ratio etc. The insurance of the public investment in forestry,

pasture's byproducts, and in the mechanical section of watershed management are under study.

The Fund has extended the active areas of insurance from 2 provinces to all 29 provinces of the country thus increasing the areas insured from 90,000 ha in 1984 to nearly 6 million ha at present. The range of products, both agricultural and horticultural has increased from cotton and sugar beet to 25 main products in addition to livestock, forestry and pastures.

Table 2.79 Development of Agriculture Insurance in Iran

Period	Performance
1970	The Ministry of Agricultural Production and Consumer Products began studies.
1974	The Ministry of Cooperatives drew plans.
1976	Agricultural Products Insurance Law was taken to Ministry of Commerce.
1979	Bill passed to establish the Relief Fund for Damaged Agricultural Units.
1983	Agricultural Products Insurance Law was established.
1984	The insurance scheme started on cotton and sugar beet in two states.
1994	Strategic livestock insurance started.
1997	Insurance in forestry, pastures, and watershed management started.

Source: http://www.aiiri.gov.ir

Development Control

Management and Planning Organization (MPO) was formed in March 2000, by the amalgamation of two major and powerful organizations, namely PBO (Plan and Budget Organization) and SOAE (State Organization for Administrative and Employment Affairs) and formally began its activities as of July 2000. MPO was formed to help realize the President's responsibilities and authorities and also to pave the way for integration and consolidation of macro management in the country.

MPO works with provincial governor to allocate budget to each ministries. The budget for the projects in province is coordinated by MPO. Currently, about half of the budget comes from central government, while another half comes directly to the local government.

Ministry of Housing and Urban Development (MOHUD) plays an important role in development control, as it is responsible land management and development control of towns and cities. In the rural area, Housing Foundation is in charge of controlling the housing development. The main legal tasks of MOHUD related to development control are as follows.

- Providing the comprehensive plan for land
- Preparing and adjusting the executive policy for urban management
- Determining the types of activities in each city or town
- Evaluating the cities' road maps in region or country for future and present
- Determining the future location of cities and population
- Localization of the new cities
- Determining the rate of cities development and capacity in future and present
- Determining the regional plan in a region including one or more township
- Providing the comprehensive plan of cities

Disaster Management

In 1992, the law of organizing national committee for decreasing effects of natural disaster was established, which aims to exchange information, study, science research and to find logical solutions for prevention and decreasing the effects of natural disasters. The prime minister is the chairman of the national committee, and the prime minister orders about formation of the provincial committees under the chairman ship of the provincial governor.

The organization structure for national and provincial committee of disaster is illustrated in Figs. 2.112 and 2.113, respectively.

Different members are defined for different kind of natural disasters in "Executive Regulation of Law about Forming a National Committee for Decreasing the Natural Disaster". For flood and oscillation of seawater and turbulence of river is under the responsibility of Ministry of Energy (MOE). The members for flood are as follows: Ministry of Interior, Ministry of Energy, Ministry of Jihad-e-Agriculture, Ministry of Road and Transport, Ministry of Housing and Urbanization, Building and Housing Research Center, Radio and TV Organization, Meteorology Organization, Geology Organization, Ministry of Telecommunication.

According to this executive regulation, related ministries in both central and local level are required to have a meeting regularly to discuss disaster prevention activities. The main topics in such discussion are budget for new projects from provincial office of different ministries. After the 2001 Flood in Golestan, there has been "flood committee" steered by MOJA. Later on, the committee is merged in provincial disaster committee under urban development department of provincial government.

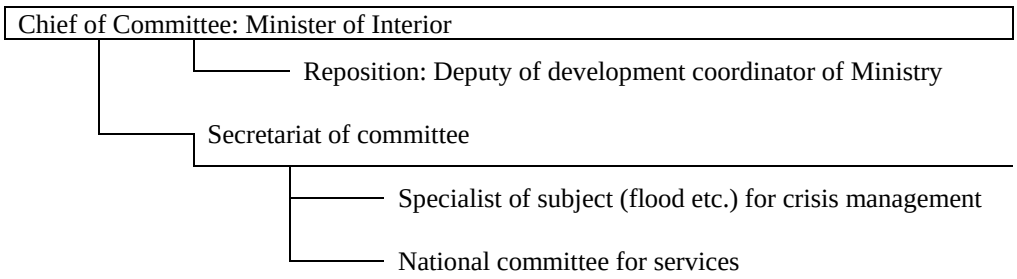


Fig. 2.112 Structure of National Committee of Disaster

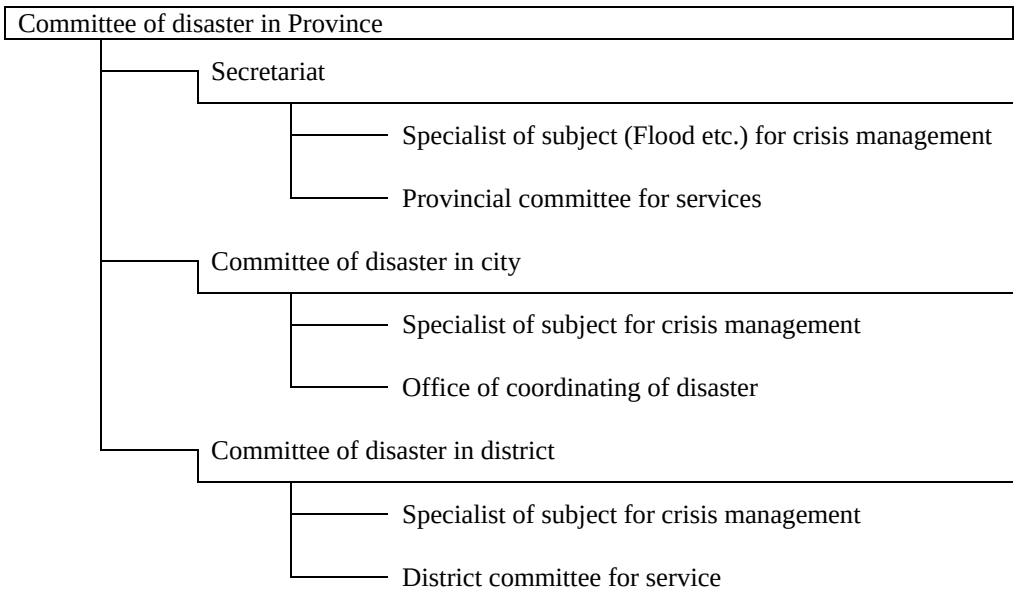


Fig. 2.113 Structure of Provincial Committee of Disaster

2.15 GIS Database Configuration

2.15.1 GIS Database Design

Through the study, JICA study team found necessity to generate a high quality GIS database for flood control. The index map of the GIS database is shown in the following figures.

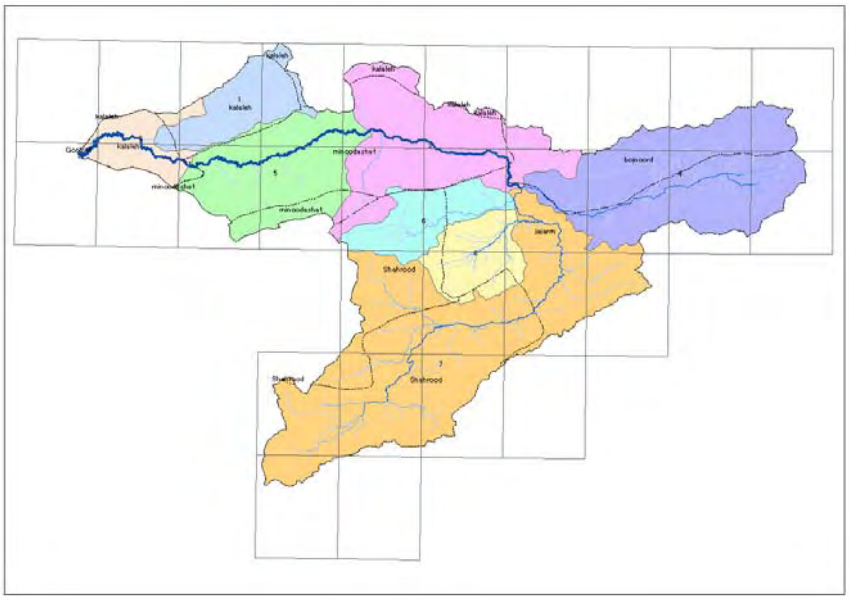


Fig. 2.114 Image Map of Madarsoo River Basin

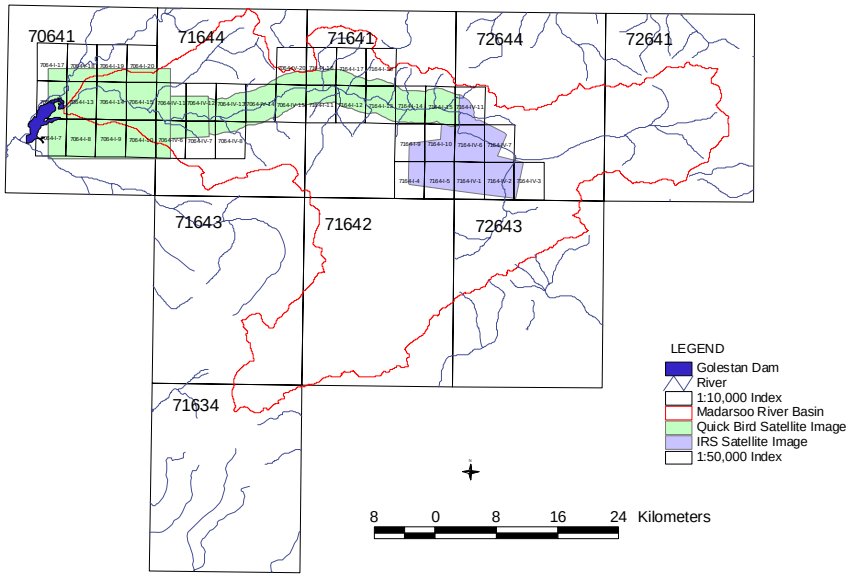


Fig. 2.115 Index Map of GIS Database Design

The GIS database covering the whole Madarsoo River basin is based on 1:50,000 scale topographic map. The study area is covered with nine map sheets as shown in the above index map. There are five categories: 1) basic data, 2) topographic data, 3) natural environmental data, 4) social economic data, and 5) disaster-related data, as shown in the following table.

Table 2.80 Specification of GIS Database

Data		Data Type	Data Source	Attributions
Basic Data	Administration boundaries	Polygon, Line	Topographic Map (1:50,000)	Statistics data
	Basin Boundaries	Polygon, Line	River and DEM (1:50,000)	
Topographical Data	Road Network	Line	Topographic Map (1:50,000)	Road Name and Payment Condition Code
	River Network	Line	Topographic Map (1:50,000)	River Name, River Class Code
	Water Body	Polygon	Topographic Map (1:50,000)	Name
	Build up area	Polygon	Topographic Map (1:50,000)	Name and Type
	Villages	Point	Topographic Map (1:50,000)	Name, Type and Statistic Data
	Major Building in Disaster Area	Polygon	Arial Photo	Name and Type
	Contours	Line	Topographic Map (1:50,000)	Elevation
	Land Cover and Land classification	Polygon	Topographic Map (1:50,000)	Type, Class Code
Natural Environment data	Land Use	Polugon	Land Use Map (1:250,000)	Type and Name
	Geology and Fault Line	Polygon, Line	Geological Map (1/250,000)	Geological Classification
	Soil Distribution	Polygon	Soil Map (1:250,000)	Soil Type
	Rainfall Distribution	Polygon	Rainfall Map (1:500,000)	Average Rainfall per month
	Natural Protect Area	Polygon	Natural Protect Map (1:500,000)	Name and Type
Social Economy Data	River Structures	Line and Point	Topographic Map (1:50,000)	Name, Type and Built Date
	Rainfall and Hydrological Stations	Point	Existing Map	Name and Type
	Historic, Cultural and Tourism Points	Point	Existing Map	Name and Type
Disaster Data	Past disaster areas	Polygon	Survey Data and Existing Map	
	Statistic Data related to Past Disaster	Text Doc and Photos	Survey	Description of disasters

In the disaster area of the Madarsoo River basin, the team designed a big scale (1:10,000 scale) GIS database. This database is generated by Quick Bird satellite imagery. The data layer includes topographic features, detail building and residence information as shown below.

Table 2.81 Specification of GIS Database Design in 1:10,000 Scale

Data Content	Data Description
1:10,000 Topographic Map Features	According to USGS design, 2.0m interval contour line and 1.0m interval sub-contour line, roads and their widths, bridges and their lengths and widths, buildings, rivers, irrigation canals, vegetation covers, specified areas, etc.
Building and Residence Information	Height, material, construction year, type of building owner, residence number, phone number, etc.

2.15.2 Adjustment of GIS Database Design

Through the investigation, the team found that there was a 1:25,000 scale topographic map covering the Madarsoo basin except for rivermouth area around the Golestan dam reservoir. Thus the team adjusted the GIS database design to use the 1:25,000 topographic map instead of 1:50,000 topographic maps for getting higher quality of GIS database. The GIS database established in this study is as follows.

Table 2.82(1/2) Specification of Adjusted GIS Database

Category	Layer	Data Type	Data Source	Attributions
Data Source Preparation	LANDSAT ETM+	Image	Satellite	8 Band
	IRS LIC	Image	Satellite	4 Band
	IRS PAN	Image	Satellite	1 Band
	QuickBird	Image	Satellite	5 Band
	Stereo Arial Photo 1:40,000 scale	Arial photos	Stereoscope interpretation	Panchromatic
	Topographic Map 1:50,000 scale	Scan Map		
	Topographic Map 1:25,000 scale	Scan Map		
	Geology Map 1:100,000 scale	Scan Map		
	GPS Point	Point	Field Survey	X, Y, Z
Administration and Basin Boundary Data	Administration boundaries	Polygon, Line	Topographic Map (1:25,000)	Statistics data
	Basin boundaries	Polygon	River and Contour (1:25,000)	Name, ID
Social Economy Data	River Structures	Line and Point	Topographic Map (1:25,000)	Name, Type and Built Date
	Rainfall and Hydrological Stations	Point	Existing Map	Name and Type
	Historic, Cultural and Tourism Points	Point	Existing Map	Name and Type

Table 2.82(2/2) Specification of Adjusted GIS Database

Category	Layer	Data Type	Data Source	Attributions
Natural Environment data	Land Use	Polygon	Land Sat ETM, IRS-LISSIII and PAN; Land Use Map (1:250,000)	Type and Name
	Soil Distribution	Polygon	Soil Map (1:250,000)	Soil Type, Label and Describe
	Natural Protect Area	Polygon	Natural Protect Map (1:500,000)	Name and Type
	Rainfall Distribution	Polygon	Rainfall Map (1:500,000)	Average Rainfall per month
	Geology and Fault Line	Polygon, Line	Geological Map (1:100,000)	Geological Classification
Topographic Data	Road Network	Line	Topographic Map (1:25,000)	Name and Payment Condition Code
	River Network	Line	Topographic Map (1:25,000)	Name, River Class, STR-order
	Water Body	Polygon	Topographic Map (1:25,000)	Name and Type
	Build up area	Polygon	Topographic Map (1:25,000), Satellite Image	Name and Type
	AS-BUILD-LINE	Polyline	Topographic Map (1:25,000)	ID, Describe
	Villages	Point	Topographic Map (1:25,000)	Name, Type and Statistic Data
	Contours	Line, Point	Topographic Map (1:25,000), Topographic Map (1:50,000)	Elevation
Topographic Map Data (1:10,000)	Land Cover	Polygon	Quick Bird Satellite Image	Type
	Contour Lines	Line	DEM and Field Point Survey	Elevation
Hazard Map Generation Data	Flood Event in Past Years	Text Doc, Photos and Videos Album	Survey Data and Existing Map	Record and coordination of every flood event
	Flood Simulation for 25 and 100-year Flood	Polygon	Mark 11 Simulation with DEM and other GIS data	
	Landslide Disaster Data	Polygon	Land Classification	Code, Class Name

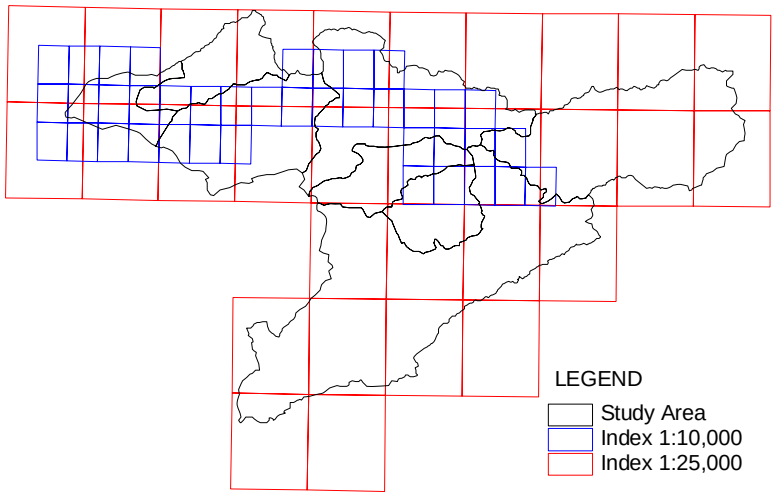


Fig. 2.116 Index Map of GIS Database

2.15.3 GIS Data for Hazard Map Generation

In the disaster area, the team also collected the flooding information in the past. Furthermore the analysis result for the future flooding was also prepared into the GIS database for hazard map generation.

Flood Event in the Past

Through the interview survey and flood information collection, the team established a flood event database. It includes record and coordination of every flood event in the past years with a photos and video album. The flood event map image is shown in the following figure. This information can be used in generating an education hazard map.

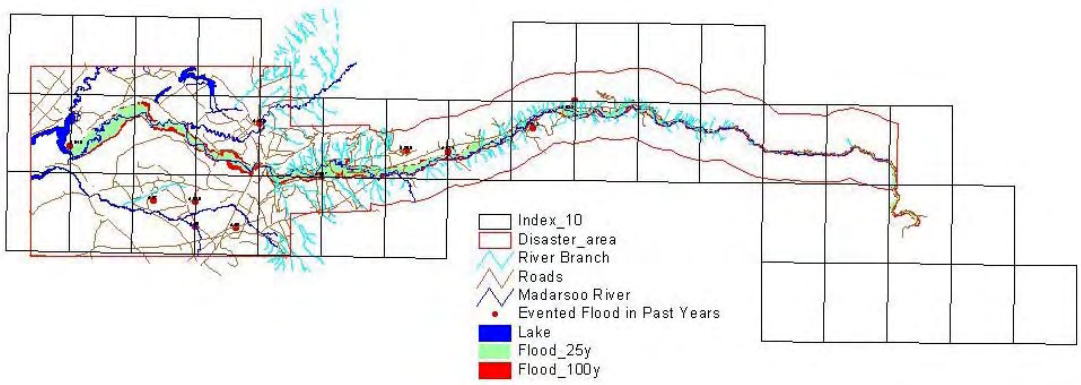


Fig. 2.117 Image Map of Disaster Data

Flood Simulation for 25- and 100-Year Flood

The team used the above GIS database in flood simulation for 25- and 100-year. To overlay this simulation result with the other GIS data layers, such as Quick Bird Image data, it is easy to understand the areas where are prone to affect the flood disaster in the future. Therefore

people could be known the areas where are safe places and how to reach there. This information could be used in generating emergency hazard map.

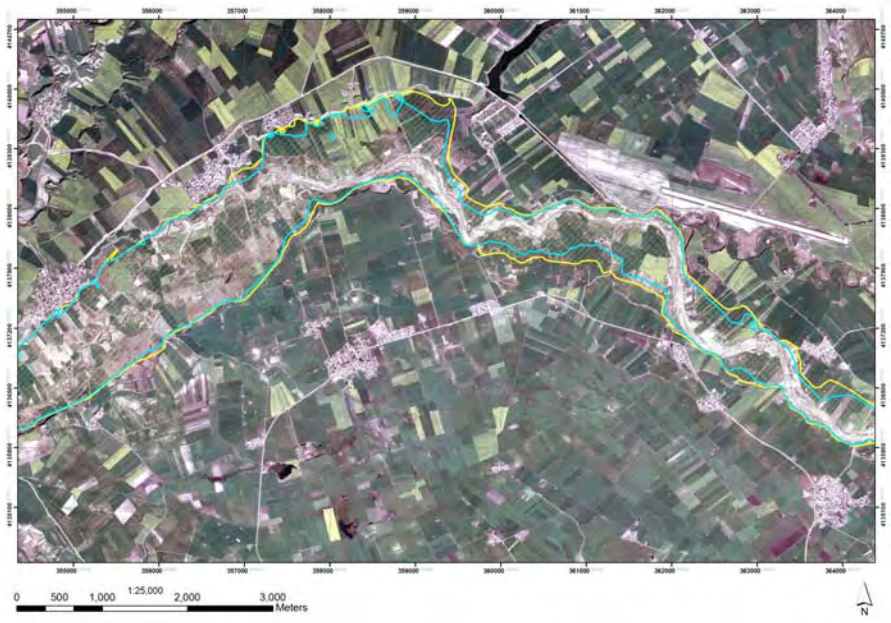


Fig. 2.118 Image Map of Flood Simulation for 25- and 100-Year Flood

Landslide Disaster Information from Land Classification

Using Land Classification data in GIS database, the Landslide disaster area can be easily clarified. Then, to overlay this landslide data with other GIS data layers, such as slope, geology, land use, buildings and so on, people will easily know where landslide disaster tends to occur, and where should be handled in high priority. Furthermore, flood control experts can use this information to reduce the damage from the flood and debris flow disaster.

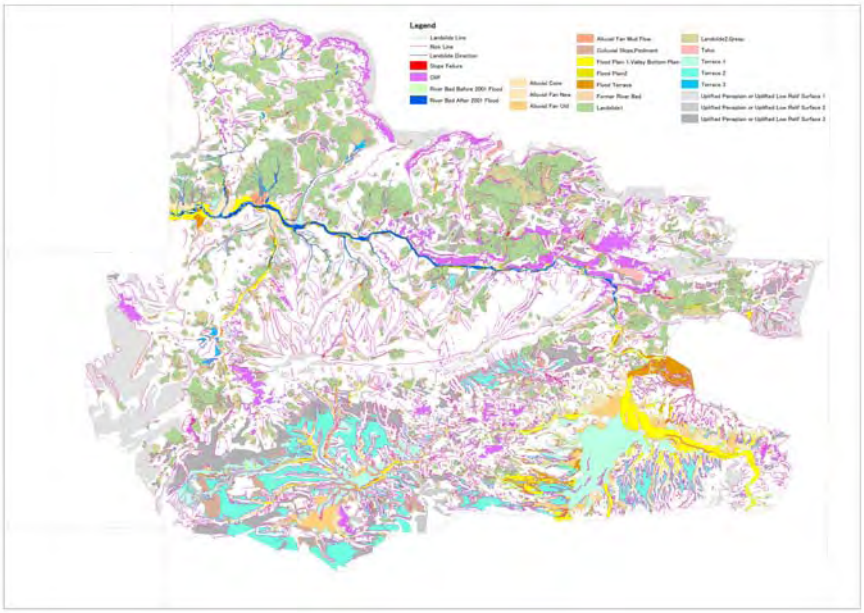


Fig.2.119 Image Map of Land Classification Information