

**THE STUDY
ON
FLOOD AND DEBRIS FLOW IN THE CASPIAN COASTAL
AREA FOCUSING ON THE FLOOD-HIT REGION
IN GOLESTAN PROVINCE
IN
THE ISLAMIC REPUBLIC OF IRAN**

FINAL REPORT

**VOLUME III-1
SUPPORTING REPORT I
MASTER PLAN**

OCTOBER 2006

Japan International Cooperation Agency

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**MINISTRY OF JIHAD-E-AGRICULTURE
THE ISLAMIC REPUBLIC OF IRAN**

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PAPER II	SOCIO-ECONOMY
PAPER III	BASIN TOPOGRAPHY, LAND USE AND GEOLOGY
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SUPPORTING REPORT I (MASTER PLAN)

PAPER I

Basin Physical Features

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PAPER I BASIN PHYSICAL FEATURES

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CHAPTER 1 BASIN FEATURES

1.1 Geographical Features

The Madarsoo River Basin was defined as a river system connecting to the Gorgan River at Garkar, Minudash, Golestan Province with a main stream originated from the mountain range in Nardein, Semnan Province passing through Dasht, Khorasan Province. In addition, Cheshmeh Khan River, one of the tributaries expanding the river basin eastward, meets the main stream at near Dasht downstream. The whole area of the river basin is 2,340 km² and expands between 55° 21' and 56° 28' in east longitude, and between 36° 58' and 37 ° 30' in north latitude.

The feature of the river basin was described in some sub-areas, which have prominent characteristics in meteorological and topographical aspects. They are; (1) Nardein-Sefid Daly, (2) Sefid Daly-Dasht Shad, (3) Dasht-Tangrah, (4) Tangrah-Chahardah Bridge and Chahardah Bridge-Garkar; Ghyz Ghaleh sub-basin; Dasht-e-Sheykh sub-basin; Cheshme Khan sub-basin; Kondoskooch sub-basin; and Agh Soo sub-basin.

General Map was shown in Figure 1.1.

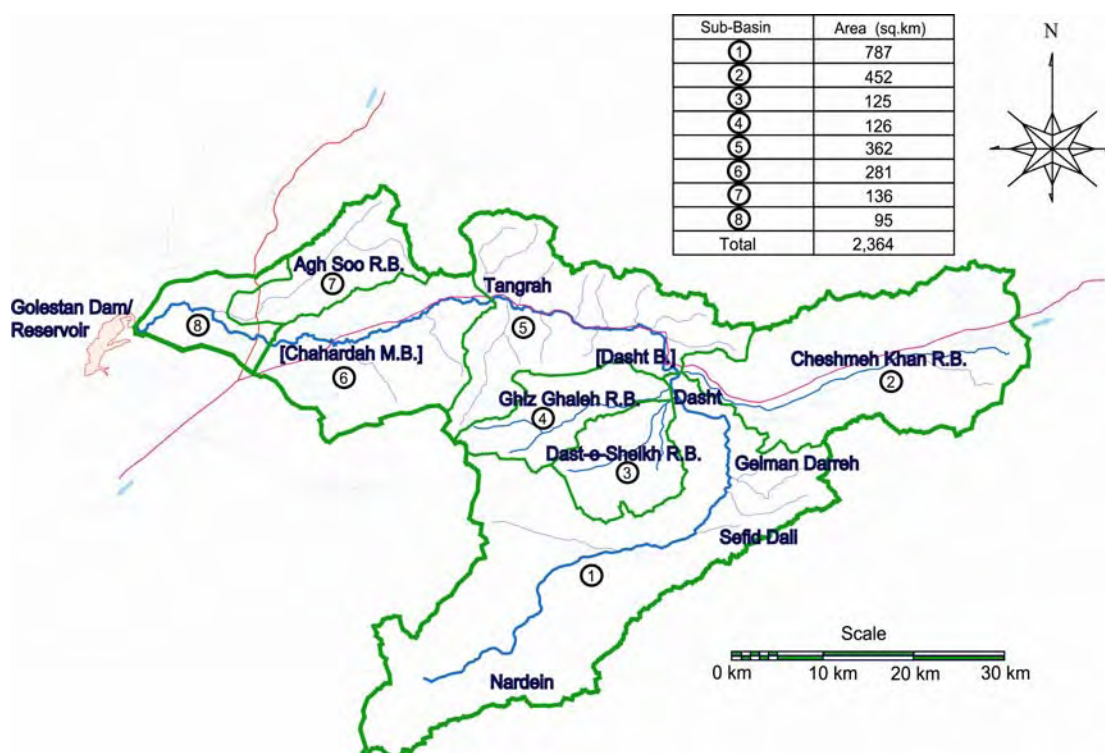


Figure 1.1 General Map of the Madarsoo River Basin

1.2 River Morphological Features

1.2.1 General Features

Riverbed longitudinal profile of the main stream taken from topographic maps with a scale of 1/50,000 is around 142 kilometers in length and 1.4 % in average slope, with 4.8 % in mountain side of Nardein, 0.6 % in Nardeen-Sefid Daly plain, 1.2 % from Sefid Daly to Dasht Bridge, 1.9 % shown in Golestan Forest from Dasht Bridge to Tangrah, and 1.1 to 0.7 % from Tangrah to the Golestan Dam Reservoir in average slope. They are shown in Figure 1.2.

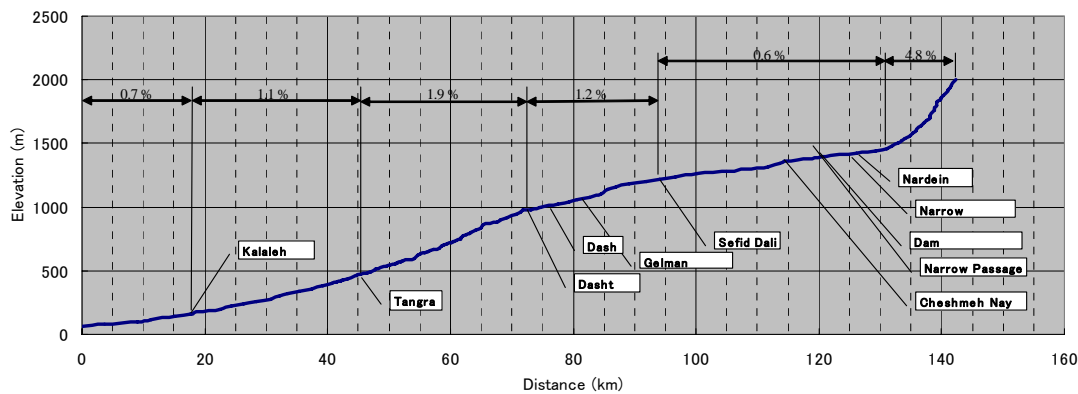


Figure 1.2 Riverbed Longitudinal Profile of the Madarsoo Mainstream

In comparison with the main stream, some of sub-basins had different feature in longitudinal profile. Ghys-Ghaleh and Dasht-e-Sheikh have steeper slopes than the main stream while Cheshme Khan has a similar slope to the mainstream, as shown in Figure 1.3.

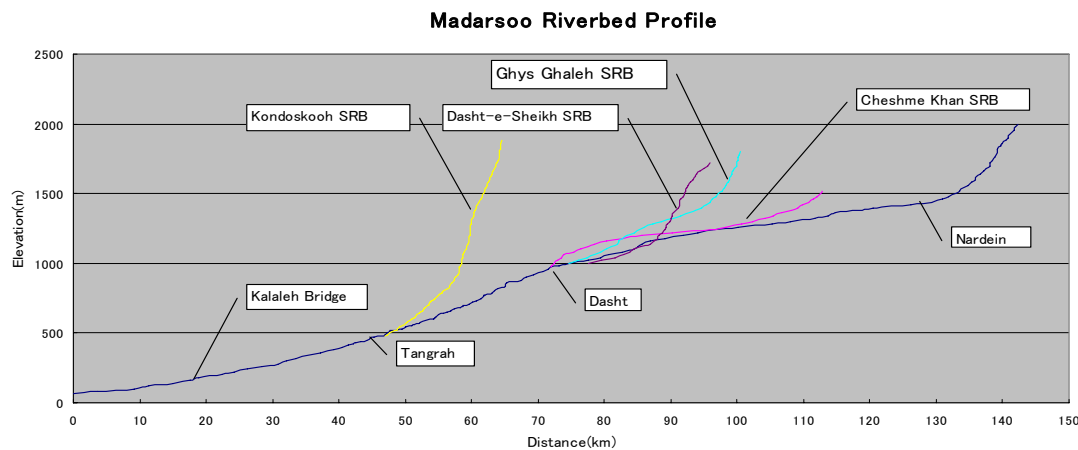


Figure 1.3 Riverbed Longitudinal Profiles in the Madarsoo River Basin

Between Dasht and Tangrah, many branches poured into the main stream. Among them Kondoskooch River is located at downstream-end and holds the biggest catchment in this segment.

1.2.2 Mainstream

Nardein-Sefid Dali

In this area, there are no marks found of river flow or riverbed so that the streamline is supposed to connect the bottoms of continuous U-shape valley shown on the contour lines of topographic map.

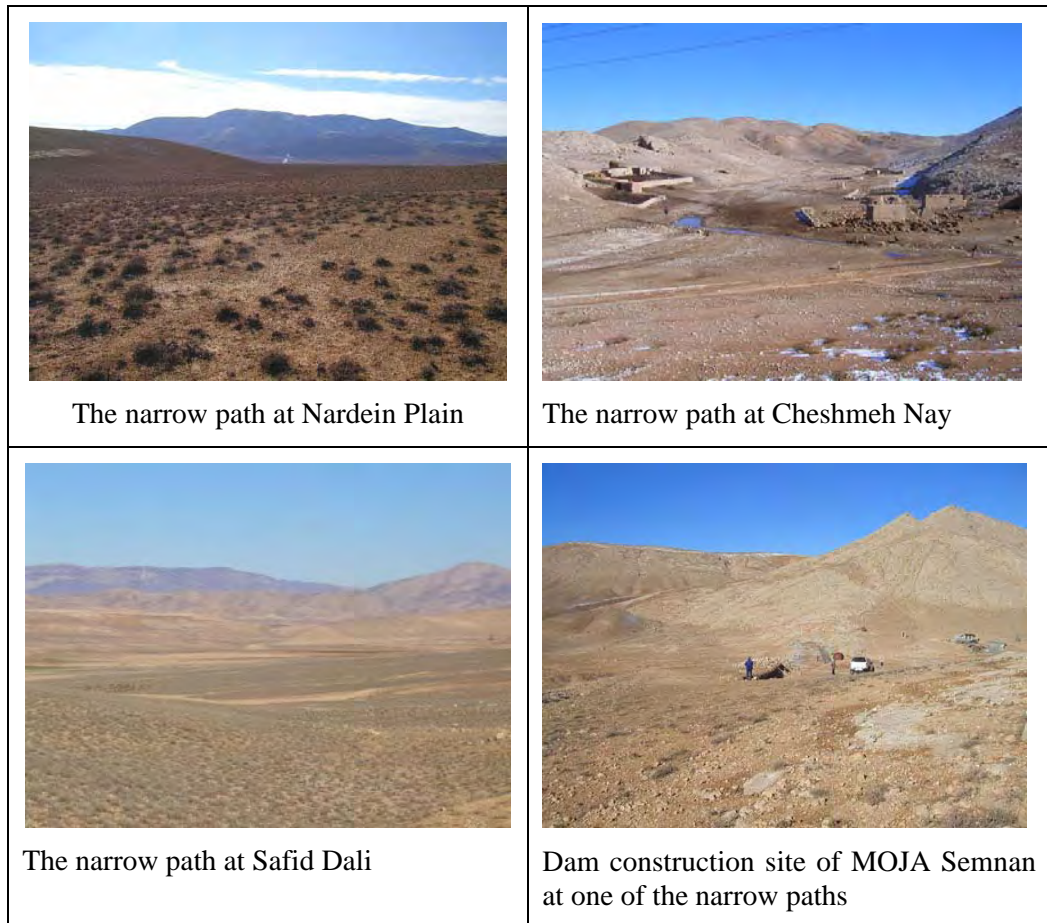
Uppermost of this basin is situated in mountains, peaks of which were higher than 2,000 m EL, in the western side of Nardein with slope of 4.8 % in average. The watercourse from Nardein towards Northeast passing through a flat plain, located at 1,415 to 1,420 m EL, which once ended at narrow path before the watercourse reached to Cheshmeh Nay, then via Kahrizli reached Sefid Dali with around 35 km in distance and 0.6 % in average slope. Among the three of narrow paths, at one of which is placed dam construction by MOJA Semnan.

Through these paths, no marks of river flow like sand and gravel remained also were found except small ditches with less than 1 m in width.

At Nardein, qanat was found but it has already been abolished because of no water underneath.

Results of the total observation suggest that the flat plain have worked as retarding basin to flood flow so that this area have not contributed causing flood to the downstream areas.

There are some existing check dams on the hillside and groundwater recharge ponds in the mouths of valleys at the south side of the basin and dam construction was on-going at one of the narrow paths.

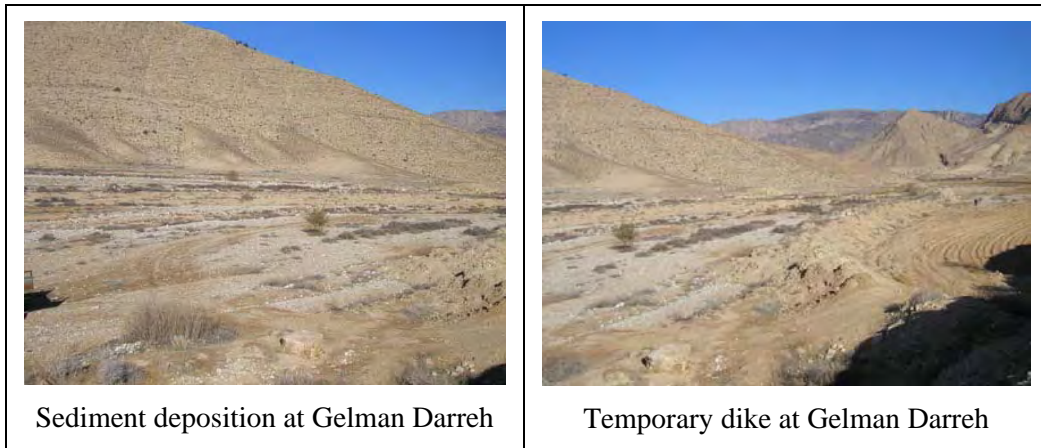


Sefid Dali-Gelman Darreh

At Sefid Dali, the main stream enters the narrow path toward Northeast, changes its direction to North, and then goes out of Gelman Darreh, where the east end of Dasht Plain. Over the riverbed near Gelman Darreh, thick sediment has been accumulated. This stretch has 1.2 % in average slope and 20 km in distance. There is clear riverbed with sand and gravel found in the watercourse at Gelman Darreh. According to the site observation and aerial-photo interpretation, the river course meanders and the riverbanks are vulnerable to erosion in this stretch.

Farmland has been developed in this area, which suffered floods and sediment deposition in the 2001 and 2002 Floods so that temporary dike was constructed with sand and gravel collected from the riverbed nearby. The trace of the floodflow and sediment deposition could not be seen in the area at the east end of Dasht Plain.

Result of the site observation and aerial-photo interpretation suggested that the floodflow in this area has affected this stretch with sediment deposition over the farmland, but may not have much contribution causing of flood against the downstream.



Gelman Darreh-Dasht

In this stretch with around 10 km in distance along the stream, the main stream merges the sub-basins of Dasht-e-Sheikh and Ghyz Galeh going to the East and meets the sub-basin of Cheshmeh Khan at the right upstream of Dasht Bridge. Riverbed meanders in Dasht Plain, which mostly has been cultivated as farmland. There is a narrow valley at the junction of the mainstream and Cheshmeh Khan. The topographic feature suggests that this area has a function of flood retarding.

Dasht village has suffered serious damages in human lives and farmland from the 2001 flood. Floodflow attacked the village from four ways, two came from Ghyz Galeh, one came from Dast-e-Sheikh and the other came from Gelman Darreh as shown in Figure 1.4. Some of dams had collapsed in those river basins during the flood but their effects to the flood could not be specified due to lack of solid evidences.

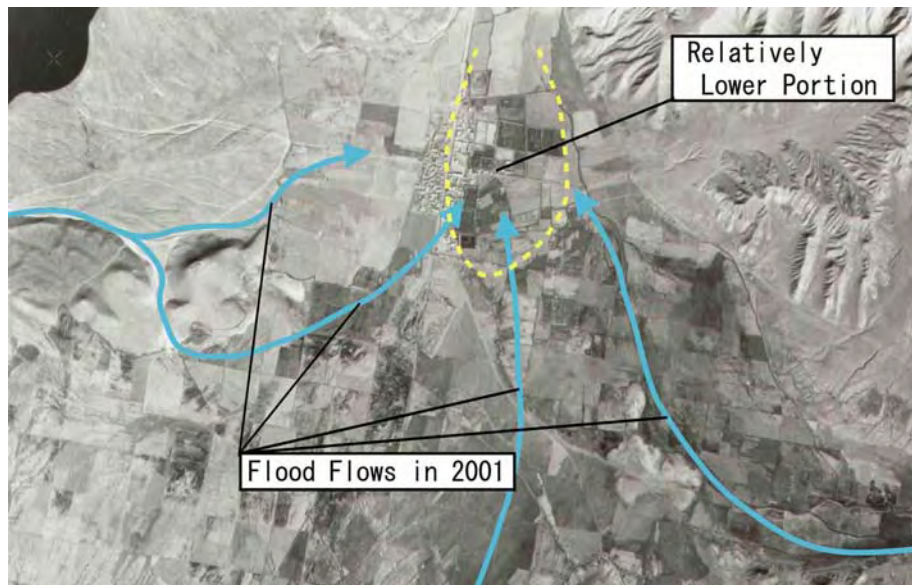


Figure 1.4 Flood Flows in Dasht during the 2001 Flood

This image was prepared based on the information from interview to the villagers and site observation without topographic survey.

Dasht-Tangrah

After the junction of the mainstream and Cheshmeh Khan, the mainstream runs through the valley of Golestan Forest and reaches at Tangrah with around 35 km in distance and 1.9 % in average slope. On the way of the streamline in this area, the stream and the main road conflicted in the narrow passages each other. Some of the geological fans, projected to the stream and exposed to the river flow attacks, has been eroded at toe portion with 5 to 6 m in height of sediment deposition layers. According to the aerial-photo interpretation, the road had been placed on the fans vulnerable to erosion; bridges had had narrow span or culverts that caused to chalk the river courses in some locations.

(1) Dasht-Chesmeh Khan Junction

Soil layer with 5 to 7 m in height is exposed in the entire area at junction of the mainstream and Cheshmeh Khan River. This soil exposure was caused by bank erosion during the 2001 Flood, and the 2002 Flood expanded the area, while it had been deposited with thick sediment before the 2001 Flood. (See Fig.1.5.)

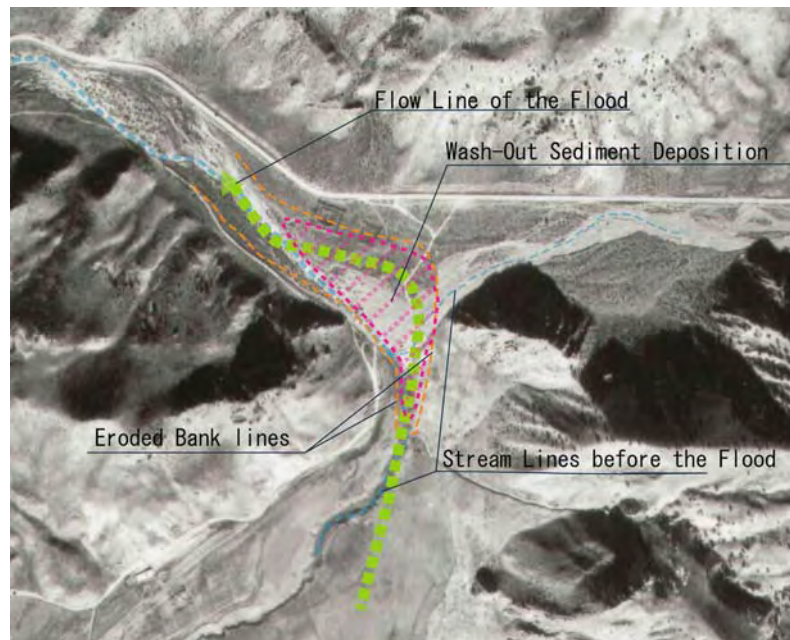


Figure 1.5 Bank Erosion in Dasht Junction Area

The face of the eroded banks is vertically dropped with sand and gravel deposition so that it is vulnerable to further erosion developing toward the upstream, farmlands in Dasht and Cheshmeh Khan. (See Figure 1.6.)

Results of the site observation and aerial-photo interpretation in this area suggests that; the junction had been placed with sediment deposition, which had clogged the exits of the both rivers before the 2001 Flood; and the collapse of the deposition had intensified floodflow power during the 2001 Flood; and the bank erosion, so-called valley-head erosion, in this area had be developed toward the farmland upstream simultaneously.

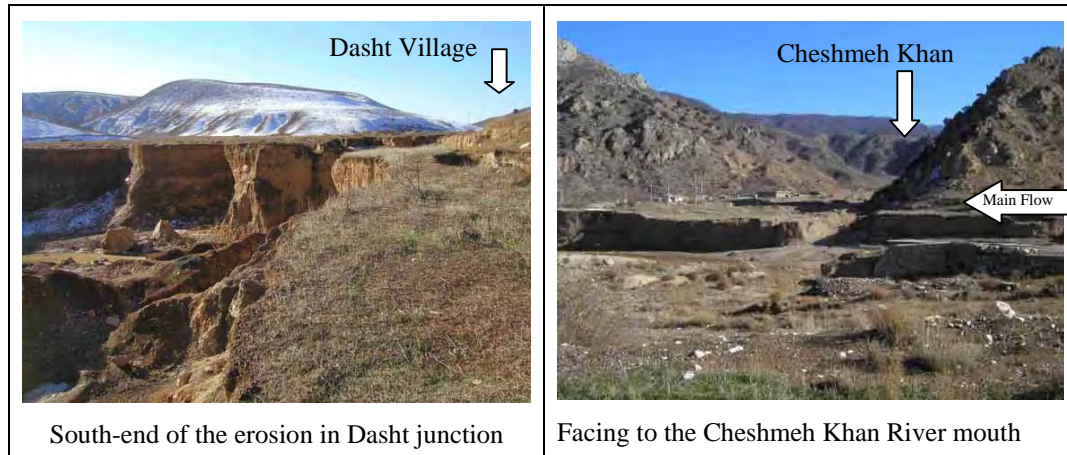


Figure 1.6 Erosion Sites in Dasht Junction Area

(2) Narrow Path

One of the critical points on conflict between river flow and road is shown in Figure 1.7.

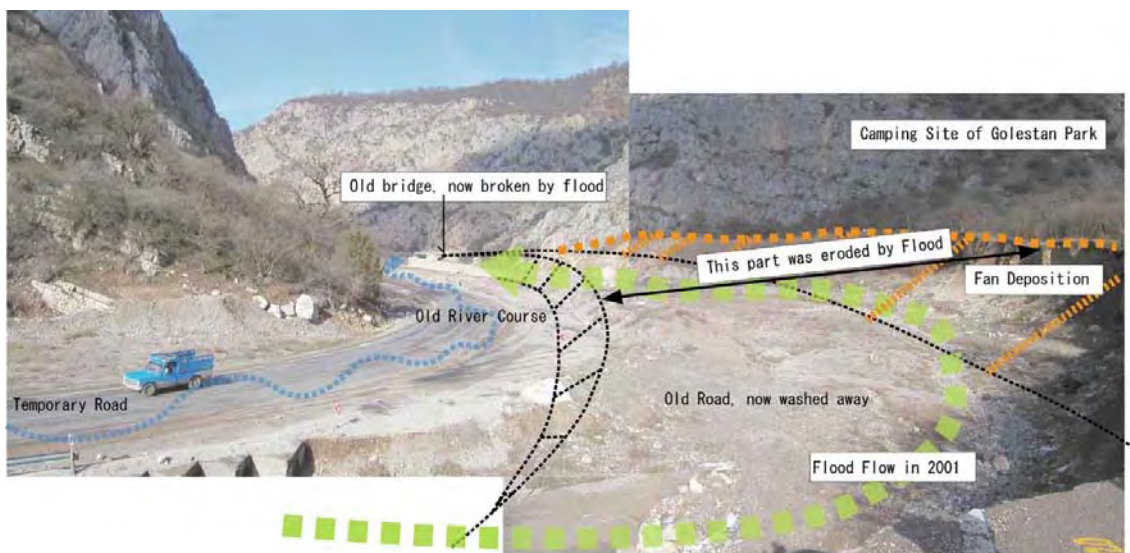


Figure 1.7 One of the Critical Points on Conflict between River Flow and Road

This narrow path has been formed by fan deposition at the right bank and solid rock at the left bank. The road had been located on the top of the fan extending downstream with concrete wall and bridge. The floodflow was dammed up in the narrow path and was intensified in its velocity to wash away the right bank deposits with the road mounted on the fan. The temporary road and river flow now intercrosses each other at the narrowest part in this area, which was the most critical part on conflict between river and road among the narrow path along the Madarsoo River.

The following photo also shows that the old road had chalked the river course with its banking and had been washed away by the 2001 floodflow, of which water level had been risen in the narrow path and intensified by the chalking.



Figure 1.8 Road Bank Washed away by the Dammed-up Floodwater in 2001

The following aerial-photograph presents the image of one of the narrow path of the Madarsoo River in this area. The fan had spread into the riverbed to narrow the river course. White colored trace shows the old road and bridges that had narrowed the river watercourses. They were broken and washed away together with sediment deposition accumulated in the riverbed in the 2001 Flood.

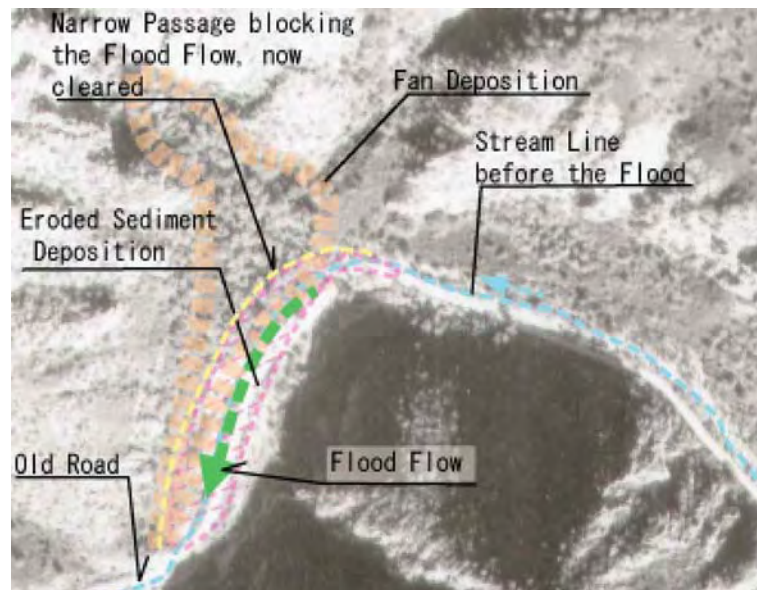


Figure 1.9 One of the Narrow Path of the Madarsoo River in the Golestan Forest

Results of site observation and aerial-photo interpretation suggest that; the conflation of river and road/bridges and the fans of tributaries had blocked the 2001 floodflow, and once such blockages were broken and intensified floodwater flowed down toward the lower reaches.

After the 2001 flood, the main road was restored. Relocated road positioning suggests the road have much more risks against floodwater overflowing the road because the new road was constructed without elevated banking and bridges. In addition, further erosion would be developed in the scoured portions because the faces of eroded soil layers are exposed against the river flow.

(3) Tributaries

There are tributaries draining from valleys into the mainstream from both of the north and south sides. Their catchments were mostly well covered in forest. Tracing debris suggests that some of them had disturbed the mainstream flow with debris flashed out from the valleys. They are at Khondoskooch valley and Golestan valley. Traces of debris flashed out are shown in Figure 1.10.

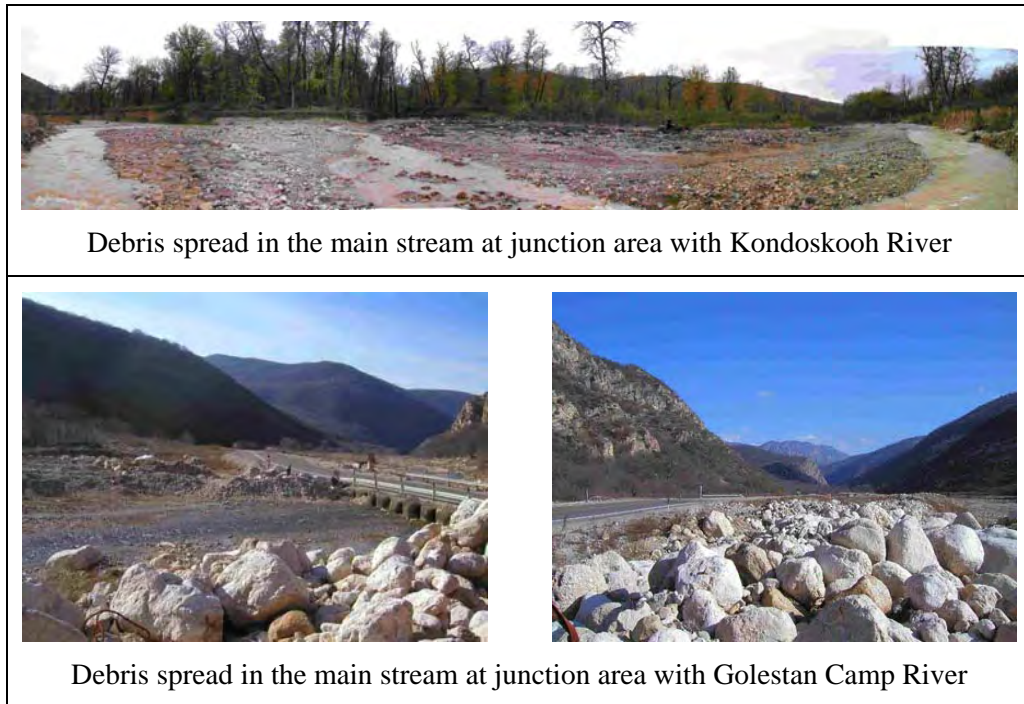


Figure 1.10 Debris Flash-out from Tributaries in the Madarsoo River

(4) Road Condition

The main road is located mostly in the narrow valley-bottom plain of the Madarsoo River in this area. After the 2001 and 2002 Floods, the main road was rehabilitated in temporary way. Pavement was restored and bridges were replaced with culverts. Culverts do not have enough capacity for some moderate and large probable floodflow, and the portions of the main road would be overflowed by the floodflow. Some of such portions were shown with photos in Figure 1.11.

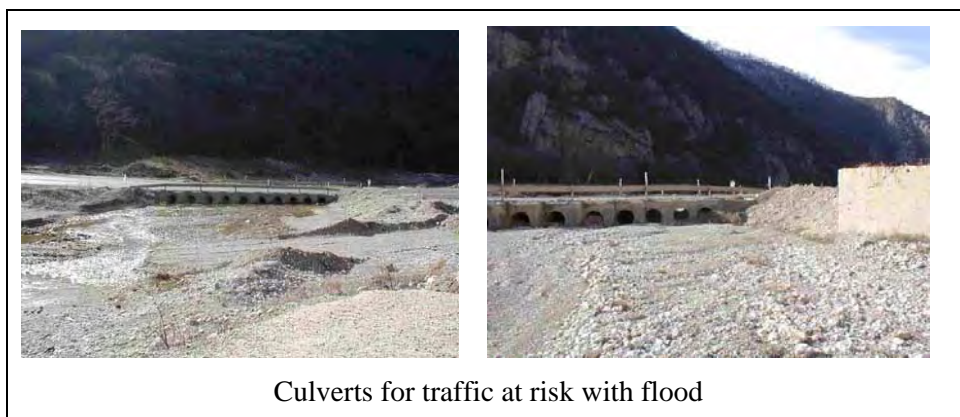


Figure 1.11 Temporary Road and Bridges in the Golestan Forest

Tangrah-Chahardah Meter Bridge

(1) Mainstream

The mainstream of Madarsoo River in this area runs from the east to west meandering in the valley-bottom plain, which is wider in width and gentler in slope. It can be clearly distinguished from the immediate upstream, Golestan Forest area, from river morphological viewpoints. The meandering has caused bank erosion in some locations, which were damaged in the 2001 and 2002 Floods. Their locations and conditions were described below.

Table 1.1 Summary on Bank Erosion in Tangrah-Chahardah Meter Bridge

Location	Condition	Remarks
Tangrah	The flow attacked the right bank, where the main road is located	
Terjenly	The flow attacked the right bank, where the main road and farmland are located. The latter is eroded.	
Loveh	The flow at the bridge attacked the left bank upstream and right bank downstream. Farmland and residence land were eroded. Bridge was provided with spillway on the right bank.	
Korang Kafter	The flow meanders and flow capacity is not enough for requirement at the bridge.	
Chahardah M. Bridge	South side of the bridge was lost by overflow of the floodwater in the 2001 Flood. Road was restored but still flow capacity is not enough for requirement at the bridge.	

Note: RHS; right hand side, LHS; left hand side

(2) Tributaries

There were many valleys in both banks along the Madarsoo River in this area. In the north side slopes, some of them had flushed debris out of the valleys into residential area and road, causing casualties and traffic disturbance. They were in Terjenly and Beshoily.

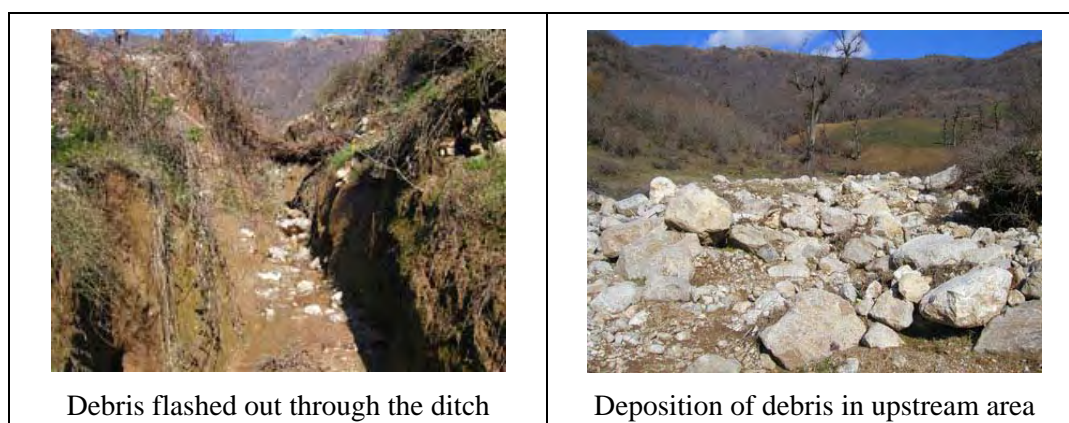


Fig 1.12 Debris in Terjenly

Chahardah-Gorgan Dam Reservoir

The flow meanders in the floodplain and 2001-2002 Floods had inundated over the farmland in this area. The meandering causes bank erosion like at immediately downstream of the Kalaleh Bridge, while the flood inundation causes serious damages of cultivating crops.

1.2.3 Chesmeh Khan River

Chemeh Khan River sub-basin defines the east end in the Madarsoo River basin. Wild land of this basin entirely covers with semi-arid grass. The streamline runs from east to west in the middle of this sub-basin in parallel to the main road. In the North side of the road the Golestan National Park is located, while in some part of the South side irrigated farmlands are located. Mountains of the both side have rills widely developed, suggesting much production of sediment. The watercourse in this area has no trace of recent floodflow.

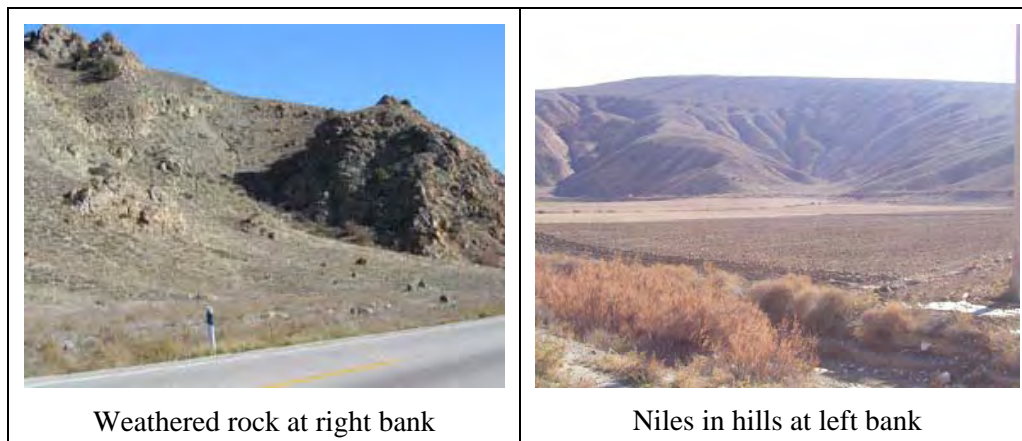


Figure 1.13 Debris Potential in Chesmeh Khan

1.2.4 Ghyz Galeh River

General

The Ghys Galeh River originates from the mountain nearby Dasht Shad at around 1,800 m EL running to the east.

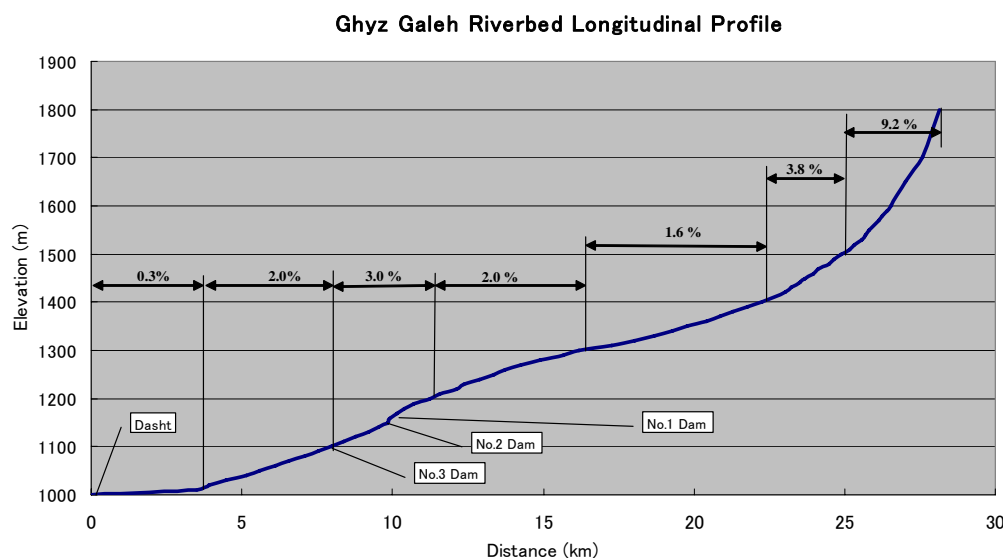


Figure 1.14 Longitudinal Profile of Ghyz Galeh River

From the top to the area at around 1,200 m EL, the bank is exposed to erosion by thick debris deposit with sharp slopes at the both sides of river course.

Downward from the elevation around 1,200 m, geological fans is projected into the river course from the valleys in the north or left bank, toes of which had been scoured. There are sediment depositions in more than 5 m thick in the riverbed that are made naturally by

boulder blockages and artificially by dam construction. They were mostly breached and the exposed faces of sediment deposit would be scoured in the further floods.

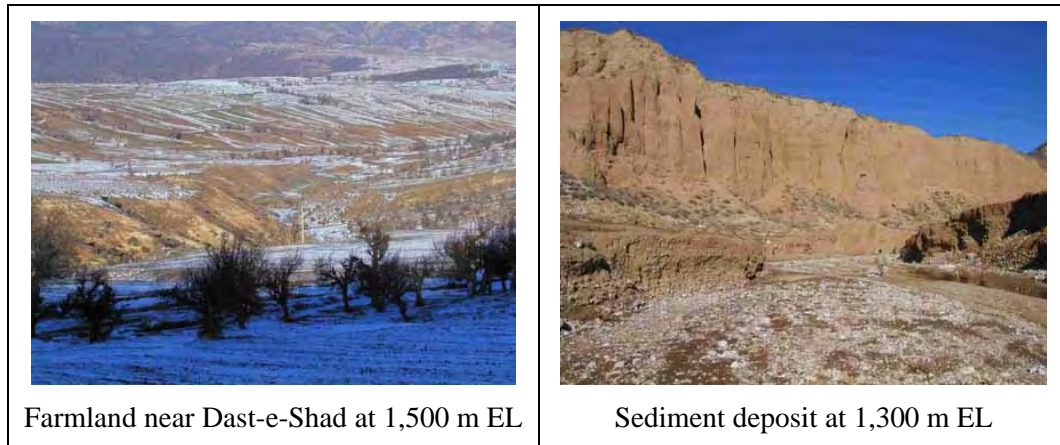


Figure 1.15 Upstream Area of Ghiz Galeh River

Existing Facilities

There were two dams and one intake along the river course of this basin, which had been breached and have no function to store water. They are supposed to be named by Ghiz Galeh No.1 and 2 dams in order from upstream. Feature of the dams and intake are described below.

(1) Ghiz Galeh No. 1 Dam

The dam had been constructed on hard rock at right bank, on debris deposition at left bank, which had been supported by large stone. In the reservoir area was accumulated sand and gravel with 5 to 6 m in depth and 1 m in maximum particle size. The perimeter of the reservoir area has been grown with bushes, which are apparently watery plants and different from those on the hillside.

Presently the bottom of the dam basis can be seen with 7 m in height from the riverbed. There was a concrete structure remained at right bank, which was supposed to be a spillway. The structure had stepwise chute provided. The embankment shape can be traced to the stamp of covering area of the dam material on the right abutment, which suggests the dam type was earth-fill dam.

The ruin of the dam suggests that the dam was washed out together with foundation material under the dam bottom, which was forced by high water level.

Restoration of the dam could not be made at the same location because debris accumulation at left bank could not bear water pressure of the supposed reservoir. Topographical and geological feature suggests that reconstruction work of the same kind dam as the previous one is supposed to place just upstream of the previous one, if it is required.

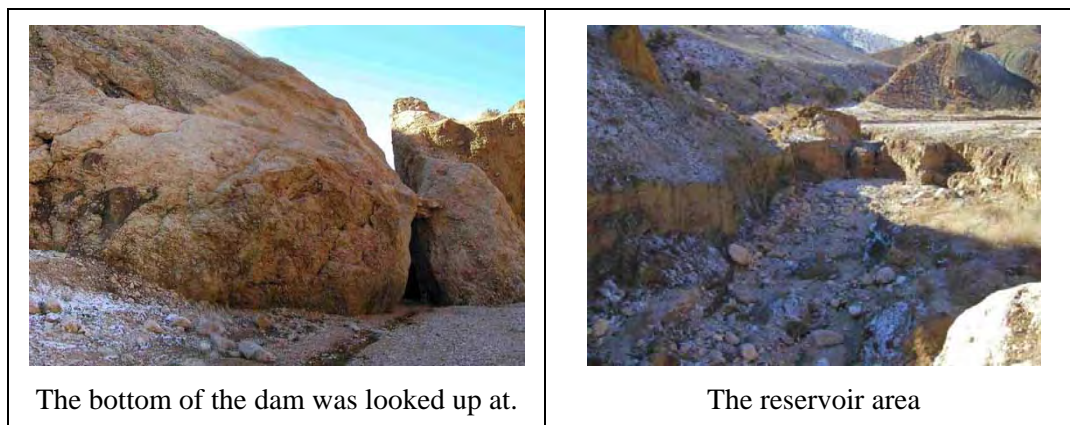


Figure 1.16 Ghiz Galeh No.1 Dam

(2) Ghiz Galeh Intake

There is masonry wall remained between big stones. The wall is a part of intake structure to collect spring water. The surrounding area was occupied with big stones. The intake facility was already reconstructed near the place.

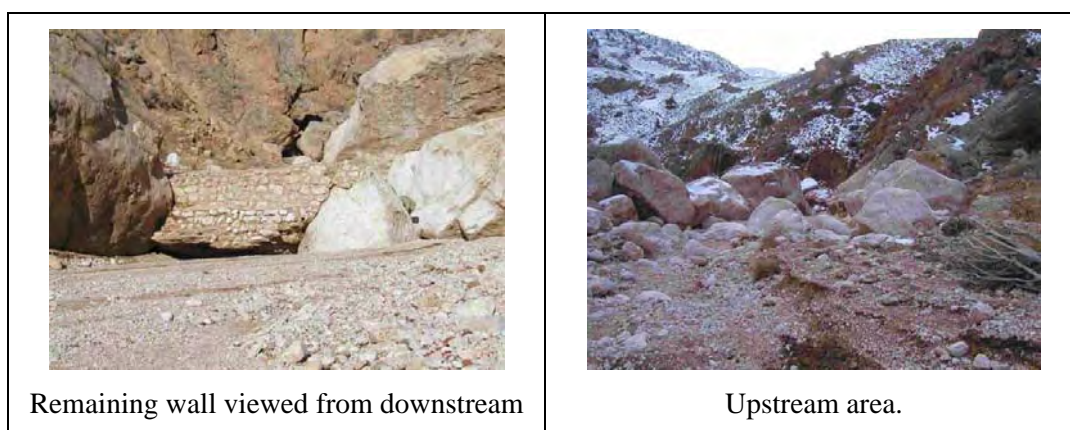


Figure 1.17 Ghiz Galeh Intake

(3) Ghiz Galeh No.2 Dam

Ghiz Galeh No.2 Dam has been founded on the hard rock at right bank, on sand and gravel layers at middle and on the debris accumulation at left bank. The dam was constructed with earth fill. Spillway was provided at left bank with excavated channel. At right bank the excavated channel was provided to supply water for the banquette on the hillside. In the reservoir area stored sediment has been accumulated, which is vulnerable to erosion.

The dam feature suggests that purposes of the dam were sediment and flood control and water supply for watershed management. There were so many traces of erosion along the top of the dam body, which suggests that water had flowed over the top. The dam was widely opened at the boundary of foundation between rock and riverbed materials.

Causes of the dam destruction were supposed to be as follows:

- Overtopping of river flow, and
- Piping through the embankment or riverbed.

The former was probably caused by shortage of spillway capacity, which was forced by blocking of driftwoods and sediment flashed out from the valleys located at the entrance of the spillway, or by the design capacity itself.

The latter is also probable cause. Presently, the stream flow is observed in upstream while it disappeared at the dam site, which suggests that it flows under the riverbed. During floods, high water level was supposed to force velocity under ground flow faster enough to cause piping phenomenon.

Therefore, reconstruction or rehabilitation of the broken No.2 dam is required. For this purpose, revision of design and location of the spillway and design of foundation treatment shall be taken into account.

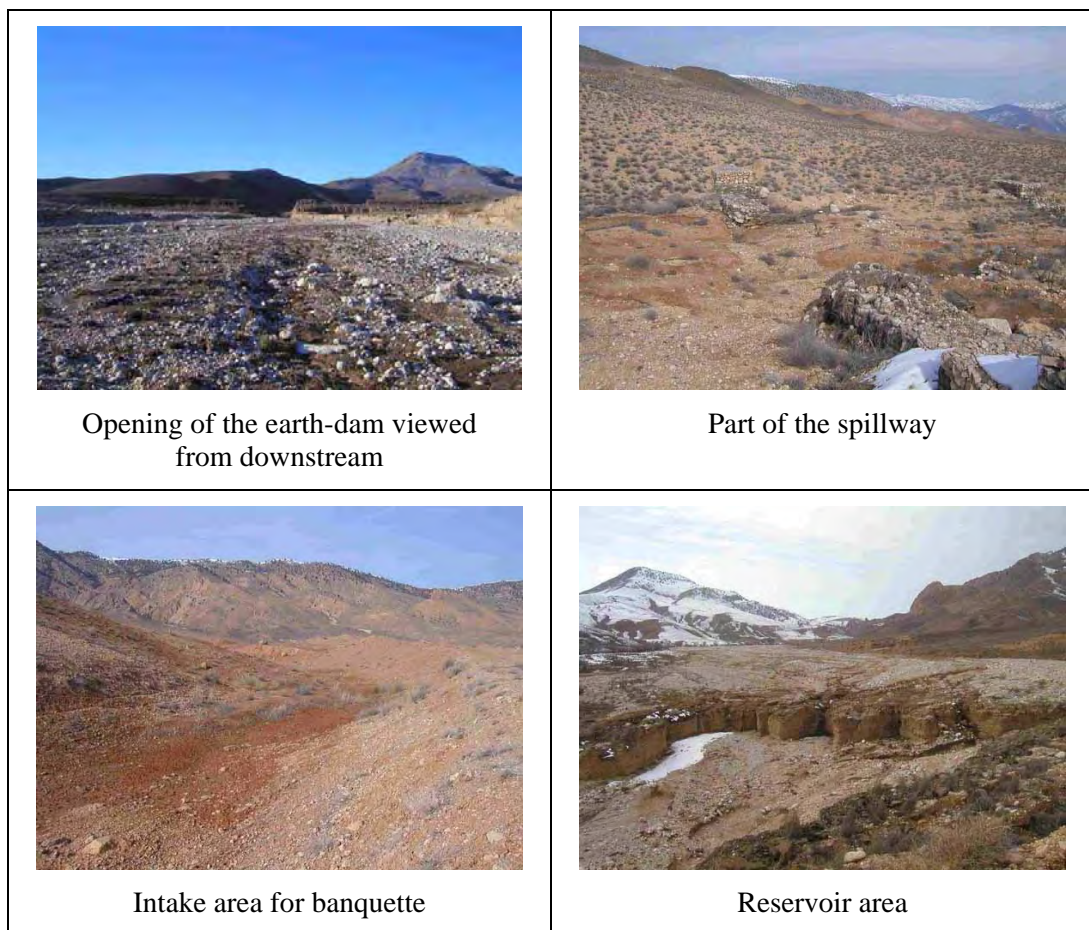


Figure 1.18 Ghyz Galeh No.2 Dam

DOE Jurisdictional Area

There are some geological fans developed in the DOE jurisdictional area. They have been transformed by the floodflow. In Figure 1.19, Fan A has been developing and producing sediment, while Fan B has been well developed and resting the production. Fan C has started to accumulate sediment. Recent floods attacked and scoured Fan A and B supplying sediment to the Fan C.

Probable flood will further more produce sediment in Fan A and scour the eroded bank of Fan A and B, and supply sediment to Fan C. In the Area D can be provided some capacity to store sediment transported from the upstream if additional structure is provided.

There are some traces of water path of runoff, stream flow or spring water in the south side of hills bordering the basins between the Ghiz Galeh and the Dasht-e-Sheikh. They suggests possible water source for Dasht Plain.

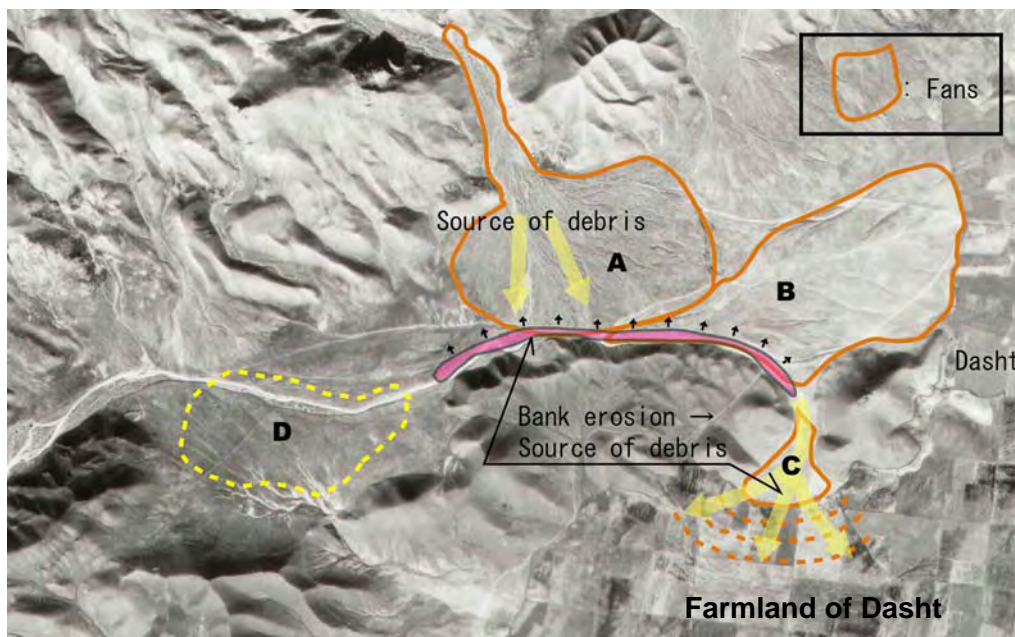


Figure 1.19 Topographical Feature in DOE Jurisdiction Area

1.2.5 Dasht-e-Sheikh River

General

The Dasht-e Sheikh River basin is surrounded with mountain ranges bordering from the Sefid Dali-Nardein basin at the south and from the Ghyz Galeh at the north. Almost whole area in this basin is bare land exposed with soft rock and sediment layers, and accordingly vulnerable to erosion. The tributaries are spread like nervures of leaf, which are channeled with V shapes and draining to the mainstream of the Madarsoo just upstream of Dasht Village. The longitudinal riverbed profile of one of the longest tributaries is shown below.

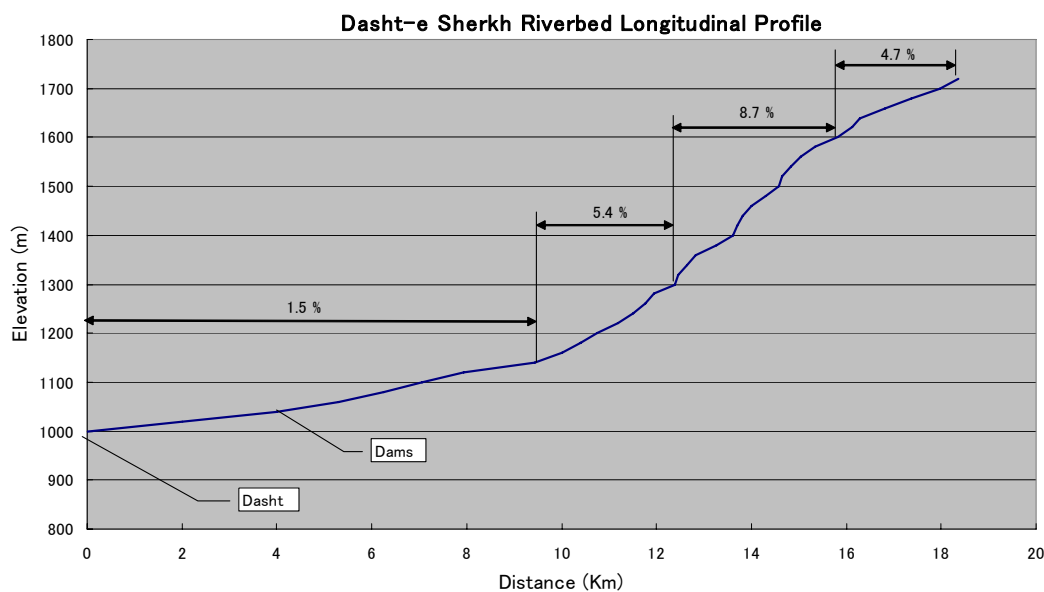


Figure 1.20 Riverbed Longitudinal Profile of Dasht-e Sheikh River

Existing Facility

There had been two dams at Sajman Mashhdi located between Dasht and Bidak, and breached by the 2001 Flood resulting in completely losing their functions. They were supposed to be named by Dasht-e-Sheikh No.1 and 2 dams in order from upstream.

Both dams were constructed of earth-fill. Spillway is not seen in observation. Traces of scouring suggest that destruction was caused by overflow of floodwater as well as piping under ground.

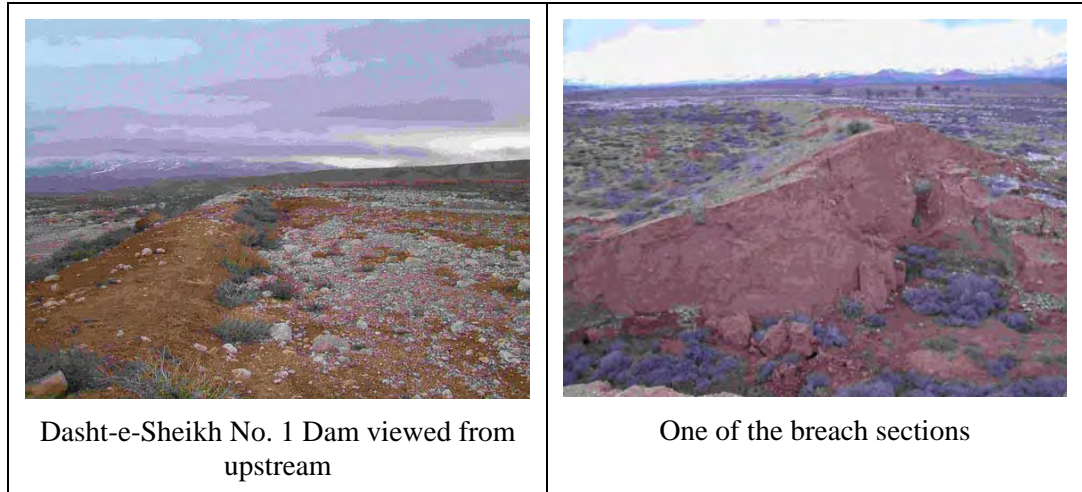


Figure 1.21 Dasht-e-Sheikh No.1 Dam

1.3 Summary on Encountered Situations

Encountered situation is described based on the analysis on the basin feature, and the results are summarized in the following table.

Table 1.2 Summary of Encountered Situations in the Madarsoo River Basin

	Sub-basin/ Segment	Encountered Situation	Required Countermeasures	Remarks
1	Nardein - Sefid Dali	Positive; Natural retarding effect to flood for downstream area	Dams at bottlenecks can increase the retarding effect.	Not much information because coordination with Semnan was not established.
		Negative; Erosion in hillsides, Shortage of water resources	Watershed management	
2	Sefid Dali - Gelman Darreh	Negative; Erosion in hillsides	Watershed management	
3	Gelman Darreh - Dasht	Positive; Natural retarding effect to flood for downstream area		
		Negative; Flood in Dasht Village and farmland. Debris flow from Ghyz Ghaleh into farmland	Flood Control Dike Watershed management in Ghyz Ghaleh and Dasht-e- Sheikh	
4	Dasht - Tangrah	Negative; Flood on road & bridges Bank erosion along the mainstream Erosion in hillsides Debris flows from the tributaries disturbing residents, traffic and river flow.	Relocation/Elevation/ Warning River training Watershed management	Required to coordinate with DOE, MOE & MORT for any works Required to coordinate with DORT, DOE, Golestan Province, and Police for warning system works to control traffic.
5	Tangrah – Chahardah M. B.	Negative; Flood Bank erosion along the mainstream Erosion in hillsides	Land use with hazard map and warning system River training Watershed management including check dams in hillsides	
6	Chahardah M.B – Kalaleh B.	Negative; Flood Bank erosion along the mainstream Erosion in hillsides	Land use with hazard map and warning system River training Watershed management including check dams	
7	Kalaleh B - Rerservoir	Flood on farmland Bank erosion along the mainstream	Hazard map & education/ dissemination River training	
8	Cheshmeh Khan	Negative; Erosion in hillsides Shortage of water resources	Watershed management	
9	Ghyz Galeh	Negative; Erosion in hillsides Flood on Dasht Village Water shortage Breach of existed dams	Watershed management including check dams and Sabo works	Required to review the design on foundation and spillway in dam construction
10	Dasht-e- Sheikh	Negative; Erosion in hillsides Flood on Dasht Village Water shortage Breach of existed dams	Watershed management including check dams	

CHAPTER 2 FLOOD/DEBRIS FLOW IN CASPIAN COASTAL AREA

2.1 General

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



Figure 2.1 Location of Target Rivers

2.2 Encountered Situations

Situations encountered through observation are described below.

2.2.1 Neka River Basin

Neka City suffered the Flood in 1999 with death toll more than 30. One of the major causes of the flood was congested residential area narrowing the river course. The authority concerned promulgated the regulation to prohibit building within 30 meters as floodplain in the both of banks from the river course.

Constriction by some bridge in the city blocked floodflow and surged up the floodwater level higher during the flood time.

There is a landslide, which was already treated with drainage works by MOJA. The villagers appreciate the works effecting to settle the land-movement.

According to the information of the authority concerned, there is a problem on driftwoods in the southern part of the river basin that clogged bridges and destroyed them during floods.

MOJA Mazandaran constructed a slit dam to capture driftwoods in one of the tributary, which was fully filled up by the captured driftwoods and sediment. In addition to this, drainage capacity of spillway is too small and little allowance of height to the left bank so that floodwater easily could spill over it, resulting in inducing the severe bank erosion.

Upstream of the slit dam, trapped driftwoods were still left in the riverbed, so that they should be removed.

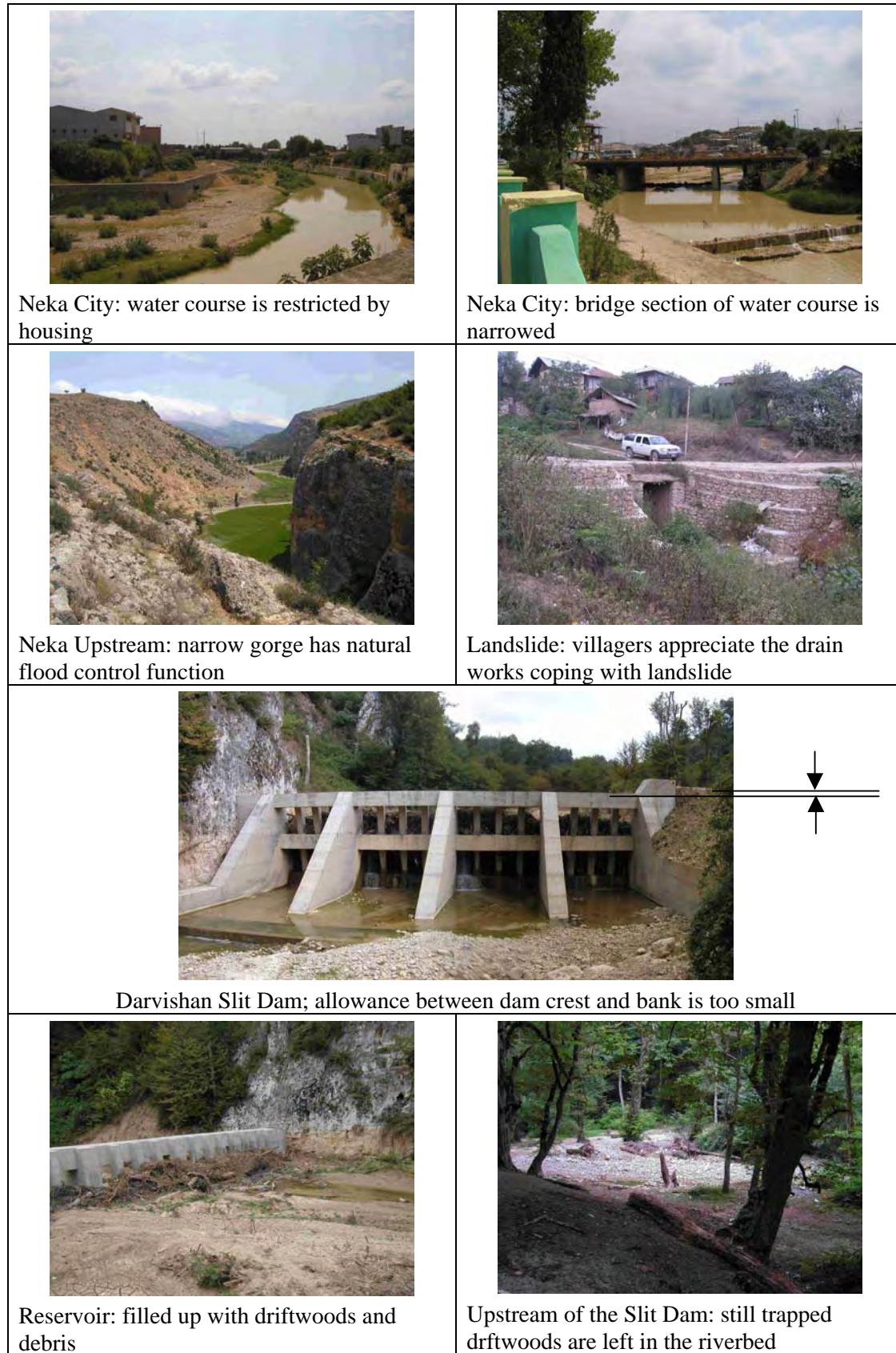


Figure 2.2 Neka River Basin in Mazandaran

2.2.2 Neiran River Basin

There is an existing flood control dam in one of the tributaries of Neiran River, which has been functioning well through the outlets to control discharge. Iron cages covers the inlet to prevent the holes clogged by driftwoods. Removing driftwoods trapped by the cages during the past flood is necessary as a preparation work to the next floods.



Figure 2.3 Neiran River Basin in Mazandaran

There is an existing gabion dam in one of the tributaries. Bottom of the dam at downstream side is loosened and some of units of gabion were washed away. The dam is located at the narrow valley with steep slope at both sides of bank with 9 m in height. One of the major reasons why such damage occurred was;

- Stones in gabions formed arch action with inter-locking between stones thrusting to the abutment at both sides of bank.

- ❑ Weights of dam body were diverted to the thrust direction against gravity that reduced vertical load or friction force between stones resulted in loosening the bottom of the dam body.
- ❑ Planar arch form of the dam axis possibly intensified such a phenomenon.

2.2.3 Masuleh River Basin

Masuleh is located on the hillside along the Masuleh River, and one of the popular towns for tourism in this country because of the old town registered to the World Heritage. Many tourists have visited there with cars through narrow passage of valley reaching to the town.

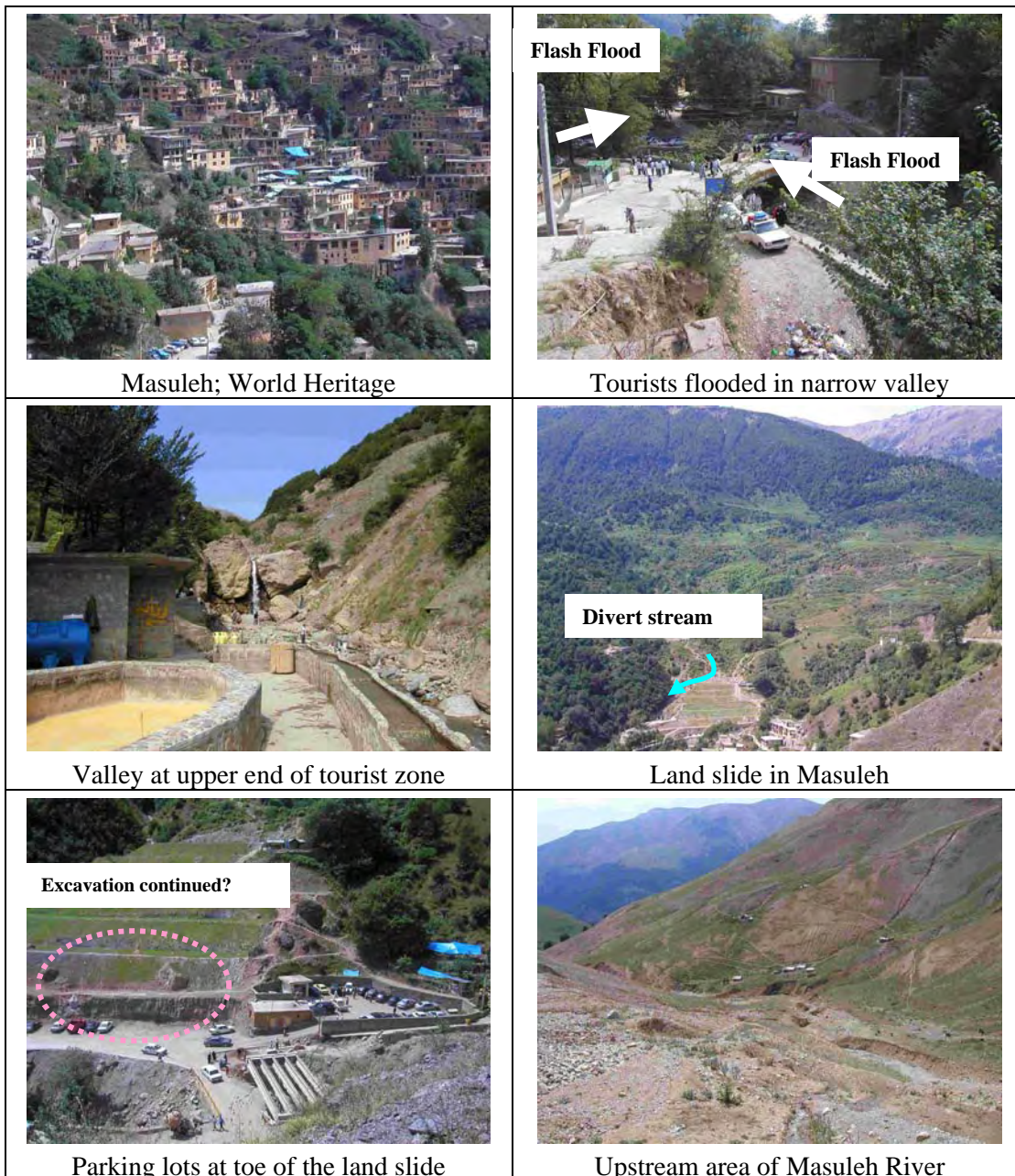


Figure 2.4 Masuleh River Basin in Gilan

Problems in this area may be debris flow, flash flood and landslide coming to the tourist zone. Especially flash flood is very serious. Almost every year they suffered floods with debris. Tourists are congested in the narrow valley during tourism season.

There are a few rainfall gauges at the town area, but no gauges in the upstream areas. In addition, the gauges have not been online system yet.

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

2.2.4 Golidagh River Basin

Two of earth dams in this area suffered overflows during the 2005 Flood, but fortunately they still exist with only downstream surface erosion.

One of them have serious problem on piping through dam body from the upstream face to the downstream. The piping hole is 1 to 2 m in diameter Possible causes of such a piping are as follows

- Wrong quality control on embankment, like dry material, less compaction, mixture of coarse material and so on.
- Hydraulic fracturing due to reduction of vertical force in dam body under arch action caused by undulation of foundation surface.

Restoration of the piping should be made with cut and replacement by adequate soil material with well compaction.

Golidagh River Basin suffered flood damages twice in 2005: the first flood occurred on 30 to 31 July and the second one on 9 to 10 August. Death toll was 27 persons and 33 persons, respectively.

According to one of the villager of Poshoy, some of people heard some extraordinary about flood coming so survived and others not but no official information at that time of floods while the road was closed by the authority.

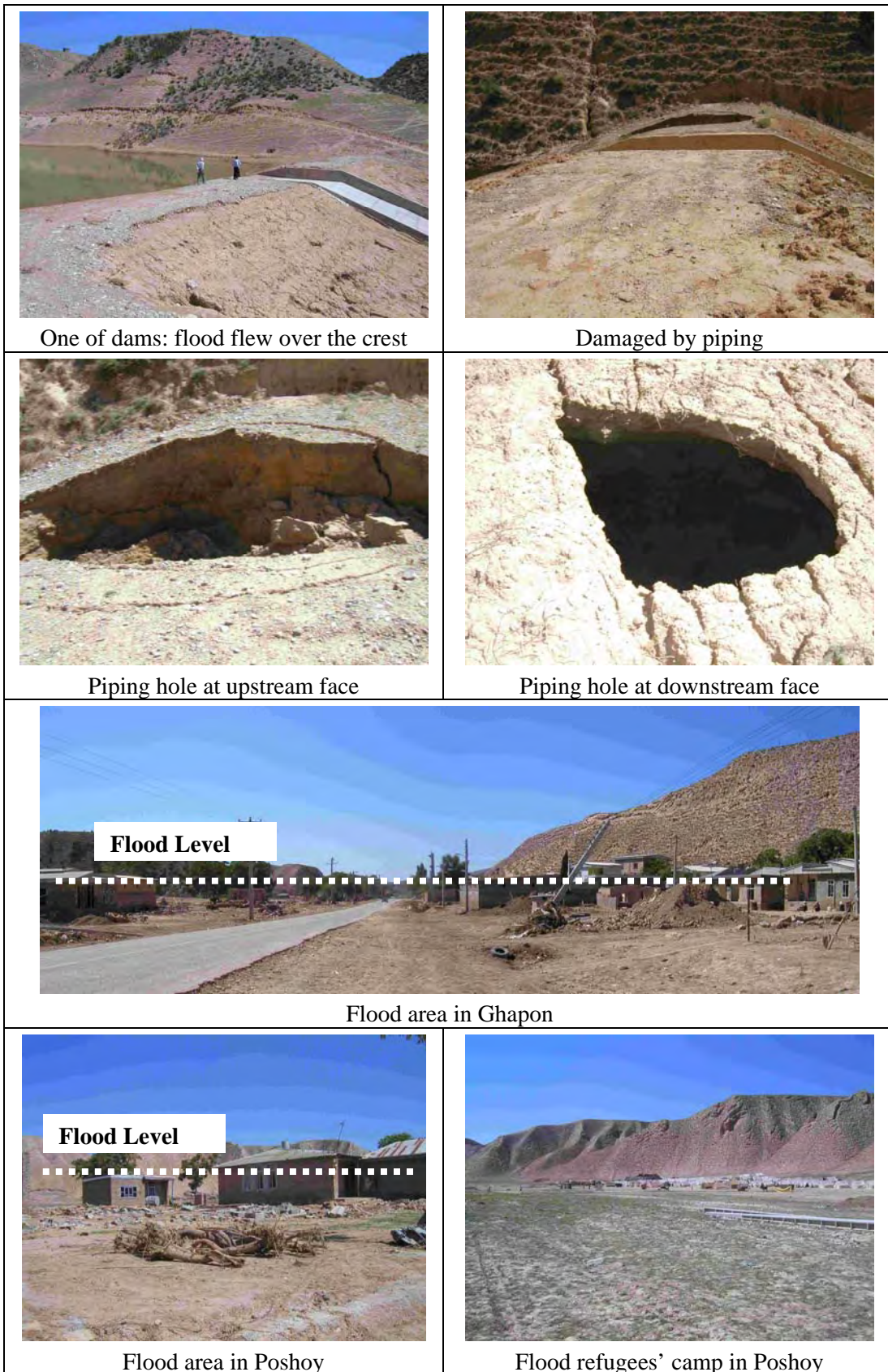


Figure 2.5 Golidah River Basin in Golestan

2.3 Lessons Learnt

Slit Dam

- (1) To provide appropriate interval between slits in slit dam taking into account size of driftwood to be trapped.
- (2) To keep an enough flow capacity for the spillway to provide the trapped driftwoods and debris filled up the reservoir.
- (3) To clear the reservoir area, in particular area behind slit dam immediately after trapping the driftwoods.
- (4) To remove fallen trees from the riverbed that is a primary countermeasure against driftwoods hazard.
- (5) To provide access road to the reservoir area to collect trapped driftwoods.

Gabion Dam

- (1) To avoid interlocking effect and arch action in designing in case that gabion dam is applied to narrow gorge.
- (2) To level the undulation by excavation or replacement with concrete.
- (3) To keep limitation of dam height or to adopt concrete or wet masonry type instead of gabion type.

Earth Dam

- (1) Not to allow earth dam for flood to overflow the dam surface due to insufficient spillway capacity, and to usually design spillway capacity of fill type dam with 1.2 times safer than the one of concrete type.
- (2) To revise the design discharge of the existing earth dam experienced overflowing for upgrading the spillway capacity.
- (3) To scrutinize the construction materials on their physical characteristics of compactibility in both laboratory and site levels.

Land Slide

- (1) To conduct drainage works as one of the most fundamental and preventive methods.
- (2) To maintain the drainage capacity.
- (3) To Provide integrating several countermeasures: cut off to reduce driving force of sliding, counter weight to increase resistant force, anchoring to tighten the sliding body increasing resistant force, and well to drain the groundwater reducing driving force of sliding.

Forecasting & Warning System

- (1) To improve the existing flood forecasting and warning system.
- (2) To apply improvement of flood forecasting and warning system, in particular to the Masuleh River and Golidagh River basins, in which the system shall be effective.

River Engineering

- (1) To give a high priority to designing river course alignment in river engineering.
- (2) To apply land use regulation as an effective method in parallel with river improvement works.
- (3) To strengthening rainfall data collection and hydrological analysis practices so as to improve planning, designing and construction works in river engineering.

SUPPORTING REPORT I (MASTER PLAN)

PAPER II

Socio-Economy

**THE STUDY ON FLOOD AND DEBRIS FLOW
IN THE CASPIAN COASTAL AREA
FOCUSING ON THE FLOOD-HIT REGION
IN GOLESTAN PROVINCE**

SUPPORTING REPORT I (MASTER PLAN)

PAPER II SOCIO-ECONOMY

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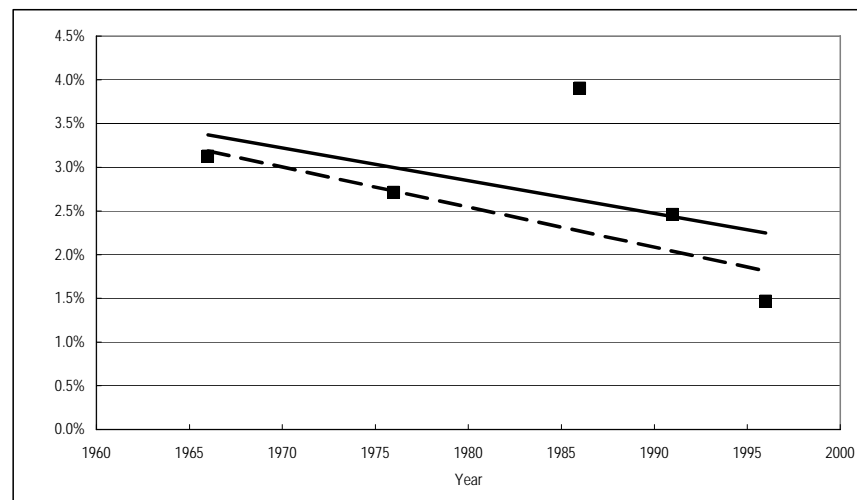
CHAPTER 1 SOCIO-ECONOMIC PROFILES

1.1 Iran

1.1.1 Social Profile

Demography

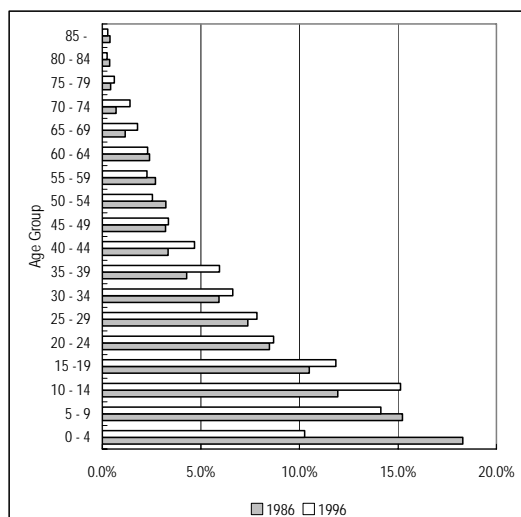
Iran's total population is estimated at 66.4 million and its growth rate is 1.5% in 2003 according to the World Bank. Iran has the second largest population, after Egypt, in the Middle East and North Africa region. The census data of Iran shows that the average annual growth rate has been decreasing with the exception in 1986. The exception may be attributed to the Iran-Iraq War which was continued over 1986. When the regression analysis is made, the characteristic of the exception in 1986 is clarified.



— Linear Regression with 1986 data
- - - Linear Regression without 1986 data
Figure 1.1 Regression Analysis of Iran's Population Growth

The R^2 value, which shows the ratio of variation explained by the regression model, of the data group with 1986 data is 0.234 while that without 1986 data is 0.775.

The population composition changed drastically between 1986 and 1996 as the share of 0 to 4 year old group reduced from 18.3% to 10.3%. The reason for the decrease in population growth can be a decline of birth rate taking into the consideration of the relatively lower infant mortality rate of Iran.



Source: Iran Statistic Year Book 2001

Figure 1.2 Population by Age Group in Iran

Other Social Indicators

Following social indicators shows preferable profiles of Iran with the comparison of other Middle East and North African Countries: life expectancy, infant mortality, access to an improved water source and gross primary education enrolment. In addition almost all of them are better than the average of lower to middle income counties. The World Bank's *Country Brief, September 2004* describes that Iran's health and education indicators are the best in the region. Furthermore, larger numbers of increasingly well-educated women seek opportunities to participate all levels of Iran's labor market and civil society. This is another side of the successful social policy of Iran. It is a new challenge for the Government to cope with in order to manage a stable economy and society.

Table 1.1 Major Social Indicators of Iran

	Iran	Middle East & North Africa	Lower-middle Income
Ave. Annual Growth (1997-2003)			
Population (%)	1.5	1.9	0.9
Labor force (%)	2.9	2.9	1.2
Most recent estimate (latest year available, 1997-2003)			
Poverty (%of population below national poverty level)	21	-	-
Urban population (% of total population)	67	58	50
Life expectancy at birth (years)	71	69	69
Infant mortality (per 1,000 live birth)	30	44	32
Child malnutrition (% of children under 5)	11	-	11
Access to an improved water source (% of population)	99	88	81
Illiteracy (% of population age 15+)	15	31	10
Gross primary education enrolment (% of school-age population)	98	96	112
Male	102	100	113
Female	95	92	111

Source: World Bank

1.1.2 Macro-economy and Governmental Finance

As many people expect, the oil and gas production shares are considerably high in Iran's national economy. The share of oil production exceeds 11% of total GDP. The share of revenue from oil and gas dominates the Governmental budget, which posted 30 - 50%.

Table 1.2 Oil and Gas Production in Iran's Economy

	1996	1997	1998	1999	2000
Share of Oil in GDP	12.9%	12.3%	11.9%	11.0%	11.6%
Share of Oil and Gas in Revenues of Governmental Budget	52.7%	36.6%	30.2%	24.5%	47.8%

Source: Iran Statistical Year Book, 2002

GDP growth rate was relatively lower in 1980s - 1990s. In 2000's, this trend changed thanks to a higher oil prices. The World Bank expects that this higher growth will continue for the next five years.

Table 1.3 GDP Growth Rate

Average Annual Growth (%)	1983-1993	1993-2003	2002	2003	2003-2007 *
GDP	2.2	3.7	7.4	6.6	5.7
GDP per capita	-0.5	2.2	5.7	5.2	4.1

*: Forecast

Source: World Bank

In addition, the deficit of Governmental budget improved remarkably to -0.2% of GDP in 2003 although it is still in red ink. The reason is the result of expenditure cuts, particularly capital expenditures according to the World Bank.

Table 1.4 Government Finance

	1983	1993	2002	2003
Government finance (% of GDP)	-6.3	-6.1	-2.4	-0.2

Source: World Bank

On the other side of the strong economic growth, Iran did not succeeded in the control of inflation.

Table 1.5 Inflation

	1983	1993	2002	2003
Consumer prices (% change)	20.5	21.2	15.8	15.6

Source: World Bank

Iran's economic structure also changed in 2000s as the share of Agriculture reduced to around 11% from 20% in 1980s - 1990s. On the other hand, the share of Industry increased from 41 % from 35 % while the services sector kept around 50% during the same period.

Table 1.6 Structure of Economy

(% of GDP)	1983	1993	2002	2003
Agriculture	18.1	20.8	11.7	11.3
Industry	34.9	36.2	40.6	41.2
Manufacturing	8.8	13.6	12.0	12.5
Services	47.0	43.0	47.7	47.5
total	100.0	100.0	100.0	100.0

Source: World Bank

1.1.3 Five Year Development Plan

The Iranian economy is managed with the Five Year Development Plan (FYDP) in accordance with the Constitution. The third FYDP started in 2000 and ends in 2005. The Plan targets annual 6 % growth rate in its period. On the other hand, the Plan continues to emphasize social development and equity. In order to expand the economic growth potential, increase the living standards of the population, and reduce unemployment, the Plan envisages a wide range of structural reforms aiming at a balanced and gradual transition to a market economy. Such reforms are summarized as follows:

Table 1.7 Reforms of the third Five Year Development Plan (2000-2005)

Sector	Agenda
Economy	Pricing system reform: <ol style="list-style-type: none"> 1. the unification of the multiple exchange rate system; 2. trade liberalization; 3. competitive allocation of credit, and positive interest rates; and 4. addressing the issue of the large energy subsidies. Private sector-based development: <ol style="list-style-type: none"> 1. strengthening the legal and institutional framework; 2. reducing the size of the public enterprise sector through privatization and public enterprise reform; 3. starting the reform of the state-dominated financial sector; and 4. strengthening of mechanisms of social protection to limit the negative transitory effects of the reforms.
Social	<ol style="list-style-type: none"> 1. Empowerment-based poverty reduction, 2. Improving the efficiency of the Social Safety Net, and 3. Addressing the social costs of reforms.
Environmental and Water Resource Management	Urban environment: <ol style="list-style-type: none"> 1. Sewerage system development, and 2. Air pollution prevention. Rural Environment: <ol style="list-style-type: none"> 1. Groundwater management, 2. Efficient irrigation network, and 3. Integrated river basin management, etc.
Governance and Transparency	<ol style="list-style-type: none"> 1. Granting much more freedom to the press, 2. Reforming the budget nomenclature, process, and control mechanisms and institutions, and 3. Regulation of monopolies and promote competitive economic activities.

Source: *Interim Assistance Strategy for the Islamic Republic of Iran*, World Bank, 2001

1.2 Golestan Province

1.2.1 Socio-economy

Demography

Population growth shows different trend between the rural area and urban area. The growth rate of the urban area had been decreasing continuously, while that of rural area had fluctuated in the past. As it is shown in the national data, even the rural area implies some declining trend if we consider the 1986 data is a exception. The 1976 data is 1.45 % and the 1996 data is 1.43 % when the further decimal digit is calculated. In addition, it should be noted that the urban growth rates are generally higher than the rural rates.

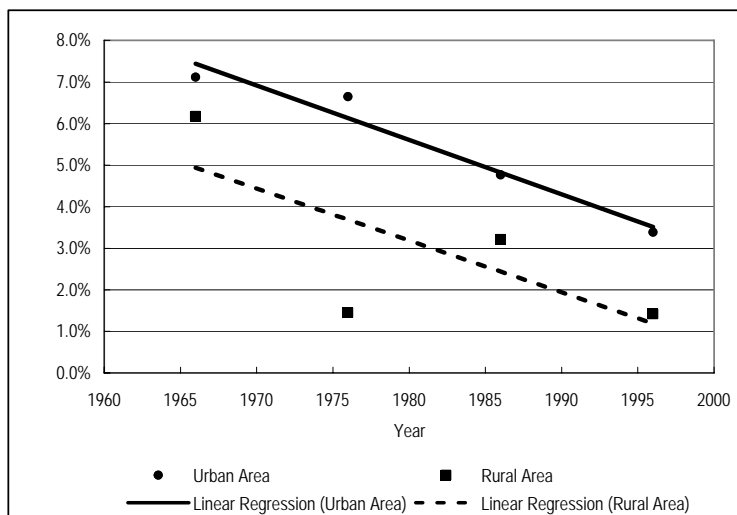
Concerning the average number of family members, that of urban area has the trend of decreasing except 1986 while that of rural area has the trend of increasing. It is noticeable that the number is higher in urban area than in rural area in early years and the figures had reversed from 1976. With an assumption that urbanization reduces the number, the urbanization in the “urban area” started in 1970s. On the other hand, the agricultural production of household has been feeding more and more family members in the rural area.

Table 1.8 Summary of Population in Golestan Province

	1956	1966	1976	1986	1996
Urban Area					
Population	70,034	139,268	265,032	422,193	588,985
Ave. Annual Growth Rate		7.1%	6.6%	4.8%	3.4%
No. of Families	9,548	26,896	51,606	80,050	119,343
Ave. Pop per Family	7.33	5.18	5.14	5.27	4.94
Rural Area					
Population	250,147	455,267	525,574	721,147	830,171
Ave. Annual Growth Rate		6.2%	1.4%	3.2%	1.4%
No. of Families	56,914	88,879	95,035	120,600	148,143
Ave. Pop per Family	4.40	5.12	5.53	5.98	5.60
Total					
Population	320,181	594,535	790,606	1,143,340	1,419,156
Ave. Annual Growth Rate		6.4%	2.9%	3.8%	2.2%
No. of Families	66,462	115,775	146,641	200,650	267,486
Ave. Pop per Family	4.82	5.14	5.39	5.70	5.31

Source: *Golestan Statistic Year Book, 2001*

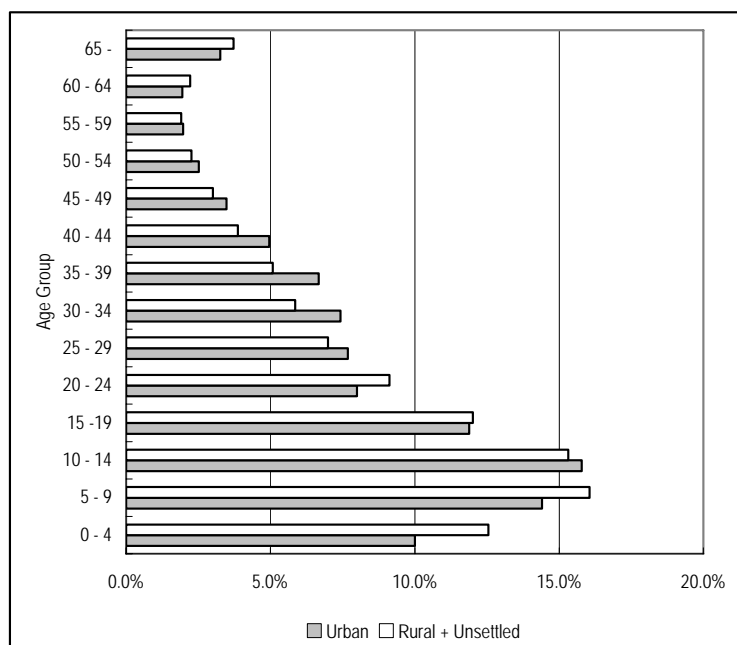
Although the 1986 data is deemed an exception, it may not be excluded for the regression analysis because the data number is extremely few and the R^2 value does not improve or does only a little (from 0.960 to 0.957 for the urban data and from 0.516 to 0.571 for the rural data). The R^2 value of the urban data is high but that of the rural is not preferable, which means the linear regression model does not explain the data variation of the latter successfully.



Source: *Golestan Statistic Year Book, 2001*

Fig 1.3 Regression Analysis of Golestan Province's Population Growth

For the population composition, the same thing can be said with the national data both for the urban area and the rural area. Namely, the decrease in population growth can be a decline of birth rate taking into the consideration of the relatively lower infant mortality rate of Iran.



Source: *Golestan Statistic Year Book, 2001*

Fig 1.4 Populations by Age Group in Golestan

Inflation

As it is shown in the national economy, one of Iran's challenges in the economic management is to control the inflation. It is the same story for Golestan Province. In the urban area, inflation is lower than the total of Iran while it is considerably higher in the rural area with indicating more than 20%. Higher inflation items are Health and Medical care in the urban area with 21.5% and those in the rural area are Health and Medical Care, Transportation and Communication, Closing and Footwear, and Food, Beverages and Tobacco.

Table 1.9 Inflation Rate by Area Type

	Total Index	Food, Beverages and Tobacco	Clothing and Footwear	Fuel and Light	Housing, Furnishings and Household Services	Transportation and Communication	Health and Medical Care	Recreation, Entertainment & Education	Miscellaneous Goods and Services
Urban									
Golestan	13.8%	14.8%	3.0%	15.2%	9.1%	13.6%	21.5%	10.2%	20.0%
Iran	15.5%	15.6%	6.2%	19.2%	9.2%	14.3%	20.6%	14.0%	17.0%
Rural									
Golestan	25.8%	26.2%	26.3%	25.8%	21.2%	27.8%	28.0%	22.3%	24.3%
Iran	18.9%	17.7%	19.3%	21.0%	14.4%	20.6%	27.1%	17.5%	18.7%

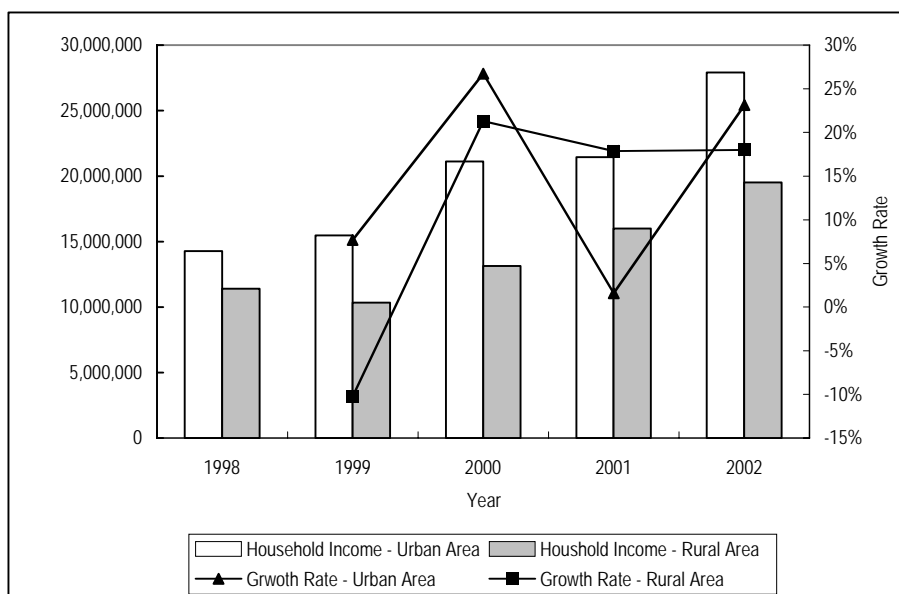
Note) Urban: Average annual growth of Consumer Price Index between 1997 and 2001

Rural: Average annual growth of Consumer Price Index between 1995 and 2001

Source: Central Bank of the Islamic Republic of Iran

Household Income

The household income has been increasing except that of the rural area in 1999. However, it should be noted that the figures are based on the current prices. It means that the real income decreased considering the high inflation rate. In addition, the growth rate drastically fluctuated especially for the rural income, which causes hardship to the people.



Source: Management and Planning Organization of Golestan

Fig 1.5 Annual Average of Household Income by Area Type

Other Socio-economic Indicators

Golestan Province can be generally ranked at the middle of all 28 Province/Administrative Divisions. Its agricultural production such as wheat is ranked at a higher level. It is noticeable that the number of medical beds per 100,000 population is ranked at the lowest level.

Table 1.10 Socio-economic Indicators

	Area (sq km)	Rank	Population in 1996	Rank	Average Production of Wheat 2000-01 (1,000 tons)	Rank	Manufacturing Establishments with 10 or More Workers in 2000	Rank	Number of Medical Beds per 100,000 in 2001	Rank	Government Budget (Current + Development) in 2000	Rank
Golestan	20,893	19	1,426,288	15	723	4	159	17	115	27	667,861	16
Tehran	19,196	22	10,343,965	1	194	15	2,716	1	279	1	3,203,868	1
Iran Total	1,629,805		60,055,488		9,458		11,200		182		26,850,497	

Source: Iran Statistical Year Book, 2001

1.2.2 Governmental Finance

System of the Government Budget

The budget of each financial year is estimated in the previous year by Planning and Management Organization, is offered to the Council of Ministers, and then is delivered to the Islamic Parliament (Majilis-Shura Islami) as a legislative bill. In accordance with changes in economic, social and political conditions as well as changes in receipts and payments by the Government, which cause the changes in the activities of governmental organizations, the Government sends a complement bill of budget to the National Consultation Assembly. This bill should be approved before the end of year. Final budget is specified after the end of each financial year in accordance with the final receipts and payments. The Governmental budget consists of the following items.

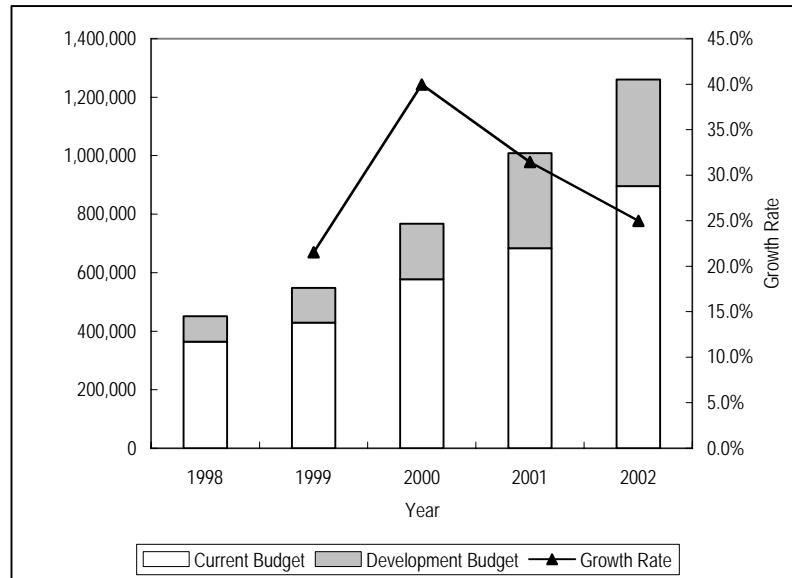
Table 1.11 Government Budget Composition

Item	Explanation
Government Total Budget	The composition of the governmental public budget as well as the budgets for banks, government corporations and government-affiliated enterprises
Government Public Budget	Financial resources required to carry out the annual programs and determines current and development credits for executive bodies
General Revenues	Revenues from oil and gas, taxes, and other incomes of the government public budget
Special Revenues	Revenues legally allotted to special expenditures in the public budget
Development Budgets	Credits provided for implementing development projects and expand current expenditures of the government's socio-economic plans
Current Budgets	Credits provided for meeting government current expenditures as well as expenditures for maintaining the level of the government's socio-economic plans

Source: Iran Statistical Year Book, 2001

Provincial Budget

The provincial budget has been increasing rapidly though it speed is reducing. However, it is not so high speed if the high inflation rate is considered. The growth rate shows the highest in 2000, which coincides with the recent highest inflation rate in 1999 showing 20.1% in the urban area and 27.6% in the rural area. The same phenomenon can be found in the household income data.



Source: Management and Planning Organization of Golestan

Figure 1.6 Provincial Budget

CHAPTER 2 SOCIO-ECONOMIC FRAME FORECAST

2.1 Flow of Socio-economic Frame Forecast

Socio-economic frame in the target year of 2025 is forecasted for the basis of the Master Plan of the Study. Socio-economic frame is comprised of (1) population, (2) income or GRDP, (3) industrial structure, (4) land use and (5) infrastructure development. Therefore, in order to make a forecast of socio-economic frame, it is necessary to make forecasts of all (1) to (3) factors. The national development plan and the regional development plan are the basis for such forecasts. The relation of each factor and flow of forecasting work is shown in Figure 2.1.

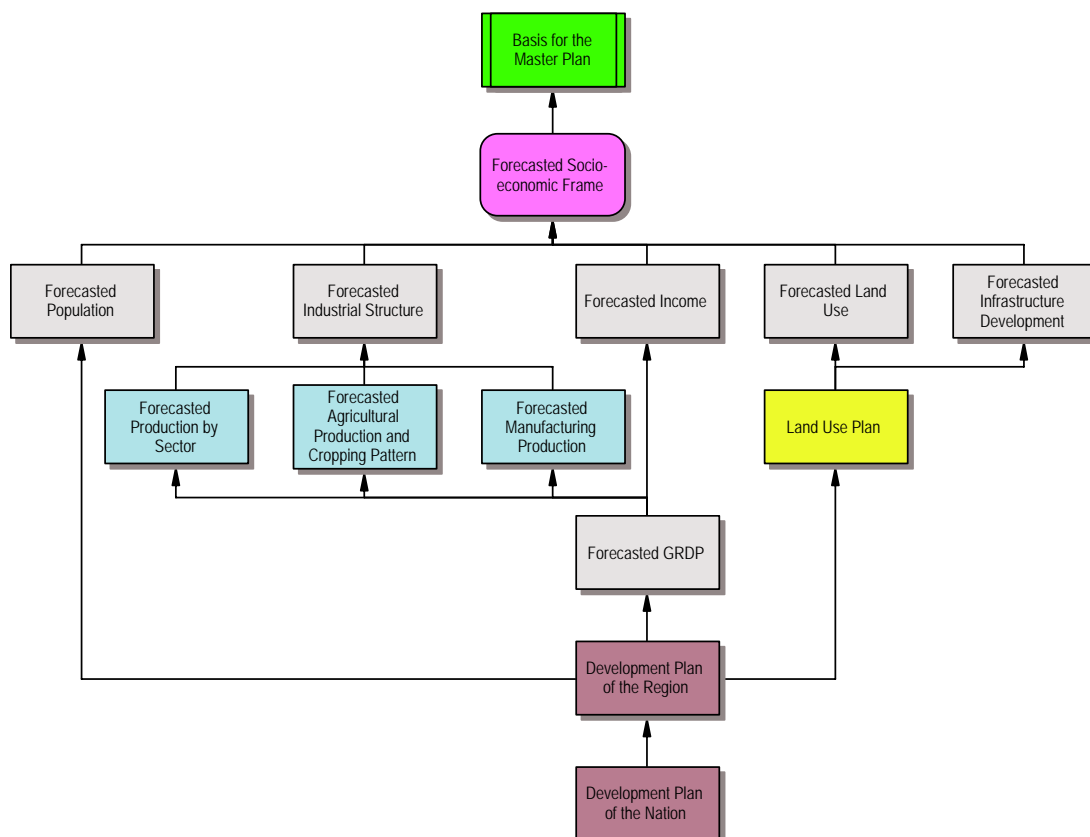


Figure 2.1 Flow of Socio-economic Frame Forecast

2.2 Preliminary Setup for the Forecast of Socio-economic Frame

As a result of the socio-economic study, following factors are setup at the master plan stage of this Study.

Table 2.1 Preliminary Setup for the Socio-economic Frame Forecast

Factor	Preliminary Setup
GDP growth	In the short-term, GDP increases steadily as it is forecasted by the World Bank. It surely depends on the international oil price. In the middle-term to the long-term, it is strongly affected by the results of the economic reform.
Regional population	The growth rate continuously decreases. The speed of decreasing depends on the urbanization and improvement of standard of living.
Regional income	The nominal income increases rapidly because of the high inflation in the short-term. The real income growth strongly depends on the result of economic management, which takes a long-time to realize. It should be noted that even nominal income increase changes the lifestyle of the household.
Land use	In the short-term, it depends on the economic activities especially agricultural production. However, this factor is strongly affected by zoning as well as regional development plan.
Industrial structure	In the long-term, it is sure that the share of primary sector decreases. However, the speed of change depends on the result of the economic reform and the national development plan which allocates the industries to regions.
Infrastructure development	It depends on the governmental budget increase for capital formation.

2.2.1 GDP Growth

According to the past actual trend of GDP, in other words the trend of GDP in 1997-constant price, it can be illustrated in the following figure.

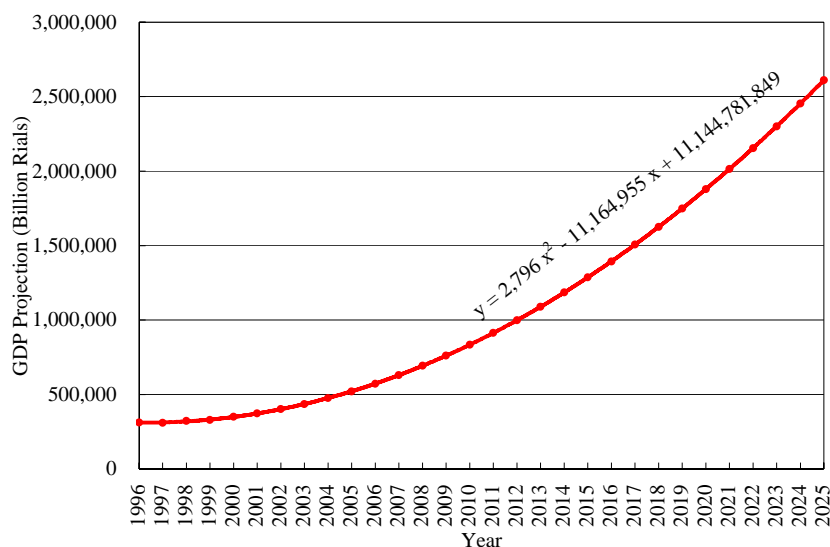


Figure 2.2 GDP Projection Based on Actual Trend

Using a formula shown in the above figure, the GDP trend for the future can be projected as shown in the following table. It may be needed to apply a social economic situation as of the year 2025, the target year of the Project.

Table 2.2 GDP Projection Based on Actual Past Trend in 1997 Constant Price

(GDP in Total: Billion Rials)										
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GDP in Total	312,531	311,123	322,701	329,103	350,910	372,685	401,874	436,009	476,141	521,863
Growth Rate against Previous Year		-0.45%	3.72%	1.98%	6.63%	6.21%	7.83%	8.49%	9.20%	9.60%
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
GDP in Total	573,175	630,077	692,569	760,651	834,323	913,585	998,437	1,088,879	1,184,911	1,286,533
Growth Rate against Previous Year	9.83%	9.93%	9.92%	9.83%	9.69%	9.50%	9.29%	9.06%	8.82%	8.58%
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GDP in Total	1,393,745	1,506,547	1,624,939	1,748,921	1,878,493	2,013,655	2,154,407	2,300,749	2,452,681	2,610,203
Growth Rate against Previous Year	8.33%	8.09%	7.86%	7.63%	7.41%	7.20%	6.99%	6.79%	6.60%	6.42%

Source: Data from 1996 to 2002 is excerpted from the Iran Statistical Year bBook 1382.

According to the actual data reported in the statistics, the growth rate of GDP in 2002 against that in the previous year is 7.83 % as indicated above. On the other hand, the annual average growth rates, which were forecasted by the World Bank, are 7.4 % in 2002, 6.6 % in 2003 and 5.7 % from 2003 to 2007 as indicated in the Table 1.3 in Chapter 1. The growth rate, 7.4 % in 2002 forecasted by the World Bank that is lower than the actual one may be on account of temporary data applied.

Anyway, the annual average growth rate of GDP based on the actual past trend shown in the above table is resulted at 8.43 % since 2003 till 2025. It seems rather optimistic comparing with the World Bank forecast. Accordingly, the other forecast is made based on the World Bank forecast as shown in the following figure.

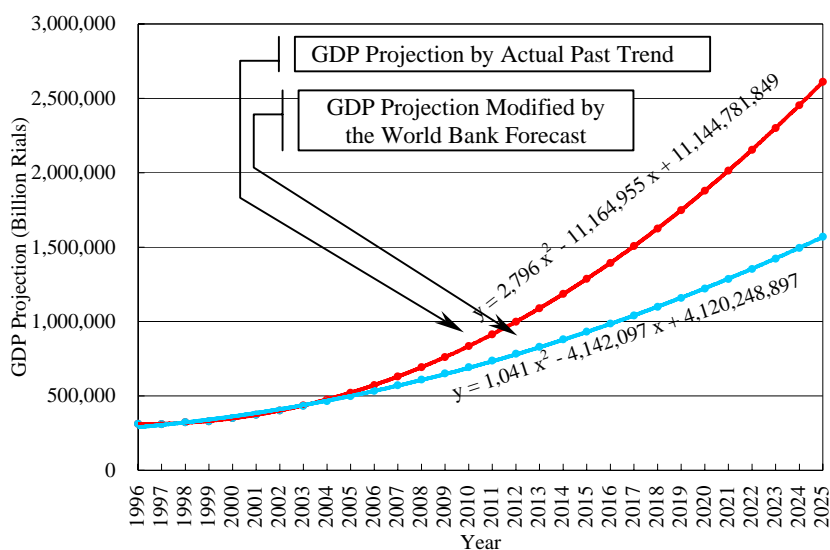


Figure 2.3 GDP Projection Based on Actual Trend Modified by the World Bank Forecast

Using the formula showing in the above figure of GDP projection modified by the World Bank Forecast, the other annual amount of GDP can be estimated for the future as shown in the following table.

**Table 2.3 GDP Projection Based on Actual Past Trend
Modified by World Bank Forecast in 1997 Constant Price**

(GDP in Total: Billion Rials)										
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GDP in Total	312,531	311,123	322,701	329,103	350,910	372,685	401,874	432,587	464,861	498,726
Growth Rate against Previous Year		-0.45%	3.72%	1.98%	6.63%	6.21%	7.83%	7.64%	7.46%	7.29%
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
GDP in Total	534,211	571,348	610,164	650,691	692,962	737,010	782,872	830,587	880,197	931,751
Growth Rate against Previous Year	7.12%	6.95%	6.79%	6.64%	6.50%	6.36%	6.22%	6.09%	5.97%	5.86%
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GDP in Total	985,300	1,040,903	1,098,625	1,158,537	1,220,720	1,285,264	1,352,269	1,421,848	1,494,125	1,569,237
Growth Rate against Previous Year	5.75%	5.64%	5.55%	5.45%	5.37%	5.29%	5.21%	5.15%	5.08%	5.03%

Source: Data from 1996 to 2002 is excerpted from the Iran Statistical Year bBook 1382.

According to this projection, the annual average growth rate of GDP based on the actual past trend modified by the World Bank Forecast shown in the above Table is resulted at 6.10 % since 2003 till 2025. It seems rather likely one than 8.43 % mentioned above. Anyway, it may say that the GDP in Iran will be grown constantly unless unexpected political, economical and financial crises will happen.

2.2.2 Population

Present Population

Total present population (2005) of the study area is 93,141, of which 46,882 (50.3 %) live in flood-prone area, and 46,259 (49.7 %) live in the other areas. Flood-prone area encompass villages which are usually affected by flood/debris flow in one way or another, and were thoroughly covered by JICA Survey for Environmental and Social Considerations conducted during October 2004 to June 2005. Other areas include Kalaleh city, police/military installations and associated housing facilities, livestock pens with associated persons, and the village with no inhabitants. Flood prone area includes 44 villages distributed in Golestan, Khorasan and Semnan provinces. Total number for city, villages and housing/pen sites in the other areas is 22, mostly being in Golesta province, at lower reaches of the basin. JICA study team concentrates on flood-prone area, and draw plans/program for protecting these villages against flood/debris flow. Therefore data/information on these villages are provided herein below in details.

Table 2.4 Population Status in Flood-Prone Area of the Madarsoo River Basin

Total Number in 2005						
Village	Household	Population	Male	Female	Child <9	Average Household Size
44	8,963	46,882	22,328	24,264	8,154	6.5

Source: JICA Study Team, Survey for Environmental and Social Considerations- October 2004 – June 2005.

Future Population

Since the target year of the plan formulated by JICA study team is 2025, population for target year is estimated with 5-year interval, to provide ground for design and establishment of infrastructures/institutions to meet future demand of the area. In estimating future population, following relation has been applied:

$$Fp = Pp \times (1 + pgr)^n$$

Where Fp is future population; Pp present population; 1 is constant number; pgr is average annual population growth rate in %, and n is years interval.

Here population is estimated for the next 20 years with 5-year interval, so $n = 5$, and average annual growth rate is set at 1.80%, assuming all factors on population growth remain constant.

Bases/reference for applying the figure 1.80% growth rate in this formula:

- Average of long-term of annual population growth rate in Golestan province is 1.72% (2.30% in urban area and 1.14% in rural area). Since the study area is comprised of urban and rural areas and largely occurs in Golestan, figure 1.72% can be used for estimating its future population.
- Result of statistical analysis performed by Iranian consultants working for Ministry of Jihad-e-Agriculture in the Madarsoo River basin, indicates that growth rate of 1.80% is reasonable in predicting population of this area. They have applied the same figure in their calculations.
- Average annual growth rate of population for the country (on long-term basis) is 1.80%, with decreasing trend.

It should be noted that with introduction/encouragement of family planning schemes by the Iranian government, and prevalence of old motto “less child, better life”, population growth rate would keep its constant trend, or even show decreasing tendency in future. Therefore data on population growth presented in this report can be reliably used in development plans.

Table 2.5 Present and Future Population in the Madarsoo River Basin

Area	Present	Future			
	2005	2010	2015	2020	2025
Flood Prone	46,882	51,256	56,038	61,266	66,982
Others	46,259	50,575	55,294	60,453	66,093
Overall	93,141	101,831	111,332	121,719	133,075
Population Density (Persons/ha)	0.39	0.43	0.47	0.51	0.56

Total area (flood prone + others) is 236,400 ha, and kept constant.

Sources: JICA Study Team, Survey for Environmental and Social Considerations, October 2004 –June 2005.
Statistical Yearbook of Golestan Province, Management and Planning Organization of Golestan- 2003

2.2.3 Regional Income

The targeted area of the Project includes two provinces of the Golestan and Khorasan Provinces. Therefore, the regional incomes for both the provinces are to be made clear. Following table shows them based on the statistics as indicated in its footnote.

Table 2.6 Gross Regional Income of the Golestan and Khorasan Provinces

Description	Province	(Billion Rials)			
		Golestan		Khorasan	
	Christian Year	2000	2001	2000	2001
	Iranian Year	1379	1380	1379	1380
Agriculture, hunting, forestry		2,747	2,878	6,786	7,771
Fishing		173	190	3	5
Mining		30	43	265	325
Manufacturing		558	506	5,764	6,006
Water, electricity and gas		73	74	937	936
Construction		471	462	2,719	2,476
Wholesale & retail trade; repair of motor vehicles and personal and household goods		2,030	2,241	7,780	9,331
Hotel and restaurants		52	57	660	826
Transport, storage and communications		466	1,057	3,261	4,120
Financial intermediate		107	134	542	675
Real estate, renting and business activities		799	867	4,642	5,618
Public administration, defence and social security		643	793	2,558	3,180
Education		473	566	2,120	2,819
Health and social work		288	348	1,456	1,889
Other community, social and personal activities		71	128	564	633
Total		8,981	10,343	40,057	46,609
Taxes on imports		89	122	456	643
Gross Regional Domestic Product (Gross Regional Income) (at market prices)		9,070	10,465	40,513	47,252
Population		1,543,860	1,574,737	6,481,635	6,611,268
Average Per Capita Regional Income (1,000 Rials/capita)		5,875	6,646	6,250	7,147

Source: Iran Statistical Year Book 1381 and 1382, Statistical Centre of Iran, Department of Publication and Information, Islamic Republic of Iran.

(Note) Population in each year above are roughly estimated based on the average annual growth rate of 2% since 1996 census..

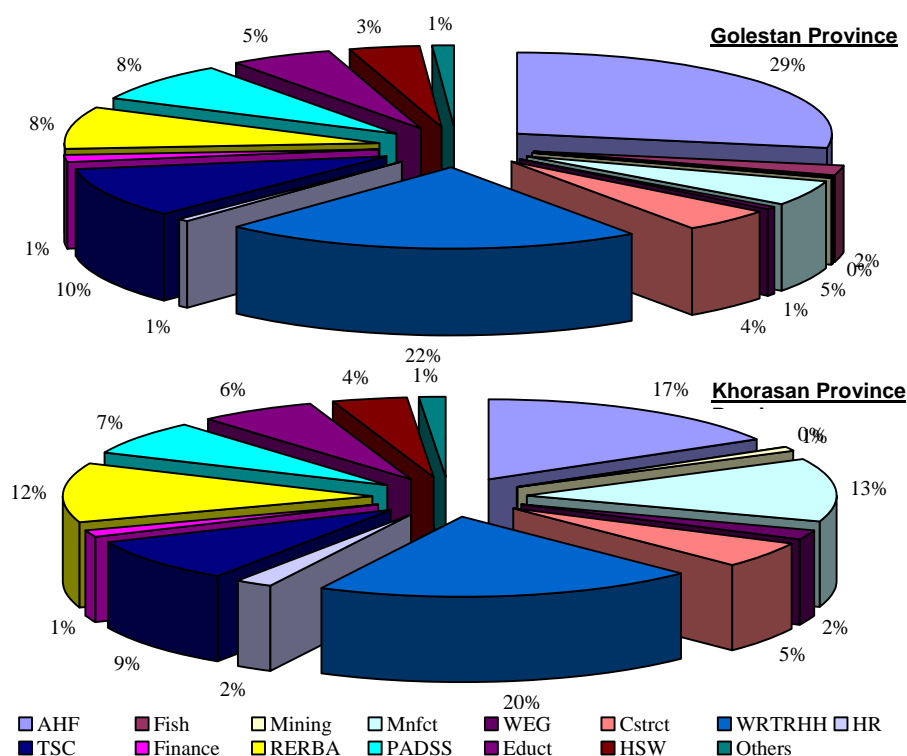
Because that the Golestan Province was newly established dividing the Mazandaran Province into two in 1997, the financial scale of the Golestan Province is still smaller than that of Khorasan Province.

It may not be sure to say something for the future status from only two years data. From the viewpoint of the financial scale of the Golestan Province, it may say to increase the regional income constantly. But it should be noted the annual inflation rate has been also rather high level as 13.8 % in the urban area and 25.6 % in rural area in the same province as discussed in sub-clause 1.2.1 of Chapter 1.

The average Per-Capita Regional Income in Khorasan Province is rather higher as 7.1 million Rials than that in Golestan Province as 6.6 million Rials as of 2001 reflecting their economic activities.

2.2.4 Industrial Structure

Following figures show an industrial structure as of 2001 in both the Golestan and Khorasan Provinces based on the Table 2.4.



Source: Iran Statistical Year Book 1381 and 1382, Statistical Centre of Iran, Department of Publication and Information, Islamic Republic of Iran.

Figure 2.4 Industrial Structures in Golestan and Khorasan Provinces

As shown in the above figures, the sectors of Agriculture, Hunting and Fishery (AHF) and Wholesale & Retail Trade, Repair of Motor Vehicles, and Personal & Household Goods (WRTRHH) share with high rates both the Golestan and Khorasan Provinces.

Between the two of AHF and WRTRHH, AHF sector shares higher as 29 % than WRTRHH sector as 22 % in Golestan Province, while those in Khorasan Province have been reversed as 17 % and 20 % respectively, reflecting their economic activities.

From the viewpoint of location of the provinces, it may say that this structural pattern of their industries will be the same for the future too.

2.2.5 Infrastructural Development

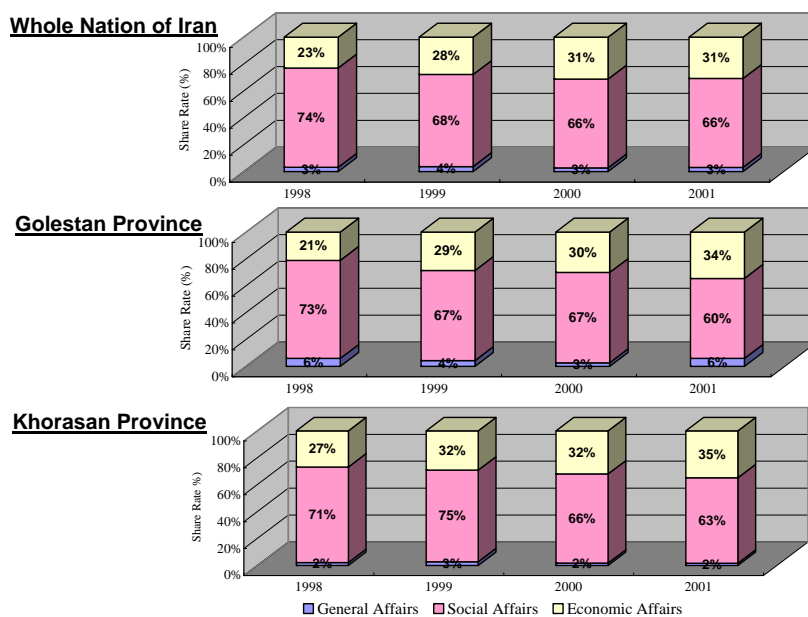
Usually, the investment for the infrastructural development belongs to the budget of development expenditure. Following table shows the current expenditure and the development expenditure of the whole nation of Iran and targeted two provinces of Golestan and Khorasan.

Table 2.7 Current and Development Expenditures of Iran and Targeted Provinces

(Million Rials)					
Year in Christian Calendar	1998	1999	2000	2001	2002
Year in Iranian Calendar	1377	1378	1379	1380	1381
Total in the Nation					
Current Expenditure	15,011,211	17,850,738	22,825,747	29,671,043	38,777,189
Development Expenditure	4,111,403	4,680,555	4,024,750	9,752,292	9,836,918
General Affairs	132,127	176,912	109,649	309,132	363,294
Social Affairs	3,034,982	3,202,932	2,659,609	6,438,275	5,934,298
Economic Affairs	944,294	1,300,711	1,255,492	3,004,885	3,539,326
Total Expenditure	19,122,614	22,531,293	26,850,497	39,423,335	48,614,107
Golestan Province					
Current Expenditure	363,064	432,910	574,128	803,761	996,221
Development Expenditure	86,970	118,649	93,733	336,439	n.a
General Affairs	5,098	5,086	2,480	19,624	n.a
Social Affairs	63,556	79,617	63,059	200,770	n.a
Economic Affairs	18,316	33,946	28,194	116,045	n.a
Total Expenditure	450,034	551,559	667,861	1,140,200	n.a
Khorasan Province					
Current Expenditure	1,551,816	1,846,956	2,351,828	2,931,108	3,851,365
Development Expenditure	357,534	393,102	324,182	814,354	n.a
General Affairs	7,761	11,559	5,700	13,800	n.a
Social Affairs	253,797	267,078	214,682	516,836	n.a
Economic Affairs	95,976	114,465	103,800	283,718	n.a
Total Expenditure	1,909,350	2,240,058	2,676,010	3,745,462	n.a

Source: Iran Statistical Year Book 1382, Statistical Centre of Iran, Management & Planning Organization, Islamic Republic of Iran.

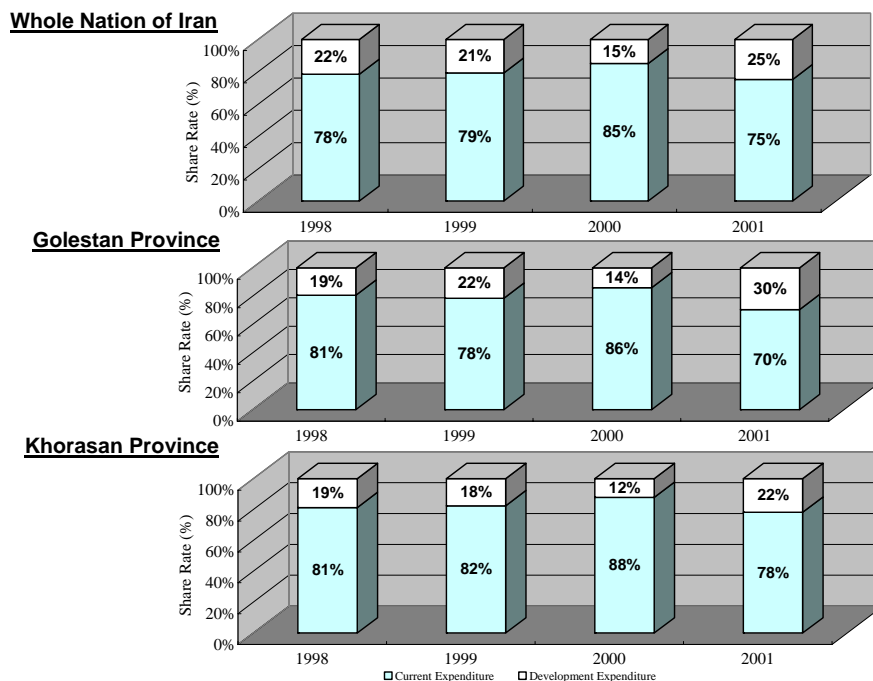
Among the development expenditures, the expenditures for social affairs include those for the urban and rural development, and the expenditures for economic affairs include those for road and transportation. Following figures show their share trend from the year 1998 to 2001 of development expenditures.



Source: Iran Statistical Year Book 1381 and 1382, Statistical Centre of Iran, Department of Publication and Information, Islamic Republic of Iran.

Figure 2.5 Share Trend of Development Expenditures

From the viewpoint of their share rate above, the expenditures for social infrastructures have been paid out with limitation. However, the share rate of the development expenditures are fluctuated ranging from 12 % in the Khorasan Province to 30 % in the Golestan Province against the total expenditures during the same period as shown in the following figures.



Source: Iran Statistical Year Book 1381 and 1382, Statistical Centre of Iran, Department of Publication and Information, Islamic Republic of Iran.

Figure 2.6 Share Trend of Each Expenditures to the Total Expenditures

Usually, almost of farmers in rural areas sell their agricultural products to wholesalers. In the case of Iran, certain farm gate prices having set by the Government are applied for some of major products like wheat and so on as a minimum standard for protecting the farmers' life. But, such Government-set farm gate prices do not reflect the actual market status like demand-supply mechanism.

Furthermore, the agricultural business is right now becoming quite difficult because of high inflation rate. The farmers should buy such investment materials as fertilizers, seeds, nurseries and others that are expensive reflecting the inflation. However, the Government-set farm gate prices are usually fixed, or only being slightly changed even they are revised. It means that the farm gate prices seem not to recover the farmers' investment cost.

If more development expenditures will be invested to road and transportation networks and to rural development for making easy to approach their market, and will give some subsidies to establish a kind of self-supporting systems to enhance farmers' intensity, it can be expected that the farmers will sell their products in the market directly with market prices. This will contribute to increase farmers' purchasing capability as one of their economic activities. In another way, if farmers have enough circumstances, they will develop their own processing factories for example in a field of some of dairy industries. This will contribute to enhance the rural economic activities.

From the viewpoint of the above, it may be required that the constant development expenditures with high level under a practicable rural development program led by the Government first.