ANNEX 6 COMPOSITE SATELLITE IMAGE WITH ROAD PLANNING

The following figures A6-2 to A6-11 are composite satellite images with road plan prepared based on the drawing made by Pasilou Consultant, which is mentioned in Annex 5. If these materials will be helpful for evaluation and reconsideration by MORT Central Office and Pasilou Consultant, it's our pleasure.

Also Figure A6-1 shows the definition of effective width to use for flow capacity estimation of bridges and it's useful to understand the meanings of the composite satellite images.

In this figure the direction of effective width always should be at right angled to river stream.

In case of that bridge is not at right angled to river stream, bridge length should be bigger than river width as shown in Fig A6-1 (2).

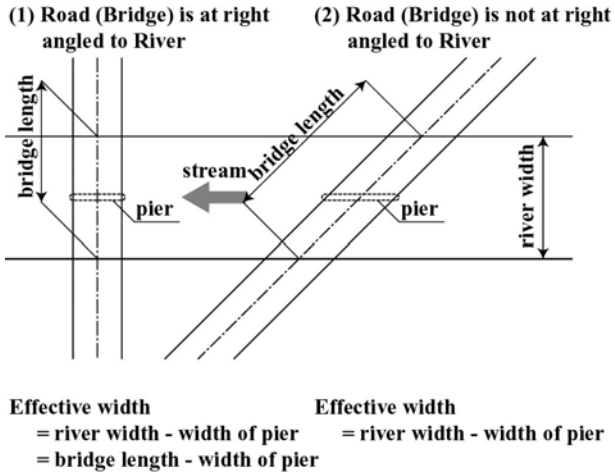


Figure A6-1 Definition of Effective Width

As shown in figures A6-2 to A6-11, all bridges crosses the river at angles of less than 60 degrees. At the time of floods, Madarsoo river generaly had about 100m width. Then all effective widths of bridges are shorter than the 100m.

Figure A6-2 Satellite Image with Road Plan (Location of Planned Bridge No.1)

Figure A6-3 Satellite Image with Road Plan (Location of Planned Bridge No.2)

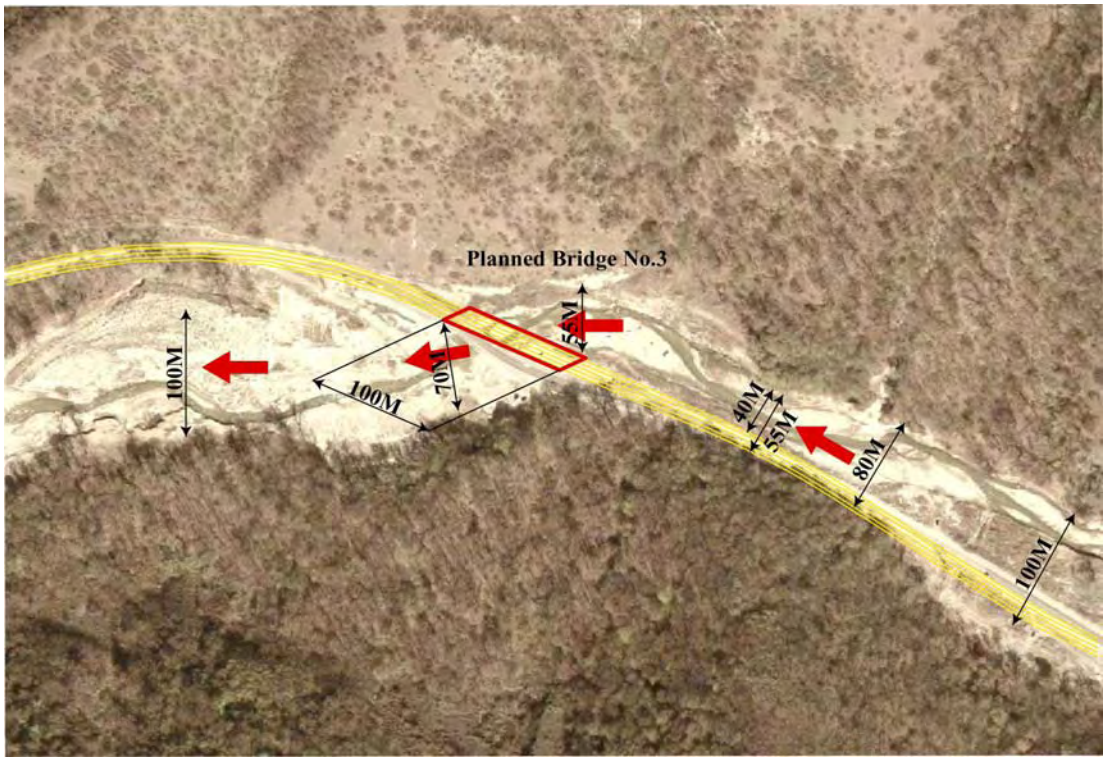


Figure A6-4 Satellite Image with Road Plan (Location of Planned Bridge No.3)

Figure A6-5 Satellite Image with Road Plan (Location of Planned Bridge No.4)

Figure A6-6 Satellite Image with Road Plan (Location of Planned Bridge No.5)

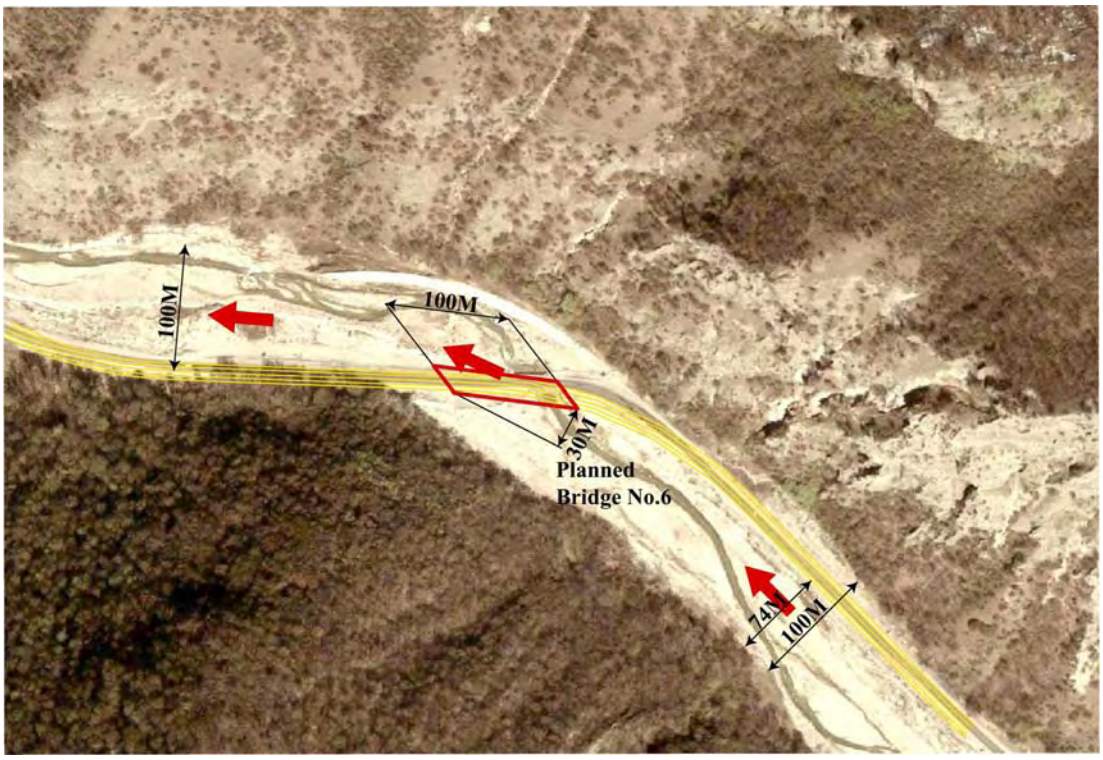


Figure A6-7 Satellite Image with Road Plan (Location of Planned Bridge No.6)

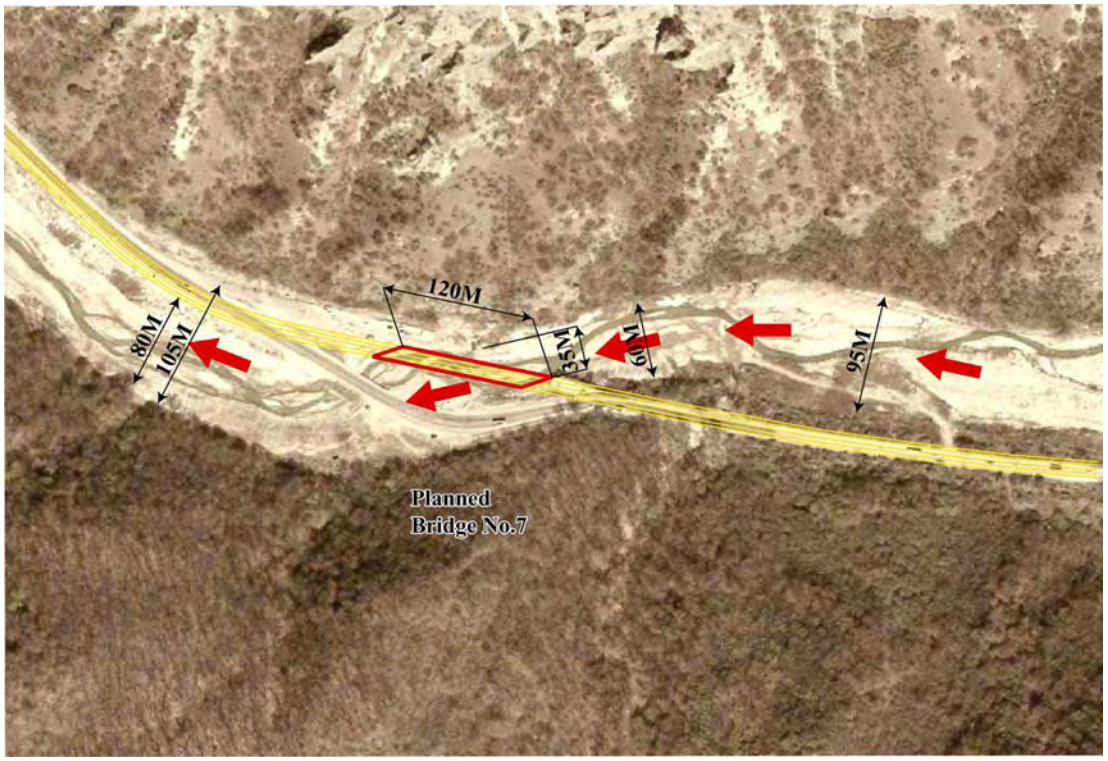


Figure A6-8 Satellite Image with Road Plan (Location of Planned Bridge No.7)

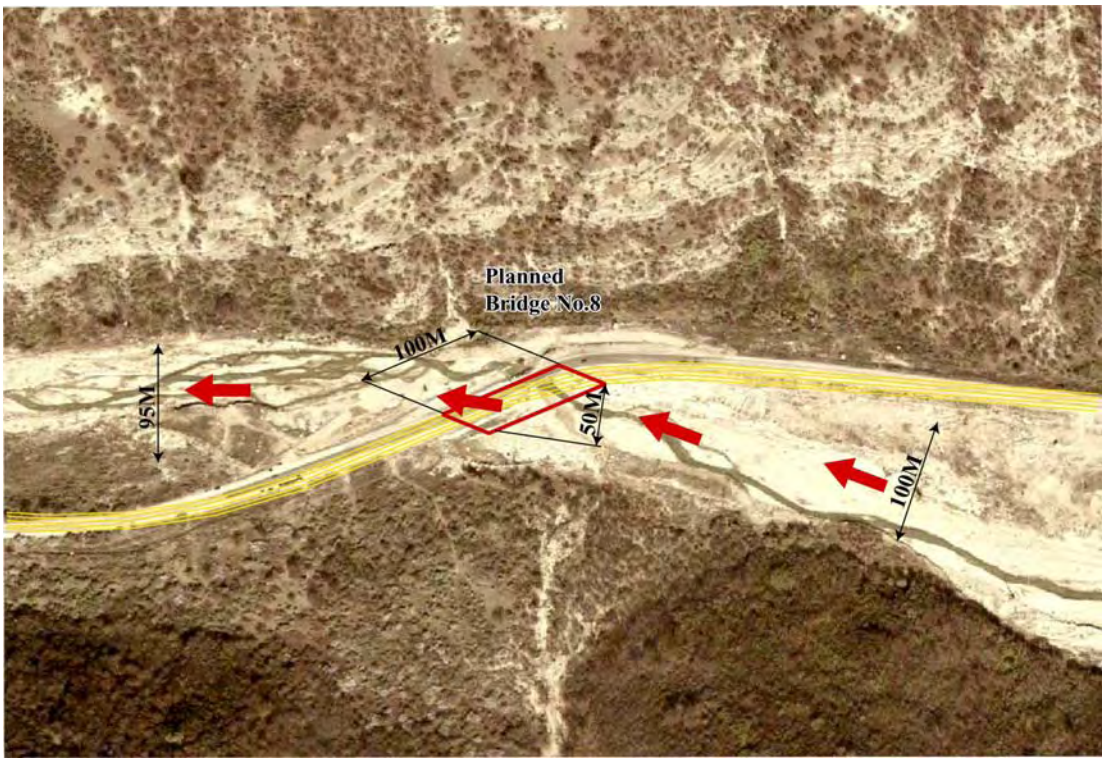


Figure A6-9 Satellite Image with Road Plan (Location of Planned Bridge No.8)

Figure A6-10 Satellite Image with Road Plan (Location of Planned Bridge No.9)

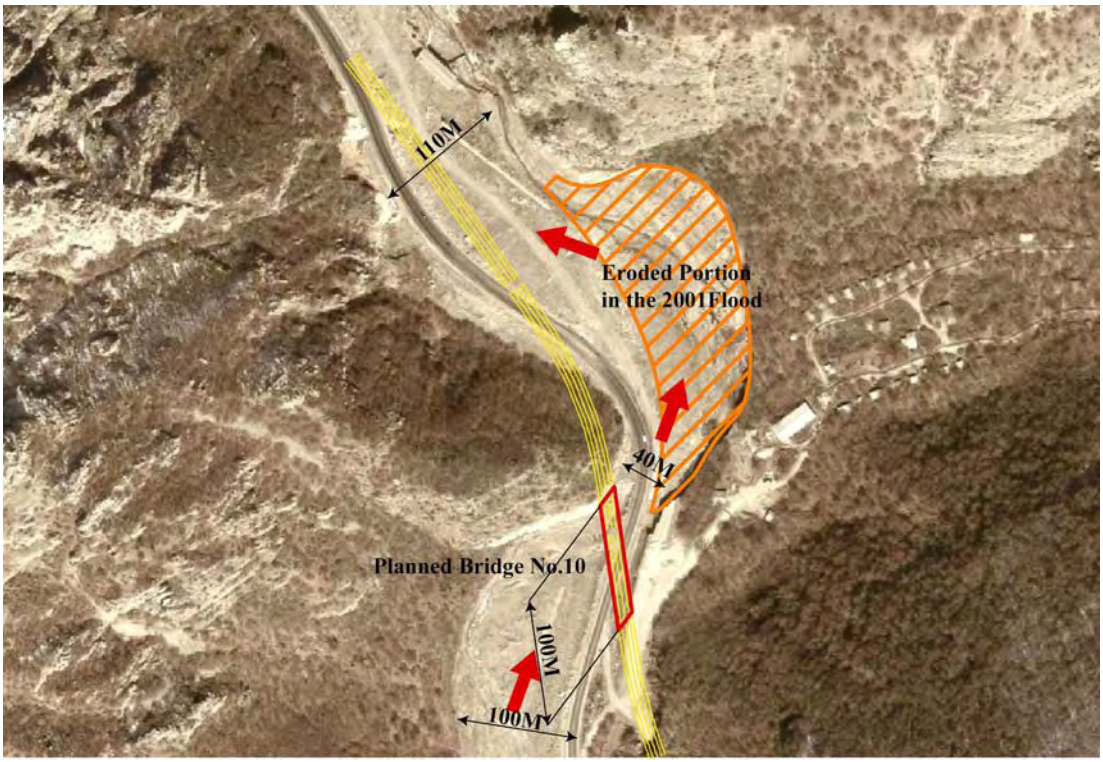


Figure A6-11 Satellite Image with Road Plan (Location of Planned Bridge No.10)

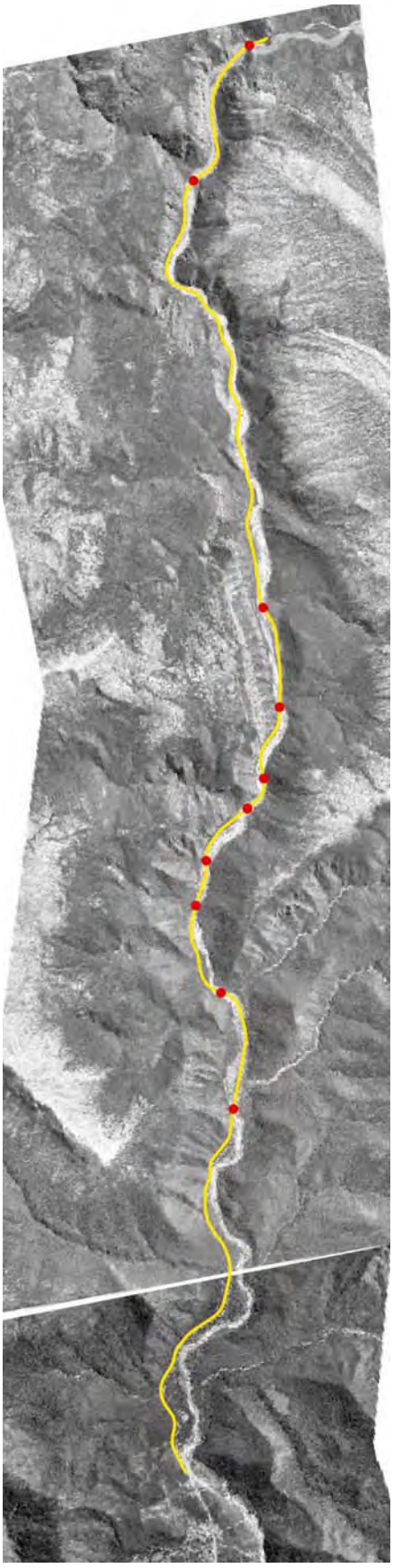
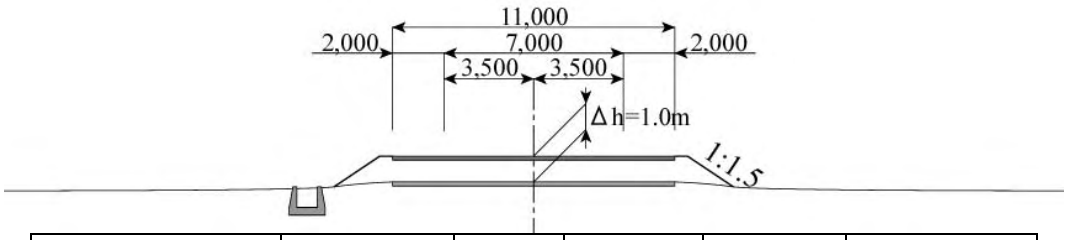


Figure A6-11 Satellite image with Road Horizontal Alignment in Golestan Park

ANNEX 7 COST ESTIMATES OF ROAD IMPROVEMENT (DRAFT)

1. Road Raising

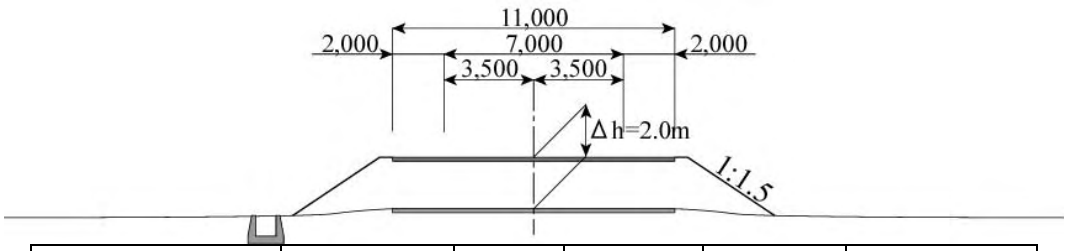
(1) Case 1 (dH = 1.0m)



Item	Spec	Unit	Quantity	Unit Price	Cost
Removal of Existing Pavement		**(m^2)**	**1,100.0**	**20,000**	**22,000,000**
Embankment		**(m^3)**	**1,350.0**	**48,000**	**64,800,000**
Slope Protection	**Planting**	**(m^2)**	**360.6**	**28,000**	**10,096,800**
Pavement	**As (t=120)**	**(m^2)**	**1,100.0**	**115,000**	**126,500,000**
Side Ditch	**Conc.**	**(m)**	**100.0**	**200,000**	**20,000,000**
Others					**60,000,000**

TOTAL : 303,396,800 Rials / 100m

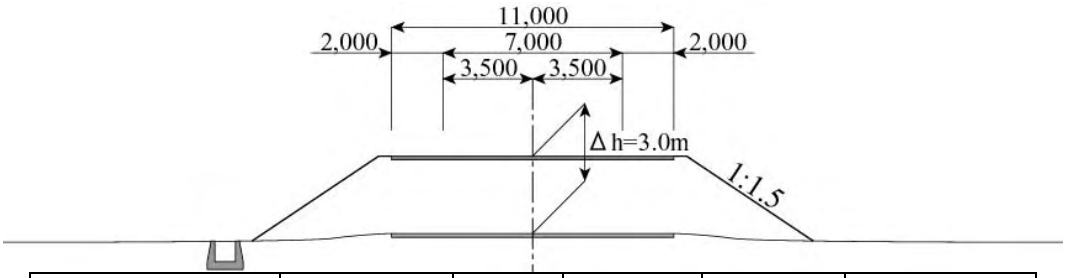
(2) Case 2 (dH = 2.0m)



Item	Spec	Unit	Quantity	Unit Price	Cost
Removal of Existing Pavement		**(m^2)**	**1,100.0**	**20,000**	**22,000,000**
Embankment		**(m^3)**	**3,000.0**	**48,000**	**144,000,000**
Slope Protection	**Planting**	**(m^2)**	**721.2**	**28,000**	**20,193,600**
Pavement	**As (t=120)**	**(m^2)**	**1,100.0**	**115,000**	**126,500,000**
Side Ditch	**Conc.**	**(m)**	**100.0**	**200,000**	**20,000,000**
Others					**60,000,000**

TOTAL : 392,693,600 Rials / 100m

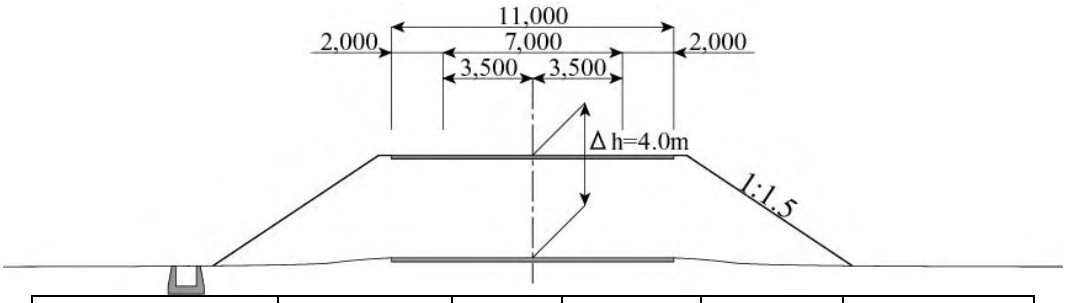
(3) Case 3 (dH = 3.0m)



Item	Spec	Unit	Quantity	Unit Price	Cost
Removal of Existing Pavement		**(m^2)**	**1,100.0**	**20,000**	**22,000,000**
Embankment		**(m^3)**	**4,950.0**	**48,000**	**237,600,000**
Slope Protection	**Planting**	**(m^2)**	**1,081.8**	**28,000**	**30,290,400**
Pavement	**As (t=120)**	**(m^2)**	**1,100.0**	**115,000**	**126,500,000**
Side Ditch	**Conc.**	**(m)**	**100.0**	**200,000**	**20,000,000**
Others					**60,000,000**

TOTAL : 496,390,400 Rials / 100m

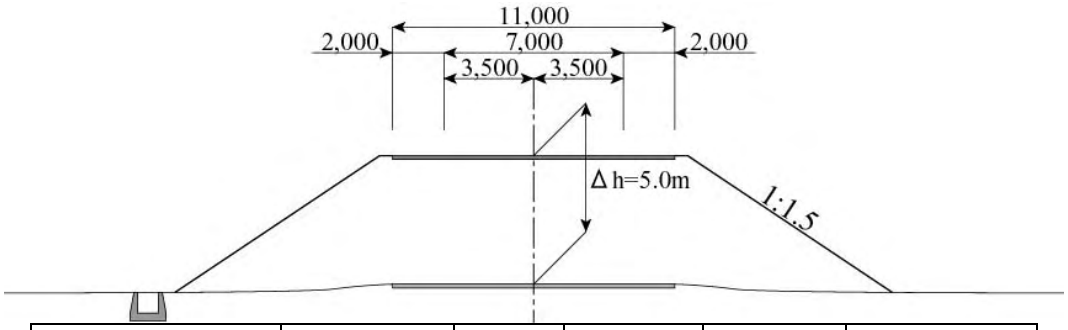
(4) Case 4 (dH = 4.0m)



Item	Spec	Unit	Quantity	Unit Price	Cost
Removal of Existing Pavement		**(m^2)**	**1,100.0**	**20,000**	**22,000,000**
Embankment		**(m^3)**	**7,200.0**	**48,000**	**345,600,000**
Slope Protection	**Planting**	**(m^2)**	**1,442.4**	**28,000**	**40,387,200**
Pavement	**As (t=120)**	**(m^2)**	**1,100.0**	**115,000**	**126,500,000**
Side Ditch	**Conc.**	**(m)**	**100.0**	**200,000**	**20,000,000**
Others					**60,000,000**

TOTAL : 614,487,200 Rials / 100m

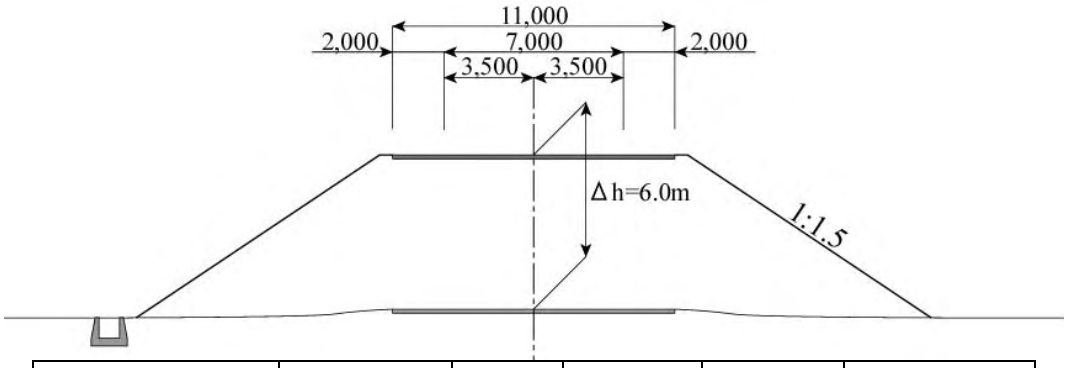
(5) Case 5 (dH = 5.0m)



Item	Spec	Unit	Quantity	Unit Price	Cost
Removal of Existing Pavement		**(m^2)**	**1,100.0**	**20,000**	**22,000,000**
Embankment		**(m^3)**	**9,750.0**	**48,000**	**468,000,000**
Slope Protection	**Planting**	**(m^2)**	**1,803.0**	**28,000**	**50,484,000**
Pavement	**As (t=120)**	**(m^2)**	**1,100.0**	**115,000**	**126,500,000**
Side Ditch	**Conc.**	**(m)**	**100.0**	**200,000**	**20,000,000**
Others					**60,000,000**

TOTAL : 746,984,000 Rials / 100m

(6) Case 6 (dH = 6.0m)



Item	Spec	Unit	Quantity	Unit Price	Cost
Removal of Existing Pavement		**(m^2)**	**1,100.0**	**20,000**	**22,000,000**
Embankment		**(m^3)**	**12,600.0**	**48,000**	**604,800,000**
Slope Protection	**Planting**	**(m^2)**	**2,163.6**	**28,000**	**60,580,800**
Pavement	**As (t=120)**	**(m^2)**	**1,100.0**	**115,000**	**126,500,000**
Side Ditch	**Conc.**	**(m)**	**100.0**	**200,000**	**20,000,000**
Others					**60,000,000**

TOTAL : 893,880,800 Rials / 100m

2. Bridges

(1) Unit Cost

Table A3-1 shows the costs needed for the reconstruction of bridges in or around the Madarsoo River Basin after the series of Floods. The type of bridges is all same, Prestressed Concrete Girder. And Figure A3-1 shows this correlation between the bridge unit cost per square meter and bridge span.

Table A7-1 Cost Data of Reconstructed Bridges and Newly Planed Bridge

Name	Width	Length	Area	Span	Total Cost	Unit Cost (per m2)	
	(m)	(m)	(m2)	(m)	(M. Rials)	(Rials)	(US$)
Gogcheh Bridge	9.500	64.000	608.0	16.000	3,000	4,934,211	548.2
Kallaleh Bridge	9.500	80.000	760.0	20.000	5,000	6,578,947	731.0
New Bridge in NGP	13.000	100.000	1,300.0	24.000	10,000	7,692,308	854.7

Converted as 1$ = 9,000 Rials
(DATA : MORT Provincial Office)

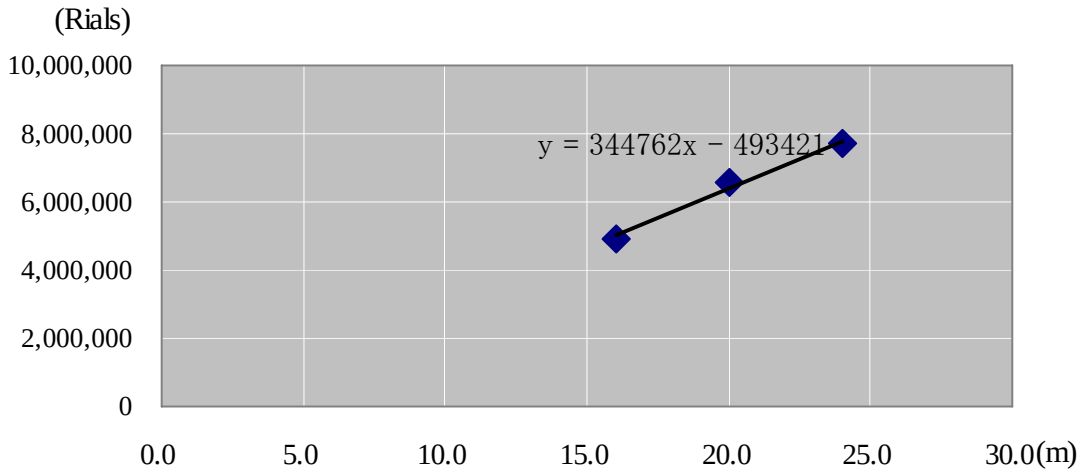


Figure A7-1 Correlation between bridge unit cost per square meter and span (m)

From the above data, the unit price of bridges can be estimated as shown in Table A3-2 at every bridge span.

Table A7-2 Bridge Unit Cost (1/2)

span (m)	unit cost (Rials /m2)	span (m)	unit cost (Rials /m2)	span (m)	unit cost (Rials /m2)
20.0	6,400,000	26.0	8,470,000	32.0	10,540,000
21.0	6,750,000	27.0	8,820,000	33.0	10,880,000
22.0	7,090,000	28.0	9,160,000	34.0	11,230,000
23.0	7,440,000	29.0	9,500,000	35.0	11,570,000
24.0	7,780,000	30.0	9,850,000	36.0	11,920,000
25.0	8,130,000	31.0	10,190,000	37.0	12,260,000

(2) Total Cost for Kalaleh bridge and 14 metry bridge improvement

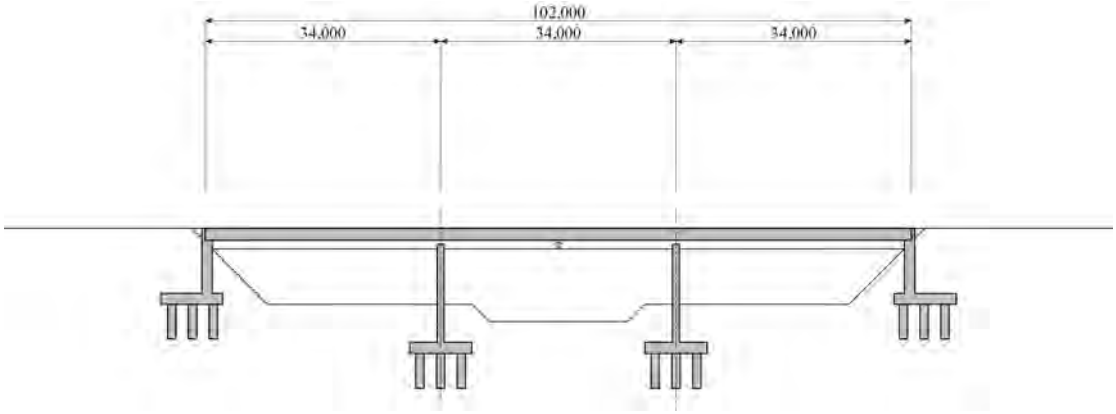


Figure A5-2 Draft of Kalaleh bridge and 14 metry bridge improvement

Name	Width (m)	Length (m)	Unit Price Cost (Rials)	Total Cost (Rials)
Kalaleh Bridge	11	102	11,230,000	12,600,060,000
14-Metry Bridge	21	102	11,230,000	24,054,660,000
			TOTAL	36,654,720,000

SUPPORTING REPORT I (MASTER PLAN)

PAPER XIII

Project Economic Evaluation

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 XIII PROJECT ECONOMIC EVALUATION

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LIST OF FIGURES

CHAPTER 1 INTRODUCTION

In general, a project will be evaluated taking engineering, economic and/or financial, institutional and environmental aspects into consideration. The engineering aspects are studied and form a part of the technical viability of the project from the viewpoint of construction, operation and maintenance. The institutional aspect of the project evaluates the existing organisation and management structures and suggests capacity building measures. The environmental aspects are studied on environmental reliability from the viewpoint of water quality, living environment, biodiversity and so forth.

The economic aspect, of the project is to determine whether the project can contribute to the improvement in the socio economic condition of people living in cities and villages along the river, in this case Madarsoo River and its tributaries. In the Project under study as discussed hereunder, it has no aspect concerning the financial evaluation because of pure public works.

An economic evaluation of the project is based on the economic cost and benefit. The benefits should be measurable in terms of direct monetary value. The economic benefit to the people can be tangible and/or intangible but it needs to be evaluated as it contributes to the national/regional economy. The economic cost can be derived by eliminating the distortion caused by the taxes, charges, duties that may be levied as per the laws and/or some other rules or regulation applicable at that point of time from financial cost.

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

CHAPTER 2 WATERSHED MANAGEMENT PLAN

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

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

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

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

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

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

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

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

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

A part of this Watershed Management Plan is included in the next "2. River Restoration Plan" discussed hereunder.

CHAPTER 3 RIVER RESTORATION PLAN

The River Restoration Plan consists of three plans as (1) the Watershed Management Works (WM or WMP), (2) the Sediment Control Works (SC or SCD) and (3) the River Improvement Works including the Erosion control Works (RI or RIW). The targeted village is the Dasht Village.

3.1 Identification of Economic Benefit

Direct Benefit

There are two categories of the Economic benefits in this kind of Project. First one is the economic benefits that can be expected in this kind of project are the amount mitigated from:

(1) an amount of houses and household movables to be damaged,

(2) an amount of such agricultural products as cereals/grains and vegetables to be damaged,

(3) an amount of floricultural products as sun-flower in this area to be damaged,

(4) an amount of products from plantation like peach and apricot and so on to be damaged,

(5) an amount of animal husbandry like sheep and goat to be damaged,

(6) an amount of products from dairy farming to be damaged,

(7) damages to the public facilities like roads, bridges, common buildings and/or common structures including official buildings, conference houses, common store-houses, mosque, cemetery and

(8) damages to the common properties like tools and equipments for agricultural works consisting of plowing machines, threshing machines, tractors, trucks, motor-cycles, bicycles, and other type of vehicles, etc.,

due to execution of the Project.

In this case, the works for WM is contributed a little bit because that the works for WMP has also a capability of sediment control.

Indirect Benefit

Furthermore, there may be a lot of other kinds of socio-economic and/or environmental benefits like those which may be derived from;

(1) conservation of the bio-diversity,

(2) keeping rural and pastoral landscape being beautiful,

(3) stabilizing a mind of people living there, and so forth.

3.2 Identification of Economic Cost

Usually, the cost for the Project is estimated in terms of financial cost, but the economic cost is to be applied for economic evaluation. Therefore, the economic cost is to be converted from the financial cost.

In this case, a Standard Conversion Factor (SCF) for tradable equipment and materials, shadow price for land acquisition cost and/or housing compensation, and for labours for the construction works, cost of transfer items such as personal income tax and corporate income tax should be taken into account.

3.3 Economic Evaluation Indices

Economic costs and benefits throughout the project life are compared in terms of present values. If the total present value of economic costs equals that of economic benefits (when, B/C=1), the discount rate used to calculate the present value is called as "economic internal rate of return (EIRR)" and uses as the main index of project evaluation to judge the project viability and/or feasibility. The other two indices are Net Present Value (NPV) and B/C Ratio. (ANNEX 1 gives details on economic evaluation indices applied).

3.4 Economic Evaluation

3.4.1 Estimation of Economic Benefit

(1) Damages to Houses and Household Movables

One of the economic benefits derived from houses and household movables in residential areas are given differences of damages expressed by land values between without the Project and with the Project.

For estimation of such damages, total residential areas (ha), total number of houses, damaged number of houses caused by the past floods, unit construction cost of houses (Rials/house), average floor area of houses (m^2/house), number and kind of household movables and their buying prices.

With the total number of houses, the damaged number of houses caused by the past floods, a damage rate can be estimated. And, after estimated the unit value of land, the amount of damages can be estimated from it by multiplying the damage rate.

Annex 2.1 shows detail of the above factors together with agricultural products, floricultural products, and products from livestock and dairy. As shown in this Annex, the damage rate was 82 % at 2001-Year flood.

As a result, the amount of Rials 567.0 million is gotten as the damaged land value without the Project case. Damages to public facilities in the residential area are estimated by a rate of 20 % in this case. So that, Rials 113.4 million is estimated for as the damaged land value of public facilities. Therefore, the total damaged land value in the residential area becomes Rials 680.3 million.

(2) Damages to Agricultural Products Including Floricultural Products

The above mentioned damages to agricultural products as cereals/grains and vegetables, to floricultural products as sun-flower and to products from plantation like peach and apricot may be united in one category as the agricultural products. Usually, the agricultural areas consist of irrigated area and non-irrigated area. In this case, it is assumed that the irrigated area is only a targeted area to be damaged according to the field investigation.

For estimation of agricultural damages, kinds of products, the area of cultivation of each product (ha), production volume of each product (tons/ha, or kg/ha), the average farm gate price of each product (Rials/ton, or Rials/kg), damage rate of irrigated agricultural area (%) are to be made clear first. These data and information are also gotten from villagers by interview survey made by the JICA Study Team. The damage rate was 80 % at the 2001-Year Flood.

Using data and information showing in the said Annex 2.1, the amount of Rials 5.8 million is gotten as the damaged land value without the Project case in the irrigated agricultural area. Damages to public facilities in the irrigated agricultural area are estimated by a rate of 5 % in this case. So that, Rials 0.3 million is estimated as the

damaged land value of public facilities. Therefore, the total damaged land value in the irrigated agricultural area becomes Rials 6.1 million.

(3) Damages to Animal Husbandry and Dairy Products

In this area, they are breeding sheep, goats, and cows in their range land (pastoral land). Among them, sheep and goats are for meat supply, and cows are for milk supply for making process milk, cheese, and butter.

For estimation of damages to animal husbandry and dairy products, kind of animals to be bred, area of range land used as pastoral land for breeding animals (ha), number of heads of each animal, meat selling mechanism of animals, unit production of meat and/or milk per head or per day of each animal (kg/head or tons/head for meat, or kg/head or kg/day for milk), the average breeders' gate price of meat and/or milk. These data and information are gotten from villagers too by interview survey made by the JICA Study Team. The damage rate was 30 % at the 2001-Year Flood.

Using data and information showing in the said Annex 2.1, the amount of Rials 0.2 million is gotten as the damaged land value without the Project case in the range land. In this case, it is assumed that the public facilities in the range land are negligible small, so that it is omitted to estimate.

Following table shows damages to be able to convert benefits when the Project will be executed.

Table 3.1 Summary of Basic Unit for Estimation of Economic Benefit Expressed by Land Value

(1,000 Rials/ha)

Land Value Due to Mitigation of Flood Damages					
Residential Area			Irrigated Agricultural Area		
Houses and Movables	Public Facilities (20%)	Total	Decrease in Productivity	Public Facilities (10%)	Total
566,955	113,391	680,346	5,779	289	6,068

(4) Annual Average Damages and Estimation of Economic Benefit

The annual average damages are calculated by means of the Probability Analysis in each case of (1) the Watershed Management Works (hereinafter referred to as "WM") only, (2) the combination of WM and the Flood Control Works ("FC") and (3) the combination of WM, FC and the River Improvement Works ("RI").

According to a flood model analysis, followings have been made clear:

Table 3.2 Flooding Area by Case of Combination of the Works by Each Return Period

(ha)

Return Period	Flooding Area Without Project			Flooding Area With WM			Flooding Area With WM + SC			Flooding Area With WM + SC+ RI		
	Residential Area	Irrigated Agricultural Area	Flooding Area in Total	Residential Area	Irrigated Agricultural Area	Flooding Area in Total	Residential Area	Irrigated Agricultural Area	Flooding Area in Total	Residential Area	Irrigated Agricultural Area	Flooding Area in Total
5	0	163	163	0	159	159	0	141	141	0	0	0
10	0	396	396	0	385	385	0	362	362	0	0	0
25	9	674	683	8	648	656	7	632	639	0	0	0
50	37	783	820	36	726	762	11	736	747	0	387	387
100	44	825	869	42	783	825	16	809	825	4	535	539

Figures shown in the above table mean that, even if some works will be executed as counter-measures, several areas will still be remained to be flooded. Using the above figures in the table, the annual average damages are calculated as shown in Annexes 2.2 through 2.9 and summarized as follows:

Table 3.3 Summary of Annual Average Flood Damages and Calculation of Economic Benefit

Under the Present Condition (Million Rials)

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

Under 2025 Year Condition (Million Rials)

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

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

As shown in the above table, the economic benefit at present condition is estimated at Rials 942 million and that at 2025-Year condition is estimated at Rials 1,779 million under the cases of combination of whole 3 works of WM, SC and RI works. In this case, the population growth rate and the increasing rate of agricultural productivities are applied as socio-economic changing factors from the present to the future in the residential area and in agricultural area respectively.

For the annual average benefit for the SCD, the followings are resulted to be used because that once the debris flow is occurred, it brings the crushing damages to the houses and household properties.

Table 3.4 Summary of Annual Average Debris Flow Damages and Calculation of Economic Benefit

WMP and SCD under the Present (Million Rials)

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

WMP and SCD under 2025 Year Condition (Million Rials)

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

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

In addition to the above, the annual average economic benefit derived from the ECD is to be calculated because that once the erosion is occurred, the river side agricultural area is to be completely washed out, and it will be no more usable forever. Accordingly, the direct economic benefit in case of Erosion Control works is the amount of damages to the river side agricultural area to be mitigated. The resulted annual average economic benefit derived from ECD is as follows:

Table 3.5 Summary of Annual Average Erosion Damages and Calculation of Economic Benefit

ECD under the Present Condition (Million Rials)

Return Period (Year)	Under the Witout Project Condition	Under the Condition with ECD	
		Remaining Damages	Benefit
1	0	0	0
5	1	0	1
10	2	0	2
25	3	0	3
50	4	0	4
100	**5**	**0**	**5**

ECD under 2025 Year Condition (Million Rials)

Return Period (Year)	Under the Witout Project Condition	Under the Condition with WMP	
		Remaining Damages	Benefit
1	0	0	0
5	3	0	3
10	5	0	5
25	7	0	7
50	8	0	8
100	**10**	**0**	**10**

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

(5) Benefits to Be Newly Generated Due to Execution of Project

Furthermore, WM works will generate new agricultural and/or livestock products additionally because the Works will develop additional agricultural area to plant some fruit trees and, range land that would be fertilized by seeding several kinds of grasses, and planned to plant the atriplex as a provender and quercus (oak) for controlling run-off time-lag and controlling soil erosion by using its root.

Following table shows a summary of the WM works:

Table 3.6 Summary of Watershed Management Works

Major Works on Watershed Management	Land Condition	Land Use	Dasht-e-sheikh Area (ha)	Ghiz Ghaleh Area (ha)	Planting
Terracing	Moderate slope area	Dry farm land	120	125	It is planned that Olive, Walnut, Corylus, Peach and Apple are to be planted. **Among them, Olive is the major crop.**
Banquette	Steep slope area	Dry farm land	1,360	180	
Furrow	Mixing of moderate and steep slope	Dry farm land	2,850		**Atriplex is the major crop** for breeding Livestocks.
		Renge land			
Changing Dry Farming	Mixing of moderate and steep slope	Renge land	140	500	For Animal breeding. It means that the productivity of meat will become higher. **Sheep, Goat and Cow are the major livestocks to breed.**
Fertilizing in Range Land		Renge land	6,000	2,700	
Seeding in Range Land		Renge land	4,200	2,700	
Mass Seeding in Range Land		Renge land	240	70	
Planting in Range Land		Renge land	4,104	380	

On the terrace and banquet, it is planned that olive, walnut, corylus, peach and apple are to be planted. But, for convenience for benefit estimation, it is assumed that the olive is the represented crop to plant. According to the MOJA Plan, the olive will be planted at 170 trees per ha. Production volume will be 10 kg from one tree at the time of 5 years after a nursery tree planted and around 100 kg also at the time of 10 years after the nursery tree planted. The farm gate price of olive is Rials 4,500/kg at 2005-price level.

Based on the above information, the benefit to be newly generated is estimated by catchment of the tributaries of the Madarsoo River. Details are shown in Annex 2.10 and 2.11.

On the other hand, it is assumed that the productivity of livestock is the same with the existing range land of the Dasht Village.

As a result, Benefits to Be Newly Generated Due to Execution of Project are estimated as shown in the following table:

Table 3.7 Summary of Basic Unit for Estimation of Economic Benefit to Be Newly Generated

(1,000 Rials/ha)

Land Value Newly Developed Productive Area Due to Watershed Management Works	
Farm Land	Range Land for Livestocks
56,653	238

The planned areas for WMP consist of (1) Dasht-e-Sheikh Area with 120 ha for terracing works and 1,360 ha for banquette works both for farm land and with 17,534 ha for range land, and (2) Ghiz Galeh Area with 125 ha for terracing works and 180 ha for banquette works for farm land and 6,350 ha for range land. The works for WMP are human voluntary works to execute under the certain schedule as mentioned above, so full execution may not be expected because there will be several hurdle to be cleared as endless maintenance for terraces and banquettes and so on. From this viewpoint, rather conservative execution rate of 75 % is assumed to execute. And, the area for the works for WMP broaden out of the targeted catchments, so it is also assumed that the benefit will accrue one fourth (1/4) for Dasht-e-Sheikh Area, and one third (1/3) for Ghiz Galeh Area.

Based on the above mentioned assumptions, the annual average benefits derived from the works for WMP in Dasht-e-Sheikh Area and in Ghiz Galeh Area are calculated as Rials 21,229 million and Rials 5,403 million from farm land, and Rials 707 million

and Rials 377 million from range land. The works of WMP is not fit for probability analysis because that the Plan is not appearance suddenly be coming like natural disaster as flood, but it is human voluntary works to execute under the certain schedule. Therefore, these benefits can be applied for the evaluation as the annual average economic benefit.

3.4.2 Estimation of Economic Cost

As discussed in the above sub-clause 2.2, a Standard Conversion Factor (SCF) for tradable equipment and materials, shadow price for land acquisition cost and/or housing compensation, and for labours for the construction works, cost of transfer items such as personal income tax and corporate income tax should be taken into account.

(1) Standard Conversion Factor

Standard Conversion Factor (the SCF) should be taken into account for tradable equipment and materials when the financial cost is to be converted into the economic cost. The SCF is calculated as 0.90707 as shown in Annex 2.12 with its calculation process.

(2) Shadow Price of Land (Agricultural Area)

The shadow price rate for land can be estimated as 0.18061. The economic cost for land can be estimated based on the financial cost for land multiplying this shadow price rate.

Agricultural productivity is one of index for estimation of shadow price of land. The formula is as follow:

$$SPRL = \frac{A_g O \,/\, CA}{FP_p}$$

Here, $SPRL$: a shadow price rate for land,

A_gO: amount of agricultural products,

CA: harvested or cropped area (ha), and

FP_p: financial price of land to be acquired for the Project.

For A_gO, the amount of Rials 7,244 per ha can be inserted that is already calculated as shown in Table 2.1. CA can be omitted because the value above and the land price are expressed as a unit per ha. For FP_p, the amount of Rials 40,000,000 per ha can be inserted as a financial price of land to be acquired for the Project for the Dasht Village as shown in the Annex 2.13.

(3) Shadow Wage Rate of Unskilled Labor

The amount of lower limit wage, 1,900,000 Rials/month being tax exempted, in other word "the minimum wage rate", should be guaranteed according to the Iranian Labor Law. However, the existing average wage for labor is 1,226,000 Rials/month accor5ding to information from MOJA. Therefore, the shadow wage rate of 0.65263 (=1,226,000/1,900,000) is applied for the Project assuming that the Project at least follow the said Law.

(4) Income Tax

There are 3 contract cases on in combination of insurance and tax in Iran, i.e. (1) salary base contract: the Contractor should pay by themselves insurance: 16.67 % and corporate income tax: 5 %, (2) the contract in the case of needed goods and equipments provided by the Contractor itself: the contract6or should pay insurance:

7.67 % and corporat6e income tax: 5 %, and (3) price list base contract: the contractor should pay insurance: 1.67 % and the Government should also pay the insurance: 5 %, and the contractor should pay corporate income tax: 5 %. Anyway, the corporate income tax is 5 % in Iran.

Personal income tax is a rate of 10 % of the excess amount of wages and/or salaries of Rials 1,900,000 per month. It means that this amount of wages/salaries is the minimum standard according to the Taxation Law in Iran.

Based on the above assumptions, the economic costs are estimated. Detail calculation processes are shown in Annexes 2.14 through 2.16, and summarized as below:

Table 3.8 Summary of Construction Cost and Its Annual Disbursement by Combination of Works

(Million Rials)

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

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

3.4.3 Project Evaluation

For Project evaluation, followings are to be taken into consideration:

- Price escalation should not be included in the cost side.
- Discount Rate of 10% is to be applied based on the similar projects in developing countries.
- Project life is to set at 50 years after completion of the construction works as mentioned above.

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

The results are shown in Annexes 2.17 through 22, and summarized as below:

Table 3.9 Summary of Economic Evaluation Result

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

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

As shown in the above table, the Watershed Management works (WM) indicate a quite high viability to execute the Project by showing the 21.08 % of EIRR under the present socio-economic condition (hereinafter referred to as "at present condition") and 21.10 % under the socio-economic condition of the year 2025 (as "at 2025-Year condition" hereinafter referred to).

On the other hand, in the cases of combination of WM + SC (the Sediment Control works) and of WM + SC + RI (the River Improvement works), EIRRs are gradually come smaller than that in the case of WM only as 16.40 % and 8.86 % at present condition, and 16.77 % and 9.38 % at 2025-Year condition. It is implying that, comparing with the result of the case WM only, costs for the other 2 cases are greater than the amount of benefits.

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

Incidentally, this kind of project is so called as public works. Especially, the works of SCD and RIW are the pure public works. Such several international financing institutions as World Bank recommend that the project of public works which is not the commercial projects showing the EIRR of 5 % can be considered as being viable from the viewpoint of the basic human needs.

Furthermore, usually the works of RIW needs a great of costs but the socio-economic benefits is derived rather not so much comparing with the costs. However, the case of combination of WMP and SCD shows an enough viability to execute the Project as 16.40 % at the present condition and 16.77 % at 2025-year condition.

Accordingly, the Project of this component has the reliability to execute from the viewpoint of basic human needs, but it should be considered to making choice of optional work items taking priority into account as a whole.

CHAPTER 4 GOLESTAN FOREST PARK DISASTER MANAGEMENT PLAN

The Golestan Forest National Park (hereinafter referred to as "the Golestan Forest") has only one route passing through it. And the route passes through at the center of narrow valley. Therefore, when once flood occur, the people there in has no any place to evacuate.

At present, several places destroyed caused by several floods in the past are under rehabilitated. But, these works are only for rehabilitation to the former state. And a drastic improvement works of the route could accept from the Government of Iran from the viewpoint to reserve natural environment and biodiversity in the Golestan Forest. This is quite reasonable from such viewpoint.

Accordingly, if no any drastic measures are made, the same damages recorded since 2001-flood will suffer again in the future. Most important measures are to inform to the people who coming to enjoy in the Golestan Forest to make them do not enter into there when the flood likely occur.

For this purpose, a systematic flood warning system is one of such measures. This component is a plan to establish a suitable Flood Forecasting and Warning System to save human life.

4.1 Identification of Economic Benefit

Direct Benefit

What kind of benefit can we expect to derive from saving the human life? Of course, the human life can not be valuated in terms of monetary. But we can estimate an amount of income loss that may be expected to earn in the future after a people end. In this case, there is a method for estimating the income loss that may be expected to earn in the future after a people end so called as "the New Hoffmannsche Methode". Actually, this method is used for a method of calculating the amount to compensate the people for their income loss to be earned in the future after a people end in the case of life insurance systems.

In this study, it is assumed that the above mentioned amount to compensate the people for their income loss is the damages to the human life.

Indirect Benefit

If the said Flood Forecasting and Warning Systems could be practically realized and successfully functioned, social effects (or socio-economic effects) derived from such systems and such functions will be great in addition to the saving of the human life with a little fund of the Government

Considerable social effects and/or socio-economic effects may be as follows:

- To stabilize the mind of the people,
- To generate a reliability of the people against the Government,
- To ensure the good relationship between the people and the Government, and
- To avoid the dead-stock of mainly the agricultural products to the markets.

4.2 Identification of Economic Cost

Usually, the cost for the Project is estimated in terms of financial cost, but the economic cost is to be applied for economic evaluation. Therefore, the economic cost is to be converted from the financial cost.

In this case, a Standard Conversion Factor (SCF) for tradable equipment and materials, shadow price for land acquisition cost and/or housing compensation, and for labours for the construction works, cost of transfer items such as personal income tax and corporate income tax should be taken into account as the same with the "2. River Restoration Plan" above.

4.3 Economic Evaluation Indices

In this component also, economic costs and benefits throughout the project life are compared in terms of present values. If the total present value of economic costs equals that of economic benefits (when, B/C=1), the discount rate used to calculate the present value is called as "economic internal rate of return (EIRR)" and uses as the main index of project evaluation to judge the project viability and/or feasibility. The other two indices are Net Present Value (NPV) and B/C Ratio. (ANNEX 1 gives details on economic evaluation indices applied).

4.4 Economic Evaluation

4.4.1 Estimation of Economic Benefit

(1) Estimation of Income Level

People who visit to the Golestan Forest may be urban residents from cities. Therefore, the income level of urban residents is needed to estimate. Annex 3.1 through 3.4 shows the average annual urban and rural household net expenditure on food and on non-food, Annex 3.5 shows average annual Income of urban/rural household, and Annex 3.6 shows their combined figures.

Comparing the amounts of income and expenditure, the amount of income is rather low than the other. It is quite reasonable as a result of such kind of survey because almost of the people do not want to express high income. Therefore, it may say that the amount of expenditure is the most likely income level.

And, it seems that almost of the people who visit to the Golestan Forest for recreation purposes are the urban residents.

Following table shows a summary of their income level per household based of the expenditure of urban residents for the last several years according to the Statistics:

Table 4.1 Annual Average Income Level per Household

(Rials/HH per annum)

Year	1998	1999	2000	2001	2002	2003
IncomeLevel	16,669,643	20,702,886	24,175,313	28,020,350	34,970,661	40,989,283

The base year for the economic evaluation is the year 2005, and all the cost is set at 2005-Year price level. Therefore, this income level is to be converted into 2005-Year level by means of extrapolation using the following formula.

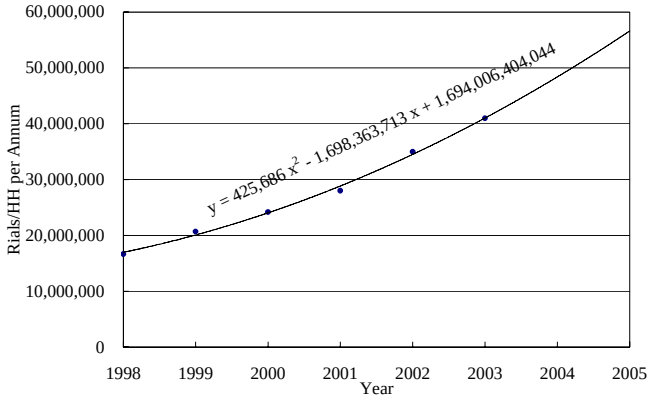

Figure 4.1 Income Trend of Urban Residents

When the year "2005" is substituted for "x", the amount of income level as of 2005 is resulted at Rials 55,521,629/HH per annum. It can be converted into Rials 4,626,802/HH per month. Workable number of persons per household is usually not only one person but also 2 persons or more, so this amount is not so much doubtful.

(2) Estimation of Number of People to Visit to the Golestan Forest for Recreation

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

Table 4.2 Number of Tourists in Golestan Province and Visitors of Museum of Golestan Forest

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

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

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

There is another information as follow:

Table 4.3 Information on Visitors to Restaurants near both the Entrances of the Golestan Forest

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

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

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

(3) Estimation of Damages to Human Life

If one tenth (1/10) of the above number of visitors to restaurants near both the entrances of the Golestan Forest is usually visiting to the Golestan Forest shown in above Table 3.3, average number of campers and/or visitors for recreation purse will be calculated at 208 people per day.

On the other hand, according to the information, 194 persons have lost their life with no any survivals because the route passes through at the center of narrow valley at the 2001-Year flood. This is not so much different number with the above mentioned calculated one. From this viewpoint, it may say that the said assumption is reasonable. If it is assumed that, (1) frequency of flood in the Golestan Forest is one fifth (once every 5 years, in other words the frequency: 20 %), (2) the average age of campers and/or visitors who are working at present: 40 years old, the annual damages to human life caused by flood in the return period of 50 years can be estimated at around Rials 5,875 million/annum (=Rials 55,521,629 × 0.7 (life cost: 30 % should be deducted)×16.804 (Coefficient of New Hoffmannsche Methode) × 45 families × 20 years × 20 %). Following box is a pigeonhole of the said assumption and estimation process.

Box 3.1 Estimation of Damages to Human Life due to Flood in the Golestan Forest

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

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

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

(4) Annual Average Damages to Human Life and Estimation of Economic Benefit

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

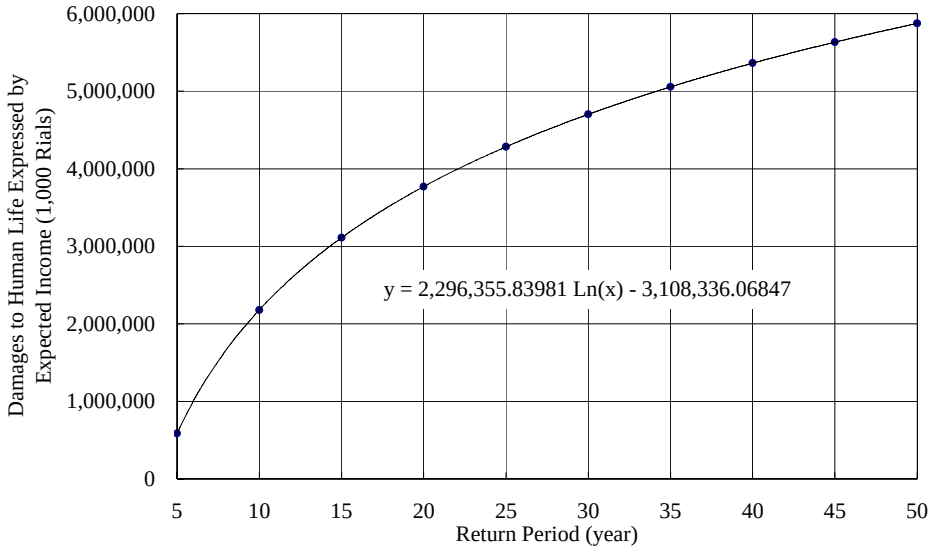

Figure 4.2 Relationship between Return Period and Damages to Human Life Expressed by Expected Income

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

Table 4.4 Estimation of Annual Average Damages to Expected Income

Without Project — 2005-price Level (1,000 Rials)

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

4.4.2 Estimation of Economic Cost

As discussed in the above sub-clause 2.2, a Standard Conversion Factor (SCF) for tradable equipment and materials, shadow price for land acquisition cost and/or housing compensation, and for labours for the construction works, cost of transfer items such as personal income tax and corporate income tax should be taken into account.

(1) Standard Conversion Factor

Standard Conversion Factor (the SCF) should be taken into account for tradable equipment and materials when the financial cost is to be converted into the economic cost. The SCF is applied the same rate as 0.90707 as discussed in the previous sub-clause of "2. River Restoration Plan".

(2) Shadow Price of Land (Agricultural Area)

This component does not need any land acquisition and house compensation. Therefore, the shadow price rate for land is not required to be applied.

(3) Shadow Wage Rate of Unskilled Labor

The shadow wage rate of 0.65263 (=1,226,000/1,900,000) is applied calculate4d by the same manner as discussed in the previous sub-clause of "2. River Restoration Plan".

(4) Income Tax

The corporate income tax is 5 % in Iran, so that this rate is applied in this component also with the same reason as discussed in the previous sub-clause of "2. River Restoration Plan".

Personal income tax is a rate of 10 % of the excess amount of wages and/or salaries of Rials 1,900,000 per month as discussed in the previous sub-clause of "2. River Restoration Plan".

Based on the above assumptions, the economic costs are estimated as summarized as below:

Table 4.5 Summary of Construction Cost and Its Annual Disbursement

(1,000Rials)

Item	Total Cost	Disbursement				
		2007	2008	2009	2010	2011
Financial Cost in Total	3,214,600	994,600	687,960	526,270	526,270	479,500
Economic Cost	2,901,858	897,837	621,030	475,070	475,070	432,850

The annual operation and maintenance cost is applied at 5 % is applied for equipment portion (60 % of the direct construction cost) of the works.

4.4.3 Project Evaluation

For Project evaluation, followings are to be taken into consideration:

- Price escalation should not be included in the cost side.
- Discount Rate of 10% is to be applied based on the similar projects in developing countries.
- Project life is to set at 50 years after completion of the construction works as mentioned above.

Using a cash flow of the said cost and benefit, the economic evaluation is made. For evaluation, the Net Present Value (NPV, i.e. B-C in terms of the present value), the Economic Internal Rate of Return (EIRR) and the Benefit-Cost Ratio (B/C Ratio) are applied as

evaluation indicators. The discount rate is applied at 10 % taking similar projects in developing countries into account.

The results are shown in Annex 3.7 through 3.8, and summarized as below:

Table 4.6 Summary of Economic Evaluation Result

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

(Note)
NPV is expressed by million Rials.

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

CHAPTER 5 DEBRIS FLOW CONTROL PLAN

This component consists of construction of Sabo-Dam near the Beshoili Village and channel improvement works of the Madarsoo River passing through the Terjenli Village both for control of debris flow at dangerous valley portions. It is under planned by MOJA, and will be executed by them.

Details of Beshoili Village are not clear yet, but it is located near the Terjenli Village, so that if the details of the Terjenli Village could be made clear, it may say that the situation may almost be the same.

The Terjenli Village has no any range land, but they are breeding livestock a lot like Sheep, Goat and cow in the residential area. Therefore, if once a flood occurs, damages are not only to houses and household movables but also to livestock in their residential area. So that, the amount of land value of the residential area is rather high comparing with the Dasht Village. Annex 4.1 shows a result of interview survey made by JICA Study Team, August 2005.

Following table shows a land value per unit area of damaged area caused by 2001-flood based on the data and information indicating in the said Annex 4.1. If the village could be protected from floods, these damages will be mitigated depending upon flood scale.

Table 5.1 Damageable Land Value of Terjenli Village

1,000 Rials/ha

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

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

CHAPTER 6 FLOOD CONTROL PLAN

This component consists of river improvement works for the main stream of the Madarsoo River at 3 bottleneck points at (1) Kalaleh Bridge, (2) 14-Metry Bridge and (3) stretch of the Madarsoo River flowing down through the Beshoili Village. The former 2 points will be designed with a flood scale of 100-Year return period because of the urban areas, and latter one point will be designed with the flood scale of 25-Year return period because of rural area

These bottlenecks bring about flood damage for the huge areas, maybe several hundred ha located at just upstream side from the points. As discussed above, even in rural areas, following amount of damages per ha might be brought about from the floods. If it is taken into consideration that the targeted areas are the urban areas, they should have several times greater value of land to be damaged when the areas will be left as it is without any counter measure. And, more over, the area to be damaged should also achieve till hundred hectares in its extents.

Table 6.1 Summary of Land Value to be Damaged in Rural Area

Million Rials/ha

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

CHAPTER 7 FLOODPLAIN MANAGEMENT PLAN

In down-stream reaches of the Madarsoo River from around Kalaleh Bridge point, the river-terrace structure has been developed with several meters (5 or 6 meters, or sometimes 10 meters) drop from the foundation where people live on. Villages and public facilities like roads are constructed on the foundation. People who live along the river-terrace use it as the agricultural area. Therefore, there will be no any human damages but there will be agricultural damages even the floods will occur.

However, because of lack of information concerning the flood occurring and/or lack of suitable information network system on flood forecasting and warning, people, especially farmers, come into such river-terrace for operation and maintenance of their agricultural land located on it even there is a dangerousness on flood, and they lose their life. As already discussed in the "3. Golestan Forest Park Disaster Management Plan" above, damages to expected lifetime of the people after their ends would become a huge amount.

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

Public announcement on specified area to be inundated by floods,

Warning to forbid anybody to enter such specified area to be inundated,

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

From this viewpoint, this component may be closely connected with and tying up with the next component of "Chapter 7 Flood Preparedness Plan".

CHAPTER 8 FLOOD PREPAREDNESS PLAN

This component is as meaning as reading:

To establish a Flood Forecasting and Warning System,

To establish a System for Avoidance and/or Mitigation from or of Flood Damage for making smooth activities of evacuation from floods based on the Flood Forecasting and Warning System above,

To develop a suitable Criteria for Warning to be Announced,

To develop Hazard Maps, and

To take Activities as Training and/or Education for developing the Public Awareness for making people rouse their self-consciousness so that they can take smooth activities for avoiding from danger of floods.

If these systems could be practically realized and successfully functioned, social effects (or socio-economic effects) derived from such systems and such functions will be great with a little fund of the Government because that the said systems could be operated by the Government's daily works.

Considerable social effects and/or socio-economic effects may be as follows:

To save the people's life (this will mitigate the damages to all the income to be gotten in the future after their ends as already discussed above),

To stabilize the mind of the people,

To generate a reliability of the people against the Government, and

To ensure the good relationship between the people and the Government,

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

But, the most important thing is to start from a part that could be easy to start. One success leads the next success. Intensities of staffs of the Government will be gradually established and ensured through this process, and the intensities of the staffs of the Government lead further success after that. Then, the people will become to rely on the Government's staffs to do their best for operating the systems.

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

Annex 1 ECONOMIC EVALUATION INDICES

Usually in a case of economic evaluation, 3 types of indices are used for evaluation in this kind of project as "the Economic Internal Rate of Return (EIRR)", "the Net Present Value (NPV)" and "Benefit Cost Ration (B/C Ration)" expressed by the following formulas.

In the other case of financial evaluation in commercial projects as taking a charge collection system into account as financial benefit, EIRR and the term "economic" should read as "the Financial Internal Rate of Return (FIRR)" and the term "financial". The calculation process is the same with the economic evaluation.

Economic Internal Rate of Return (EIRR)

The EIRR is to be calculated using a cash flow of economic cost* and economic benefit during the project life. This EIRR is defined by the following formula:

$$\sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t} = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t}$$

Where, T = the last year of the project life,

C_t = an annual economic cost flow of the project under study in year t,

B_t = an annual benefit flow derived from the project in year t, and

R_e = the Economic Internal Rate of Return (EIRR) (a discount rate** to be used for costs resulted at the same amount of the benefits in terms of the present value).

It means that, if the total present value of economic costs equals that of economic benefits (when, B/C=1), the discount rate used to calculate the present value is called as "economic internal rate of return (EIRR)" and uses as the main index of project evaluation to judge the project feasibility and/or viability the other two indices are Net Present Value (NPV) and B/C Ratio.

Net Present Value

The NPV is expressed as "B - C" and defined by the following formula:

$$NPV = B - C = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t} - \sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t}$$

***** Economic cost of a project is identified as opportunity cost of the project. In this case, if goods and services would be invested in the project under study, they could no longer be utilized for other projects. This implies that the benefits of the other projects could have been created would be sacrificed. These sacrificed benefits of the other projects are so called opportunity cost of the project.

****** The World Bank says that "the discount rate reflects the rate of fall of the value of consumption over time." (William A. Ward and Barry J. Deren, Ed."**The Economics of Project Analysis -A Practitioner's Guide**-" IBRD Technical Paper).

Regarding the EIRR, the Asian Development Bank (the ADB) says that "the projects have viability when the resulted EIRR exceeds the Opportunity Cost of Capital (the OCC). In almost the developing countries, the most likely EIRR is ranging from 8 % to 12 %. Therefore, there will be no any issues if the resulted EIRR exceeds the 12 % to execute the projects, but if the resulted EIRR is less than the rate of 12 %, it is required some specified explanation concerning the benefits that could not be converted into monetary terms." ("***Occasional Papers -Economic and Financial Appraisal of Bank Assisted Project***" ADB Appraisal Paper No.11, January 1978).

Also regarding the EIRR, the World Bank says that "if the OCC (in other words, "the EIRR") is resulted at 5 % except the non-commercial projects, it is too low. But if it is resulted at 20 %, it is too much. Usually, the World Bank adopts the rate of 10 %." (Warren C. Baum and Stokes M. Tolubert, Ed. "***Investing in Development -Lessons of World Bank Experiences***-" IBRD, June 1985).

Anyway, unless the amount of cost and benefit are not changed in the same project, always a certain EIRR is to be resulted even if any discount rate is applied. In other words, the EIRR has a meaning to avoid arbitrariness of the B/C ratio.

It means that, if the present value of the benefit subtracting by the present value of cost would become positive, then the project being under study will have a reliability to execute.

Benefit Cost Ratio (B/C Ratio)

The B/C Ratio is defined by the following formula:

$$B/C = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t} \Big/ \sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t}$$

It means that, if the rate of the present value of the benefit dividing by the present value of the cost would become more than "1.00", then the project being under study will have a reliability to execute.

The project life is assumed at 50 years after completion of the construction works for the Project. Cash flow of the economic cost and economic benefit should be made for the period from the first year of the construction works to the end of the project life unless otherwise preconditioned.

In this case, annual operation and maintenance cost (O&M Cost) should be taken into account. And, some amount of replacement cost should also be taken into consideration since some parts of the initial works for the facilities, as metal works may not be durable during the project life.

SUPPORTING REPORT I (MASTER PLAN)

PAPER XIV

Disaster Management

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

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PAPER XIV DISASTER MANAGEMENT

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CHAPTER 1 VULNERABILITY AND CAPACITY OF VILLAGES IN THE STUDY AREA

1.1 Social structure

1.1.1 Village Structure

Total population of the surveyed 30 villages along the Madars 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, minimum from 193 to maximum 3200. The average village population is 1,082, which is the manageable size as unit.

Population ration by age groups is as follows: 0-14years is 34%, 15-64 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.

1.1.2 Household Characteristics

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

Table 1.1 General Household Characteristics

Category	Characteristics
Family type	Nuclear # of Children 4 plus (50%)
Housing unit	235 sq m (average) single-floor (90%)
Land ownership	Self-own (96%)
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 square meters, and the average is 235 square meters. Most (more than 90%) housing units are single floor. Majority of people (96%) own the 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).

1.1.3 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.

1.1.4 Lifestyle

Comparative numbers of villagers in the study area were once nomad 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.

1.2 Local Organization and Cohesion

1.2.1 Organization

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

1.2.2 Meeting place

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

1.2.3 Mutual Cooperation

Bond of family, bond of neighborhoods is tight. People knows each other 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, information of possible flood was informed to those who may not access to such information by local initiatives.

1.2.4 Village Actors

Village actors relates 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 are also influential figures in villages.

1.2.5 Decision -making System

Village council is the final authority to decide village matters, however, 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. Village councilors are elected by villagers. Annual council meeting are held for council members.

1.3 Disaster Experience

1.3.1 Flood situation

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

1.3.2 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.

1.3.3 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, firing guns that informs extraordinary situation was used by council members.

1.4 Disaster Knowledge

1.4.1 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.

1.4.2 Analytical Capacity for Evacuation

First of all, majority of people (90%) know where they should evacuate, however, several percents of the respondents do not know the evacuation place. Some people went to see the water level of the river to inform the villagers. Accurate flood monitoring system that can inform early warnings is very much expected by the villagers. Person and criteria for giving direction of evacuation are not clarified yet.

1.5 Participation

1.5.1 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 was active; to become a member of the rescue team counted most, and to receive rescue training, evacuation training, to become a member of disaster management committee follows.

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

1.5.2 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 village, the role of villagers, public sectors, local organizations can be delineated and self-help attitude can be enhanced.

1.5.3 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 are left for the head of the family. However, women usually have complete decision-making power regarding their personal life.

CHAPTER 2 MASTER PLAN OF DISASTER MANAGEMENT IN VILLAGES

2.1 Framework of the Master Plan

2.1.1 Purpose

Civic construction to mitigate flood and debris flow is now under planning. However, there is limitation of such mitigating measures for overwhelming level of hazards. To mitigate by civic constructions are unrealistic in respect to cost and duration of construction.

To prepare for such overwhelming disasters that mitigation measures cannot prevent, it is necessary to have risk management system which villagers and tourists can access to appropriate information about floods and debris flows and immediately evacuate in coordination with the concerned public authorities. community resilience.

The mitigation measures of civic construction and such community resilience is the two major components of the holistic disaster risk management and they are complimentary to each other for establishing safer community.

For this reason, establishment of village based risk management system, which is autonomously conducted by villagers are essential. Master plan for village based risk management system is proposed.

Figure 2.1 Collaboration among Public Community and Private

2.1.2 Strategy

To establish village based risk management system, it is important for villagers and tourists to understand the basic concept that each individual has to have self- help attitude that your life should be protected by yourselves. It is also important that everyone has to have proper knowledge about disaster risk management, and identify the risk judging by information of mass media such as TV and radio, and decide evacuation actions accordingly. Such information and evacuation system need to be established. There is an indigenous way of communication within the village, therefore such system needs to be enhanced for development.

To establish such system, it is important to develop the system not only by self-help endeavor but also by mutual help, in cooperation with local communities, such as village council, non-governmental organizations, village based organizations, and local public authorities. The role of the public authorities is to give necessary support to the village community. Major role of the public authorities are to establish systems of proper information distribution and evacuation order within public authorities and to village council.

In this chapter, master plan for village based risk management, especially education for disaster mitigation and preparedness, information and evacuation system is to be studied.

Disaster risk management is not enough just at village level, it is necessary to have joint efforts, among villagers, local communities, and public authorities. It is alsp effective to go through participatory planning process.

To establish this system requires time, so things that can easily be accomplished may conduct first as step by step process.

According to the JICA Study provision, three terms has been set; short term is from 2006 to2010, Mid term is from 2011 to 2015, and finally the long term is from 2016 to 2025. Detail plans were delineated in these three stages.

2.1.3 Thematic Programs

(1) Disaster Education for Villagers

(a) Public Help

Programs that can be conducted by public sectors are prepare disaster education materials, disaster education for schools and villages, and support of village activities. Followings are the lists of programs.

Disaster education materials such as brochure, hazard maps, bulletin boards for villagers and campers.

Train school teachers, dispatch experts and lecturer of disaster managements.

In Iran, the primary school is compulsory. The average number of students at the primary school and lower secondary school are 1.4 - 1.9 millions a scholastic year, and are more than the average number of the others in the last five year, according to IRAN STATISTICAL YEAR BOOK 1382. It is important to learn knowledge of mitigating damages, practicing emergency drills at the primary school and lower secondary school. It is important for teachers to learn the knowledge. However, it takes long time to train all the teachers. Until there is sufficient number of teachers, public authorities shall dispatch technical staffs to villages in cooperation with community, such as NGO, CBO.

Implementation of disaster education such as basic knowledge development of phenomena and causes of floods and other disasters, preparation of emergency kits, attitude of evacuation, emergency medication, evacuation methods.

(b) Mutual Help

○School education

Disaster education by teachers

Disaster education by using educational materials

○Villagers education

Disaster education to different organizations such as Council、Basij, RCS, Imamu Khomeini Foundations

Disaster education by using educational materials

Implementation of disaster education such as basic knowledge development of phenomena and causes of floods and other disasters, preparation of emergency kits, attitude of evacuation, emergency medication, evacuation methods.

Promotion of disaster education by Ministry of Education and RCS at individual and family levels

(c) Self Help

Participation to disaster educational courses

Disaster education for family members

(2) Information Distribution

(a) Public Help

Proposed disaster management plans are based on early warning system.

Methodological information is transmitted by fax from Meteorological Office to Province Disaster Management Committee. Villages are not informed directly. MOE, Police, and local offices of RCS give direction of evacuation, only when they can access to the vulnerable area. In case of Dasht and Terijenly village, no information was transmitted, according to interviews.

Therefore, evacuation actions are not smooth, due to delay and insecurity of transmission of flood information to villages. Furthermore, because of inaccuracy of methodological information, evacuation action is not timely.

Villagers have suspicious about methodological information.

However, in case of night time disasters, villagers cannot react by themselves. Consequently, early warning including estimation is essential.

Establish effective and accurate information distribution system.

(b) Mutual Help

Traditional way of transmitting information within the village functions well.

The main source of information is TV and radio. Meteorological information is broadcasted only at regular times, and no special information about extraordinary weather is provided.

While villagers are awake during daytime, information can quickly be transmitted among villagers by mosque speakers, motorbikes, cars, running around, and mouth to mouth communications.

Whereas, most villagers are not awake during night time, they can hardly receive information through TV and radio. The speed of transmitting information is possibly reduced.

For such a village like Terjenly, that debris flow and flood may occur within twenty minutes to one hour, the information transmission may not be in time. It is essential to distribute early warning information through public authorities and mass media.

(c) Self Help

Information can be transmitted quickly by traditional method within the villages. Since most of the villagers are working in the village. However, information sharing need to be secured among the family members.

(3) Evacuation

(a) Public Help

Official designation and equipment of evacuation sites

Installment of necessary equipments for evacuation

Displacement of disaster risk management experts and lecturers

Assistance of necessary costs for conducting drills

Conducting drills in collaboration among villagers, communities, local organizations and public authorities.

(b) Mutual Help

Joint plan and implementation of drills in coordination among Village Council, Basij, RCS, Imam Khomeini Foundations

Evacuation drills utilizing early warning system

(c) Self Help

Participation in drills

Plan of evacuation for family members

(4) Capacity building for public officials

(a) Support for Villages

Villagers have high awareness and motivation about learning disaster management.

(b) Support for Passenger

＜Ordinary time＞

Preparation of disaster education materials, such as brochures, hazard maps, and sign boards at camping sites.

＜Emergency time＞

Enhancing evacuation management for tourists and campers

Table 2.1 Current situations and Plans of Village Disaster Risk Management

Items	Current situations	Plans
Information Distribution	There is no information regarding disasters from public authorities. Means of communication within the public authorities are either by phone or fax. In case of power failure, the system will not function.	Establish operational disaster information system within public authorities. Establish disaster information system between public authorities and village councils. To enhance telecommunication fail-safe operational system.
	There is an Information route from public authorities to Red Crescent Society (RCS) to villagers but it is not functioning well.	To establish collaborative information sharing networks among public authorities, RCS, NGOs, CBOs.
	The only reliable source of information is weather report which announce every one hour or so by TV and radio. The program does not correspond to special announcements for sudden change of weather. The accuracy of information is low.	Run a telop and broadcasting irregular programs of disaster information, collaborated with TV and radio Develop accuracy of weather information.
	Village has traditional way of information distribution, such as mosque speaker, and mouth to mouth direct communication. Mosque speaker cannot be used during power failure.	Establish organized information distribution and operation system by utilizing traditional information distribution methods. Establish information distribution system which utilize siren that can function during power failure. To install generator or solar battery in Mosque speaker.
Evacuation Method	Judgment of evacuation is based on individual experience, and possibility of causing human loss is high. There is no plan of assisting evacuation of elderly and handicapped.	Secure several evacuation routes. Secure options for evacuation modes (such as foot, tractor, bike) To establish evacuation methods of elderly and handicapped. Conduct regular evacuation drills. Establish criteria of evacuation by experts referring to weather information, rainfalls, river conditions.
Evacuation site and equipments	Evacuation sites are cemetery on a hill and farmland.	Several evacuation sites shall be designated officially.
	Neither shelter nor equipments are installed at evacuation sites.	Install shelters and equipments at evacuation sites
Disaster Education	Villagers have high motivation of awareness raising, but not enough education has been conducted. The necessary education is listed below. ・ basic knowledge of flood disaster ・ Organized method of information distribution ・ Criteria of evacuation ・ Organized method of evacuation ・ Training of disaster risk managers ・ Collaborative network of public authorities, NGOs,RCS,CBOs	Dispatch disaster managers to educate villagers and school children. Conduct pilot activities for community based disaster management activities (such as information distribution and evacuation) and disaster education programs. Prepare awareness raising leaflets for tourists. Prepare signboards of awareness raising for tourists in Golestan National Park. Train local disaster managers. To publish and circulate documentation of past disasters (books, videos)
Disaster management Plan and Evacuation Plan	Evacuation methods are not organized by plans but based on individual judgment	Evacuation methods shall be planned by villagers. Periodical evacuation drill shall be conducted. Review of evacuation plan occasionally.

Note: Short term（2006- 2010）,Mid term（2011-2015）, Long term（2016-2025)

SUPPORTING REPORT I (MASTER PLAN)

PAPER XV

Institutional and Legal System

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 XV INSTITUTIONAL AND LEGAL SYSTEM

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CHAPTER 1 GENERAL

1.1 Scope of the Study

Rainfall is precious source of water for human life as well as agriculture. However, rainfall can sometimes cause flood disaster. To reduce negative impact of flood disaster, an integrated policy is necessary. In legal and institutional component in this Study, the scope of study is two-folds:

- - To examine status of Laws for flood disaster prevention.
- - To propose an improvement in Law and institutions.

For this purpose, laws and institutions related to flood disaster in Islamic Republic of Iran (hereafter mentioned as Iran) will be compared with other systems.

1.2 Floods in Iran

In this section, significance of flood disaster in Iran is reviewed in the context of history as well as its recent trend, and in comparison with other natural disasters. Natural disaster in Iran in 1903-2004 is summarized in Table 1.1, to demonstrate the importance of flood disaster. Here, it should be noted that this is an international database so that smaller flood may not be included. Nevertheless, it may be worthwhile to compare relative significance among different kind of natural disaster.

As this table shows, flood is less frequent disaster in Iran when it is compared with earthquake, because Iran is semi-arid country and is located in very high rate of tectonic movement. Besides, flood is ranked as second significant natural disaster in Iran in terms of number of casualties and affected people, whereas flood is rated as the third significant disaster in terms of economic damage amount.

Table 1.1 shows the worst 10 disasters in Iran in the same period in terms of number of affected people. Among them, the 2001 flood which affected Golestan was the worst flood disaster and the 3rd worst disaster. Likewise, the 2002 flood which also affected Golestan is ranked as the worst 10-th disaster.

Recent trend of flood damages in Iran is summarized in Figure 1.1 to Figure 1.3, taken from national statistics for flood disaster. Number of flood is increasing in Iran as shown in Figure 1.1. Apparently, the amount of damages to infrastructures and agriculture is evidently increasing as shown in Figure1.2 and Figure 1.3. Moreover, flood occurs in nation wide in Iran, though there are regional variations as shown in Table 1.3. These figures demonstrate the importance to consider flood as disaster, and to consider flood prevention in Iran for the future. Especially, two consecutive major floods that affected Golestan in 2001 and 2002 are historically significant ones to change prevention policy.

Table 1.1 Natural Disaster in Iran during 1903-2004

Disaster type	No. of Events	Killed	Injured	Home-less	Affected	Total Affected	Damage USD (000's)
Earthquake	82	146,572	174,212	276,815	1,811,046	2,262,073	10,572,241
Flood	60	7,544	539	190,620	3,361,501	3,552,660	3,727,220
Wind Storm	9	308	85	5,500	6,200	11,785	28,540
Slides	4	116	44	0	100	144	0
Drought	4	0	0	0	62,625,000	62,625,000	9,500,000
Epidemic	3	372	0	0	2,500	2,500	0
Extreme Temperature	1	158	0	0	0	0	0
Wild Fires	1	0	0	0	0	0	0

Source: "EM-DAT: The OFDA/CRED International Disaster Database

Table 1.2 Worst Natural Disasters in Iran in terms of affected people during 1903-2004

Disaster	Date	Affected	Area
Drought	2000	37,000,000	Fars, Buchehr, Yazd, Kerman etc.
Drought	2001/7/1	25,000,000	Sistan & Baluchestan, Khrasan etc.
Flood	2001/8/10	1,200,200	Golestan, Khorasan, Semnan
Flood	1980/7/1	950,000	Khuzestan
Earthquake	1990/6/1	710,000	Rasht, Astara, Zanjan etc.
Drought	1964	625,000	
Flood	1993/2/8	484,728	Kerman, Boir, Kohkiloye, Fars etc.
Earthquake	1977/4/7	400,000	Shahr Kord
Earthquake	2003/12/26	305,600	Bam (Kerran province)
Flood	2002/8/12	200,000	Golestan, Khorasan, Semnan

Source: "EM-DAT: The OFDA/CRED International Disaster Database

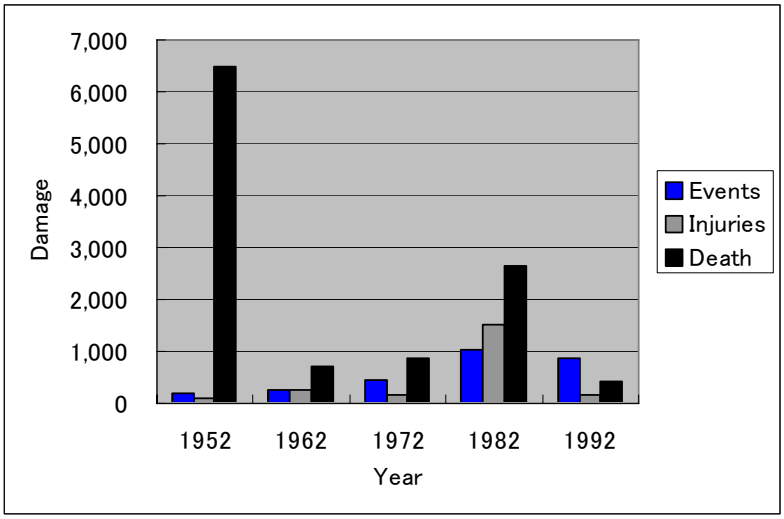


Figure 1.1 Flood Damages in Iran during 1952-1992

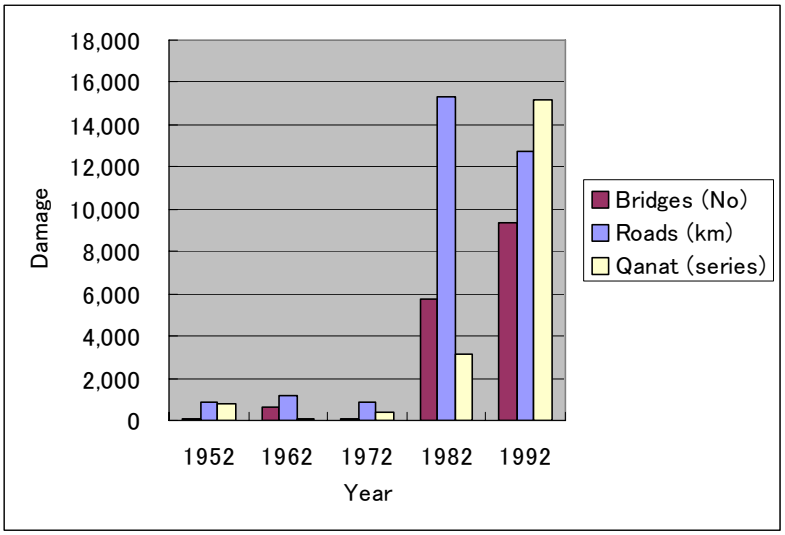
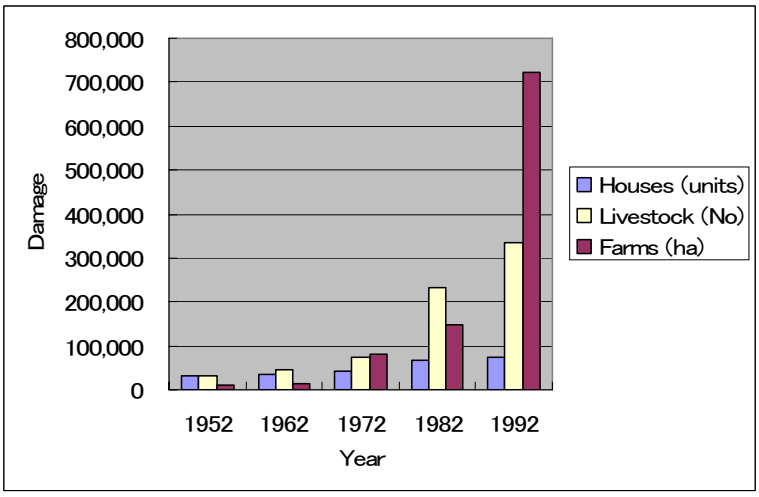


Figure 1.2 Flood Damages in Iran during 1952-1992



Source: Sharifi et al., 1999

Figure 1.3 Flood Damages in Iran during 1952-1992

Table 1.3 Flood Damages in Iran during 1952-1996

Province	Events	Injured	Death	Channels	Roads	Farms	Bridges	Livestock	Qanat	House
Khorasan	349	180	622	0	2,750	76,529	731	80,300	1,939	34,641
Gilan	220	7	19	0	179	15,973	199	1,530	190	7,928
Khozestan	202	72	301	0	633	128,843	6,323	55,720	724	23,451
Kerman	171	7	320	0	13,534	78,951	1,096	226,945	9,599	30,636
Mazandaran	154	12	152	0	38	59,890	133	18,002	947	16,337
Fars	139	44	1,407	0	1,005	178,687	5,007	46,228	487	20,321
Esfahan	136	431	2,409	0	2,742	21,266	85	28,521	659	12,011
Tehran	135	771	3,015	0	251	7,795	49	16,489	58	4,690
Kordestan	130	30	36	10	658	6,057	124	1,043	8	2,471
E. Azarbaijan	111	45	310	24	3,192	11,628	60	7,049	33	3,697
Hamadan	106	69	100	0	353	108,316	495	5,115	63	4,175
W. Azarbaijan	102	70	174	15	403	27,805	610	8,749	72	13,065
Bushehr	96	0	266	0	238	1,143	114	13,573	32	9,572
Lorestan	85	2	381	0	351	3,118	202	2,973	1,007	5,101
Systan & Baluchistan	83	38	396	0	1,455	65,124	0	103,855	727	12,260
Semnan	69	97	75	1	374	7,495	90	36,488	320	6,344
Kermansh	62	58	87	8	530	6,801	38	1,416	38	9,788
Hormozgan	54	0	58	0	10	400	7	1,370	80	1,312
Golestan	54	0	17	0	10	119,530	22	4,888	1	5,271
Charmahal	51	98	51	65	285	6,467	15	2,280	14	8,582
Illam	51	60	39	0	76	5,275	221	15,246	0	1,941
Kohkiloe	50	4	43	0	229	8,650	159	4,272	1,808	6,962
Ardabil	46	26	241	62	466	13,704	87	5,646	376	2,878
Yazd	44	6	427	0	1,006	374	40	7,390	113	1,005
Markazi	42	49	87	4	116	5,311	25	13,460	222	5,575
Zanjan	18	3	43	0	1	3,135	0	8,725	0	1,090
Ghazvin	16	5	13	0	0	8,060	7	1,120	3	82
Qom	10	5	14	0	10	308	0	380	30	0
Total	2,786	2,189	11,103	189	30,895	976,633	15,939	718,773	19,550	251,186

Source: Sharifi et al., 1999

CHAPTER 2 ANALYSIS OF STATUS IN IRAN

2.1 Status of Laws in Iran

Important laws in Iran related to flood disaster prevention are selected and translated for the review as shown in Table 2.1. It is noted that laws for environment management has long history in Iran, as most of them were established in 1960's. 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. Environment policy appeared in 2nd 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 4th National Development Plan is also dedicated to Environmental Protection.

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

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

In the 3rd 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 4th plan in Chapter 10 "national security" as well.

Table 2.1 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 & Range
1975	Environment	Protection and Enhancement of Environment Law
1979	Environment	Constitution, article 45 & 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 1st Socio-Economic and Cultural Development Plan
1992	Disaster	Organizing National Committee to Decrease Effect of Natural Disaster
1995	Development	The 2nd Socio-Economic and Cultural Development Plan
2000	Development	The 3rd Socio-Economic and Cultural Development Plan
2000	Watershed	Establishment of MOJA
2003	Disaster	The Integrated Disaster Plan of Iran
2005	Development	The 4th Socio-Economic and Cultural Development Plan

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".

2.2 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. This section describes such efforts. 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 Figure 2.1.

Figure 2.1 Interest and Responsibilities Among Institutions in Iran.

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

2.2.1 Watershed Management

Ministry of Jihad and Agriculture 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 in Table 2.2. Watershed management department is responsible for mechanical measures such as check dam construction. In Tehran, these sections are merged as Forest, Rangeland, and Water organization (FRW).

Table 2.2 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 studies on master plans. People's participation in watershed management taken into account.
1982-1988	Sediment problem emerged. Comprehensive definition of WM was defined.
1989-1993	Preservation of development, rehabilitation of natural resources in 1st development plan.

Source: Behbahani, 1994

2.2.2 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 2.3. The Insurance Find 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, frost-bite, and earthquake. Doubt is so far 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, pastural by-proclucts, 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 hectares in 1984 to nearly 6 million hectares 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 2.3 Development of Agriculture Insurance in Iran

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

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

2.2.3 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.

The Ministry of Housing and Urban Development (HUD) 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 HUD related to development control are as follows.

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

2.2.4 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 province governor. The organization structure for national and provincial committee of disaster is illustrated in Figure 2.2 and Figure 2.3, 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 sea-water and turbulence of river is under the responsibility of Ministry of Energy. The Members for flood are as follows: Ministry of Interior, Ministry of Energy, Construction Jihad Ministry, Ministry of Road and Transport, Ministry of Housing and Urbanization, Building and Housing Research Center, Radio and TV Organization, Meteorology Organization, Geology Organization, Agriculture 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.

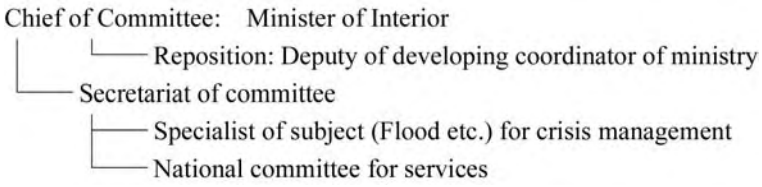


Figure 2.2 Structure of National Committee of Disaster

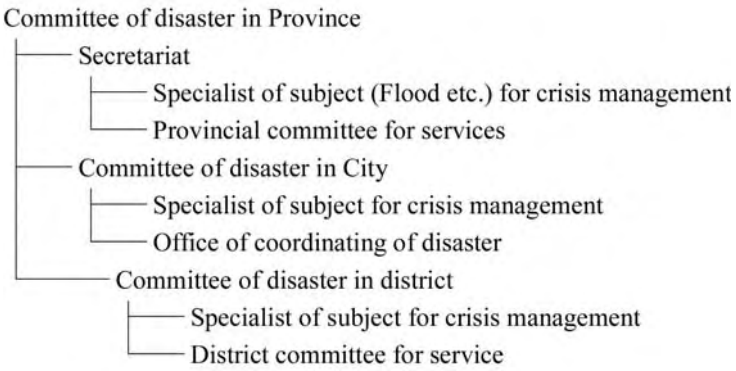


Figure 2.3 Structure of Provincial Committee of Disaster

CHAPTER 3 COMPARISON WITH OTHER SYSTEMS

3.1 Flood Disaster Prevention System in Japan

In Japan, where annual average precipitation is 1700mm, and most of the urban development has been made on flood plain, flood has been the most frequent natural disaster. Japanese houses are traditionally made of wood, and housing development means massive exploitation of forest wood, causing deforestation of upstream and eventually frequent flood disaster. For this reason, the Japanese historically recognized the importance of forest protection as a means of flood prevention.

In modern era, since 100 years ago, three important laws regarding flood disaster prevention were established in Japan. Table 3.1 shows important laws related to flood disaster prevention in Japan. River law which mentions about river works was established in 1896. Forest law and Sabo laws were established in 1897. Forest law mentions forest conservation to prevent disasters. Sabo law mentions about definition of sabo works, and limitation of land use in hazardous area. Later, flood prevention law was established in 1952, with an emphasis of non-structural measures for flood disaster prevention.

In spite of these efforts, it was still difficult to reduce flood disaster, especially during the period of post second-world war. Due to the major typhoon that caused worst flood damage in Japans' history in 1959, killing more than 5,000 people, Japanese government established disaster prevention basic law in 1961. This law was a major change in disaster policy from post- disaster response to pre-disaster prevention, as shown in Table 3.2.

Though the river law was originally established for flood disaster prevention from the viewpoint of structural measures, however, the law went through major updates two times. In 1964, the idea of water resource management was added, and then the idea of environmental management was later added in 1997. With many efforts made under this law, the number of human loss and lost houses has been reduced significantly as shown in Figure 3.1 and Figure 3.2, respectively. The economic loss, however, has not decreased very much as shown in Figure 3.3, due to the ever increasing concentration of properties in flood plain.

It is found recently that majority of victims during heavy rain are due to sediment related disaster. For sediment disaster prevention, Landslide prevention law was established in 1958, Law Concerning Prevention of Steep Slope Collapse Disaster was made in 1969. Most recently, Sediment Disaster Countermeasures for Sediment Disaster Prone Areas Law was made in 2000. As the potential area for sediment disaster is so many, that the objective of the law is only to protect life rather than protect properties.

It should be noted that structure measures have been a major policy of flood disaster prevention in Japan, because land use control is not effective in practice due to existing high population concentration in flood plain. However, as river works are expensive yet it is not perfect to prevent flood disaster, non-structural measures are also emphasized recently. Development of flood hazard map has become mandatory in 1997, to provide information regarding the evacuation under flood disaster (IFNET, 2003).

Table 3.1 Laws Development Related to Flood disaster Prevention in Japan

Year	Name of Law
1880	Provision and Saving Act for Natural Disaster
1896	River Law
1897	Erosion Control (Sabo) Law, Forest Law
1908	Flood Prevention Association Law
1911	Flood Control Expenditure Funds Special Account Law
1947	Disaster Relief Law
1949	Flood Control Law
1950	Temporary Measures Law for Subsidizing Recovery Projects for Agriculture, Forestry and Fisheries Damaged due to Disasters
1951	Law concerning National Treasury share of expenses for recovery Projects for Public Civil Engineering Facilities Damage due to Disasters
1952	Meteorological Service Law
1955	Temporary Measures Law for Financing Farmers, Forestry men and Fishermen Suffering from Natural Disasters
1958	Landslide Prevention Law
1960	Soil Conservation and Flood Control Urgent Measures Law
1961	Disaster Countermeasures Basic Law
1964	River Law 2nd revision
1969	Law Concerning Prevention of Steep Slope Collapse Disaster
1972	Act Concerning Special Financial Support for Promoting Group Relocation for Disaster Mitigation
1997	River Law 3rd revision
2000	Sediment Disaster Countermeasures for Sediment Disaster Prone Areas Law

Source: Cabinet Office, Government of Japan, "Disaster Management in Japan"

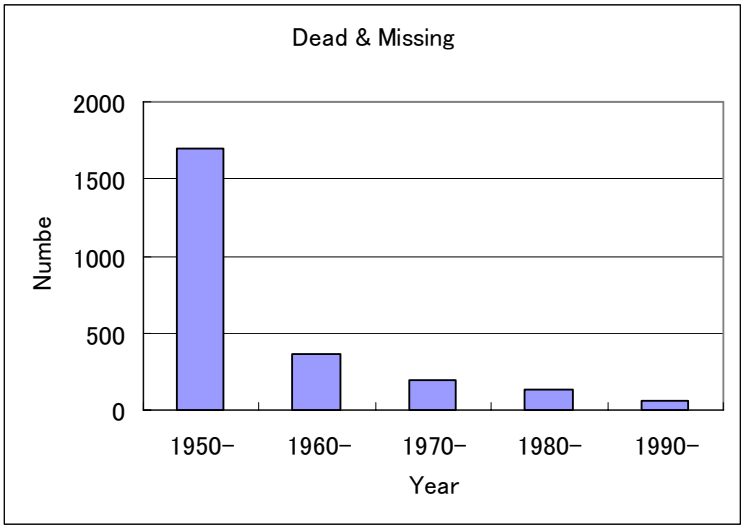


Figure 3.1 Annual Averages of Dead & Missing by Flood in Japan

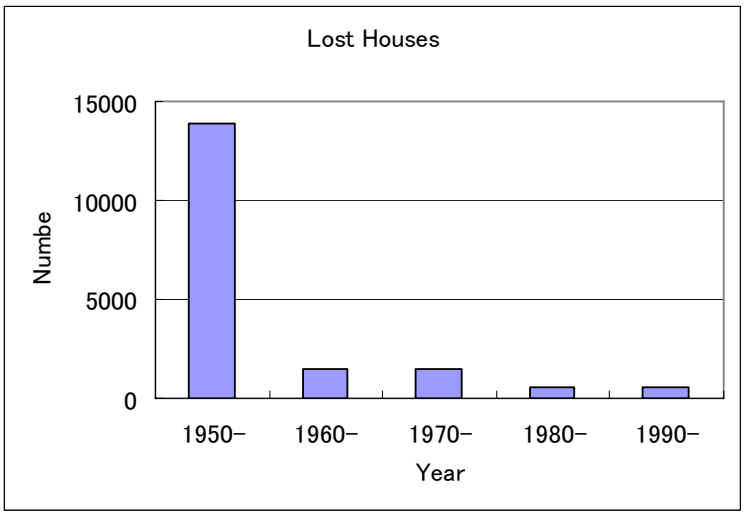
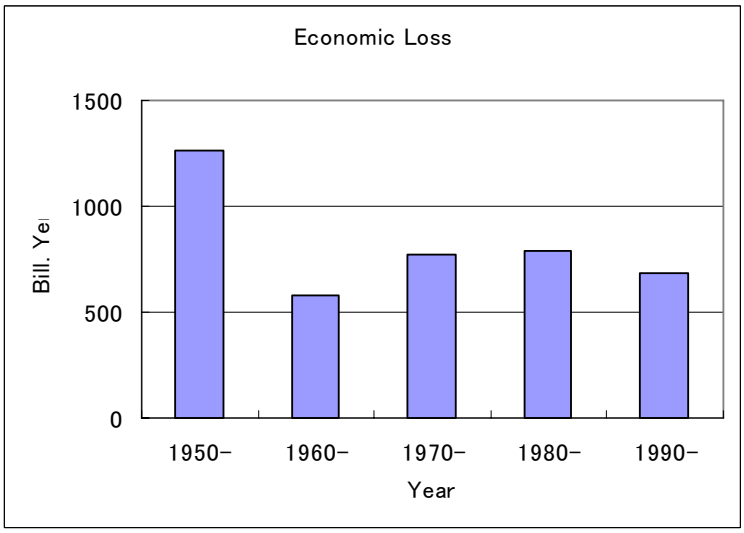


Figure 3.2 Annual Averages of Dead & Missing by Flood in Japan



Source: Suetugi, 2004.

Figure 3.3 Annual Averages of Dead & Missing by Flood in Japan

Table 3.2 Contents of Basic Disaster Prevention Plan in Japan (Excerpts)

Part 3 Flood Disaster Prevention
Chapter 1 Preventive Measures
Section 1 Flood Resistant Development
Section 2 Preparation for Response, Restoration, and Reconstruction
Section 3 Promotion of Preventive Activities among Citizens
Section 4 Promotion of Research & Observation for Disaster and Prevention Measures
Chapter 2 Emergency Response
Section 1Measures Immediately Before Disaster
Section 2 Assurance of Communication Immediately After Disaster
Section 3 Establishment of Response System
Section 4 Prevention of Disaster Spreading and Secondary Disaster
Section 5 Search and Rescue, Hospitalization
Section 6 Assurance of Emergency Transportation
Section 7 Evacuation & Sheltering
Section 8 Procurement and Supply of Food, Water, & Goods
Section 9 Sanitation and Burials
Section 10 Maintenance of Social Security and Price Stabilization
Section 11 Emergency Relief of Facilities
Section 12 Public Information to Victims
Section 13 Acceptance of Voluntary Helps
Chapter 3 Restoration and Reconstruction
Section 1 Establishment of Basic Policy on Restoration & Reconstruction
Section 2 Principles for Swift Restoration
Section 3 Principles for Reconstruction Program
Section 4 Assistance for the Victims
Section 5 Assistance for Small-Medium Sized Business and Other Economic Recoveries

3.2 US Systems for Flood Disaster Prevention

The US government also started structural measures for flood control to prevent flood on major rivers since 1917. Later, the object of structural measures was extended to all rivers in US in 1936. However, they realized the limitation of structural measures to prevent flood. After through study of possible measures, US government established “National Program to Control Flood Damage” in 1966. The history of law development for flood prevention is summarized in Table 3.3. The contents of National Flood Insurance Act of 1968, and the Flood Disaster Protection act of 1973 are summarized in Table 3.4.

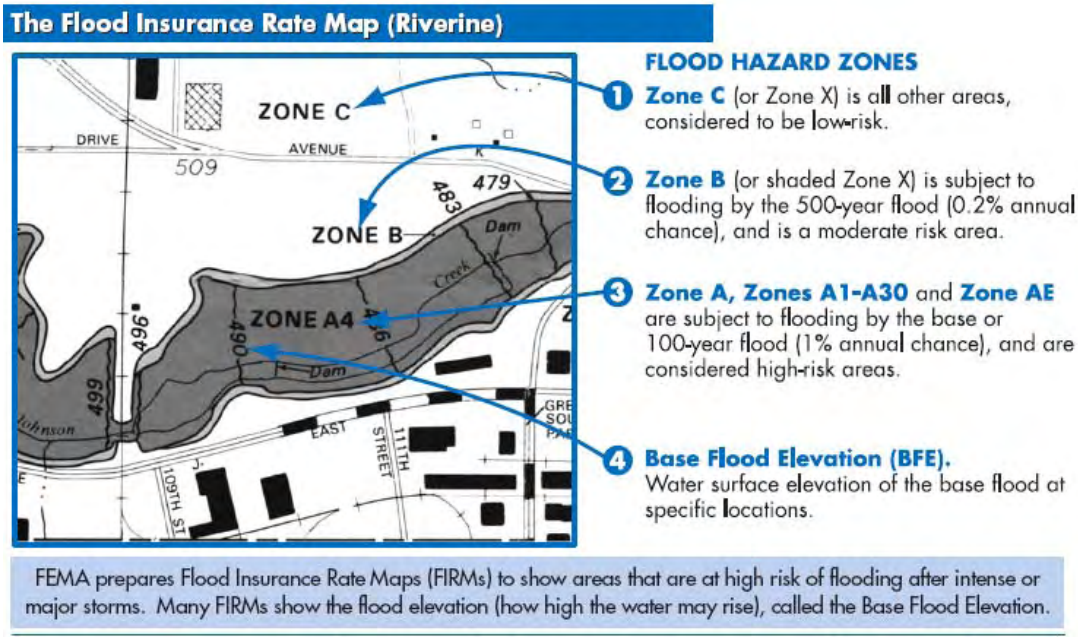
The idea of the program is to use hazard map with land use control and flood insurance program. Figure 2.7 shows an example of flood rate map. Area A is flood potential area for 100 year return period, as regarded as high risk area. Area B is flood potential area for 500 year return period, and regarded as moderate risk area. Area C is flood potential area out of 500 year return period, and low risk area.

Table 3.3 History of Law Development for Flood Disaster Prevention in US

Year	Law development
1965	Southeast Hurricane Disaster Act
1966	Feasibility study of national flood insurance program.
1968	National Flood Insurance Program
1973	Flood Disaster Protection Act
	272,500 policy holders in flood insurance
1994	National Flood Insurance Reform Act
	2,800,000 policy holders in flood insurance
2003	4,400,000 policy holders in flood insurance

Table 3.4 Contents of the "National Flood Insurance Act of 1968, as Amended, and the Flood Disaster Protection act of 1973, as Amended, 42 U.S.C. 4001 et. seq"

Chapter	Title
Subchapter I	The National Flood Insurance Program
Subchapter II	Organization and Administration of Flood Insurance Program
Part A	Industry Program with Federal Financial Assistance
Part B	Government Program with Industry Assistance
Part C	General Provisions
Subchapter III	Coordination of flood Insurance with Land-Management Programs in Flood-Prone Areas
Subchapter IV	General Provisions



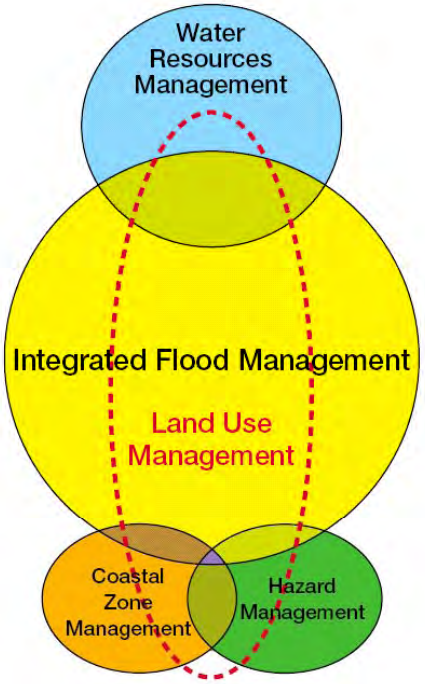
Source: "Quick Guide", Texas State Floodplain Manager, 2003 (http://www.tfma.org)

Figure 3.4 Flood Insurance Rate Map in US

3.3 Integrated Flood Management Program by WMO

The Associated Program on Flood Management (APFM) is a joint initiative of the World Meteorological Organization and the Global Water Partnership. It promotes the concept of Integrated Flood Management (IFM) as a new approach to flood management. The program is financially supported by the governments of Japan and the Netherlands. The case studies of flood management in different countries are demonstrated in the web site.

The program stresses that policy for flood management should integrate water resource management, land use management, hazard management, and coastal zone management, as shown in Figure 3.5, as they are closely related each other.



Source: http://www.apfm.info/

Figure 3.5 Integrated Flood Management Scheme by WMO

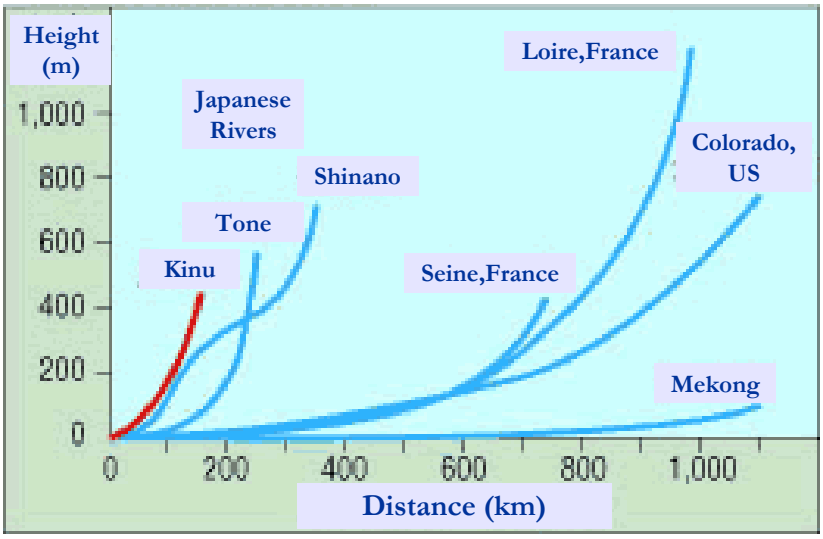
CHAPTER 4 COMPARISON OF DIFFERENT SYSTEMS

Backgrounds for flood disaster are compared as shown in Table 4.1. The rainfall in Golestan, Iran, the amount is limited compared to that in Japan or US. As for river topography, rivers in Golestan are steep, and are more similar to that in Japan as shown in Figure 4.1.

However, the population density is still low in Golestan, compared to that in Japan. This would mean structural measures are not cost-effective to protect human life and properties. Rather, non-structural measures such as flood plain management and flood insurances as used in US would be more effective.

Table 4.1 Different Background between Iran, Japan, & US

	Golestan	Japan	US
Rainfall (mm/year)	200-700	1700	760
River topography	Steep	Steep	Gentle
Population (million)	1.4	127	293
Area (10^3 km^2)	21	377	9826
Pop. density (person/km^2)	68	337	30



(Source: Ministry of Land, Infrastructure, and Transportation, Japan)

Figure 4.1 Topography of River in the World

When law development in Iran and Japan are compared, difference trend is found as shown in Table 4.2. In Japan, where flood disaster has been a major problem historically, disaster prevention has been primary concern in River Law. Later, other issues such as resource management and environmental management were included to the law. On the other hand, environmental protection has been fundamental concern in Iran, and laws for resource management were developed in 1980's and disaster prevention were developed in 1990's.

Table 4.2 Different Trends in Law

Iran		Japan (River Law)	
1960's	Environment	1896	Disaster
1980's	Resource	1964	Resource
1990's	Disaster	1997	Environment

CHAPTER 5 RECOMMENDATIONS

Disaster is a negative interaction between human and nature. Though it is not possible to stop occurrence of heavy rain or flood, however, it is possible to reduce its effect with proper knowledge about disaster and human effort.

As shown in previous section, approaches for flood disaster prevention are different from country to country. The approach can change even in a same country due the changes in technology and socio-economical condition. Nevertheless, successful measures and lessons in other countries are worth studying. On the other hand, it should be noted that there are many working system and mechanism in Iran, which are potentially useful for flood disaster prevention.

Generally speaking, because the population density in the study area in Golestan is not so high, non-structural measures should be given priority, rather than the structural measures. For example, the idea of flood plain management combined with flood insurance can be practical measures, as used in US. For this, development of flood hazard map to evaluate of hazard potential is necessary. For the implementation, following steps are proposed.

5.1 Recommendations to provincial government

For Golestan Provincial Government, following steps are recommended. Flood hazard map which will be developed in JICA study can be a common platform for different institutions to promote integrated flood plain management, together with agriculture product insurance.

Development of a flood hazard map.

- Flood hazard map will be developed during JICA Study.
- Counterpart institution is expected to learn development methodology through technical transfer during JICA study.

(1) Authorization of flood hazard map in Provincial Disaster Committee.

- MOJA shall present flood hazard map to regularly held provincial disaster committee, and its application shall be discussed.
- Flood disaster prevention policy in other countries shall be presented and studied in the committee.
- If possible, ordinance regarding the use of flood hazard map shall be made in provincial government.

(2) Application of flood hazard map to rural development.

- MOJA will use flood hazard map for agricultural land use.
- Housing foundation shall use flood hazard map for the rural development.
- Relocation of houses in flood damaged area developed.

(3) Application of flood hazard map to agricultural insurance.

- Flood hazard map can be reflected to agricultural land use.
- Flood hazard map can be reflected to insurance premium as well.
- Flood hazard map can be used to promote farmers' participation in agriculture insurance.

(4) Application of flood hazard map to early warning and evacuation.

- Flood hazard map can be used to demonstrate hazardous area to MORT.
- MORT or ITTO can use hazard map to demonstrate hazardous area to tourists.

5.2 Recommendations for National Government

To extend successful experience in Golestan Province in flood disaster prevention to whole country, it is recommended that national government should lead the improvement by legal reform, and local government can implement new policy. The necessary steps are described in the following and are illustrated in Figure 5.1.

(1) Strengthening of existing laws

- Articles about preventive measures should be added to existing laws, like river law, forest law, and sabo law in Japan.
- Laws for environmental protection can be strengthened to add articles of disaster prevention from the view point of environmental protection. For example, protection of forest can be good measure for disaster prevention as well. As environmental laws have long history in Iran, they can be effective measures for disaster prevention if they are revised with such considerations.
- Fair water service law can be also strengthened, as it is the most fundamental law for river management. For this, river law in Japan can be a good reference.
- Laws for rural development or road may add articles to avoid development in flood potential area.

(2) Specific Law for flood disaster prevention

- A specific law for flood disaster prevention should be established, as flood is not regarded as disaster in terms of law, though individual efforts has been made in different institutions.
- Laws for sediment disaster prevention should be made. This may include designation of hazardous area and restricted land use of such areas.
- Disaster committee law should add articles that require each institution to establish disaster prevention work plan. For this, Japanese basic law on disaster prevention can be a reference.

(3) Coordination of different laws

- Existing laws should be linked to the disaster prevention law, as it is fundamental law in disaster prevention in Iran.
- Disaster prevention should be linked with national development plan, as same manner as environment issues are mentioned in the plan, so that the prevention measures are included in the development process.
- Existing environmental laws have long history, and they can be used to strengthen flood prevention measures.
- Finally, division role in each measure are shown in Table 5.1, in comparison with systems in other countries.

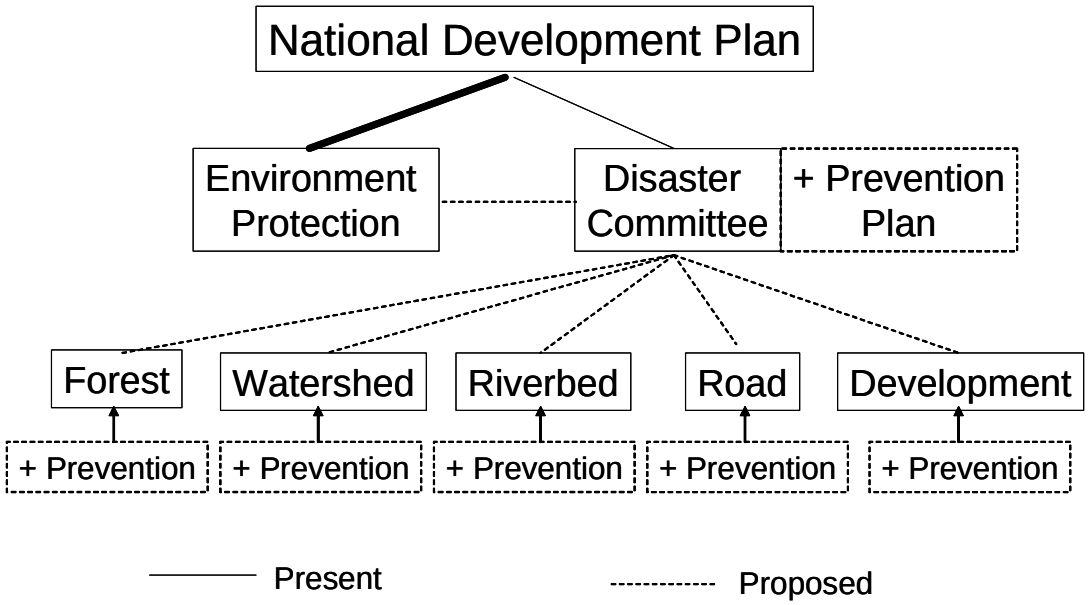


Figure 5.1 Proposed Improvements in Law Systems in Iran

Table 5.1 Proposed Division of Role in Each Measure in Iran

	Forest	River works, Dam	Warning	Hazard map	Land use	Insurance
Iran	MOJA	MOE, MOJA	IRIMO	MOJA, MOE	HUD, MPO, MORT	Agriculture Bank, MOJA
Japan	MAFF	MLIT	JMA	1994- MLIT	Weak	
US			NOAA	FEMA	Flood Plain Manager	National Insurance Program

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SUPPORTING REPORT I (MASTER PLAN)

PAPER XVI

GIS Database

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 XVI GIS DATABASE

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CHAPTER 1 GIS DATABASE DESIGN

1.1 GIS Database Design at First Stage

Through the study in first stage, JICA study team found to generate a high quality GIS Database for flood control is necessary. And the JICA study team also designed a GIS database. The index map of the GIS database is shown in the following figure.

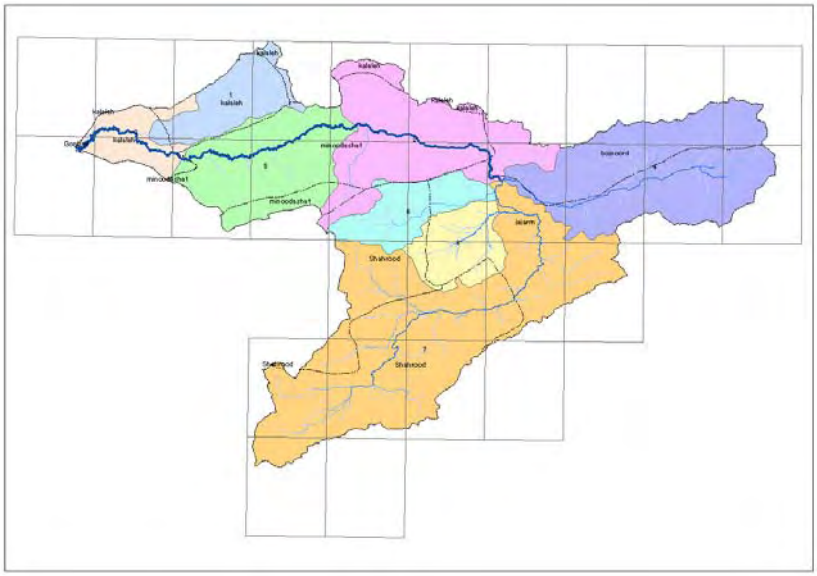

Figure 1.1 Image Map of Madarsoo River Basin

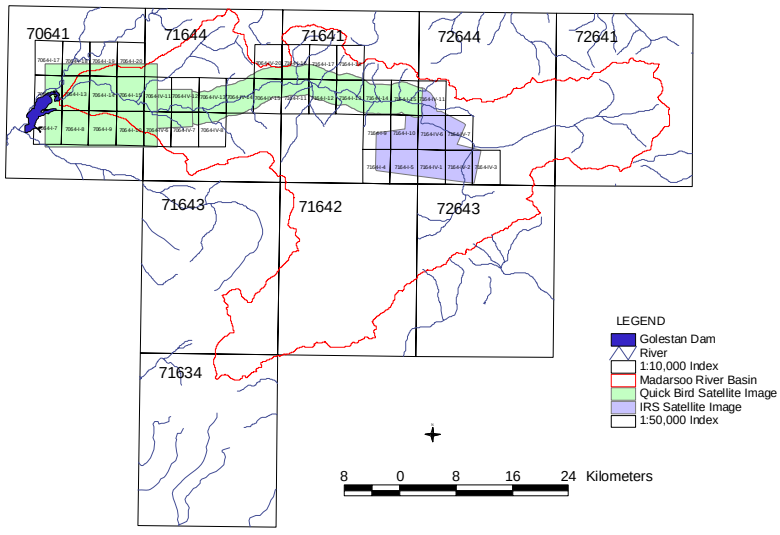

Figure 1.2 Index Map of GIS Database Design

The GIS database covering the whole Madarsoo river basin is based on 1:50,000 scale topographic map. The study area is covered with 9 map sheets as shown in index map. There are five categories: basic data, topographic data, natural environmental data, social economic data, and disaster-related data as shown in the following table.

Table 1.1 Specification of GIS Database Design in 50,000 scale

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 disaster area of Madarsoo river basin, the JICA study team designed a big scale (1:10,000 scale) GIS database. This database is generated by Quick Bird satellite images. The data layer includes topographic features, detail building and residence information as shown in the following table.

Table 1.2 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, and so on.

1.2 Adjustment of GIS Database Design

However, through the investigation, JICA study team found there is a 1:25,000 scale topographic map covered Madarsoo river basin except river mouse area in Golestan dam. So JICA study team adjusted the GIS database design to use this 1:25,000 topographic map instead of 1:50,000 topographic map for getting higher quality GIS database. The GIS database established in this study is as follows.

Table 1.3(1/2) Specification of 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
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

Table 1.3(2/2) Specification of GIS Database

Category	Layer	Data Type	Data Source	Attributions
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 years Flood	Polygon	Mark 11 Simulation with DEM and other GIS data	
	Landslide Disaster Data	Polygon	Land Classification	Code, Class Name

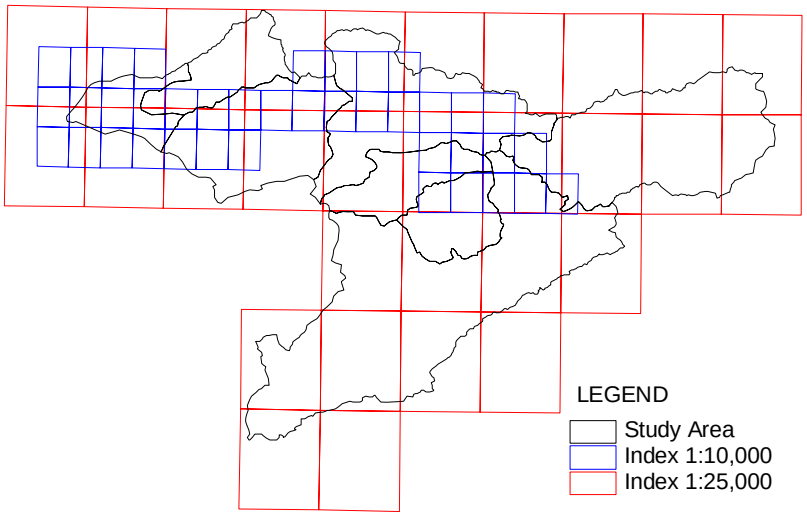

Figure 1.3 Index Map of GIS Database

CHAPTER 2 GIS DATABASE ESTABLISHMENT

2.1 Data Source Preparation

2.1.1 Satellite Image – LANDSAT ETM+

The Landsat-ETM+ image was taken on July 2002, It was geo-referenced by GPS survey point and 1:25,000 topographic map. It has 8 spectral bands as shown in following table.

Table 2.1 Specification of Landsat ETM+ Satellite Image

Band	Ground Resolution (m)	Description	Spectral Range
1	30	Visible Blue	.450 - .515
2	30	Visible Green	.525 - .605
3	30	Visible Red	.630 - .690
4	30	Near Infrared	.775 - .900
5	30	Mid/Short Wave Infrared	1.550 - 1.750
6	60	Thermal Infrared	10.400 - 12.500
7	30	Mid/Short Wave Infrared	2.090 - 2.350
8	15	Panchromatic	0.52 – 0.9

The image map of Landsat ETM+ displayed by RGB color is as follow.

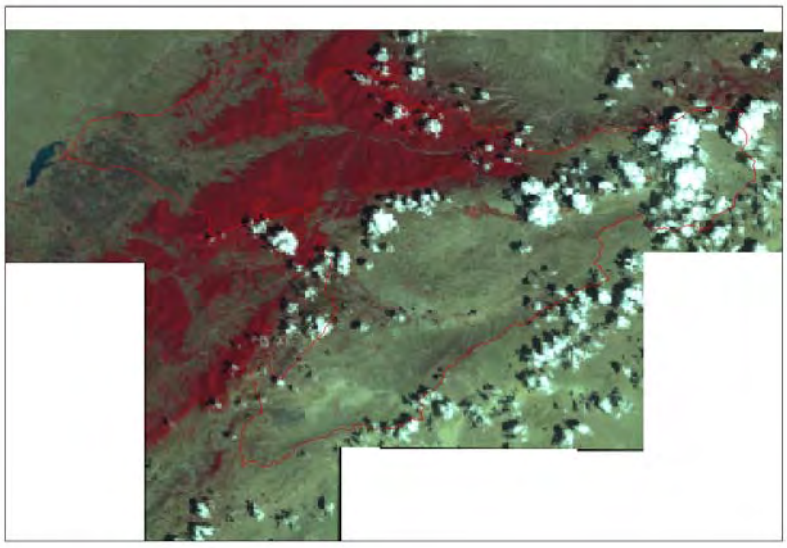

Figure 2.1 Image Map of Landsat ETM+

2.1.2 Satellite Image – IRS LIC

The IRS LIC image was taken on May of 2004. It was geo-referenced by GPS survey point and 1:25,000 topographic map. It is a 4 layers multi-spectral data. The data resolution is about 23 meters per pixel.

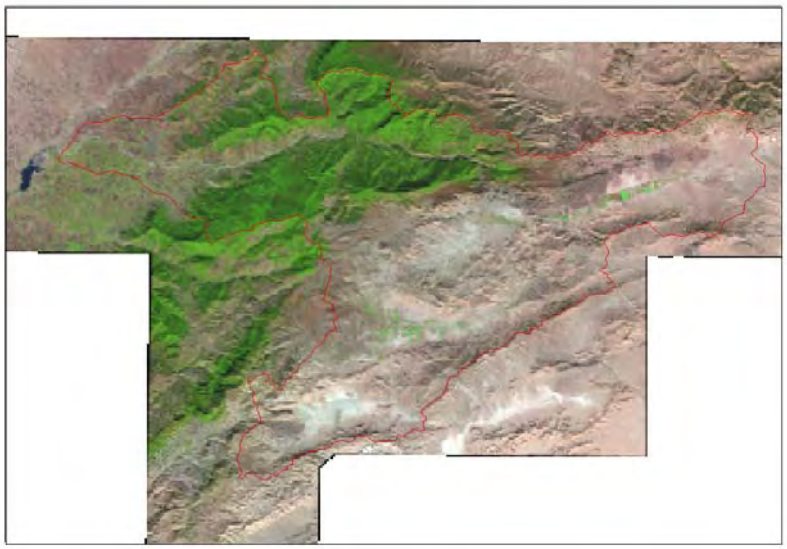

Figure 2.2 Image Map of RIS LIC

2.1.3 Satellite Image – IRS PAN

The IRS PAN image was taken on May of 2004. It was geo-referenced by GPS survey point and 1:25,000 topographic map. It has only one band data. The data resolution is about 5 meters per pixel. This data covers only upstream area of Madarsoo river basin.

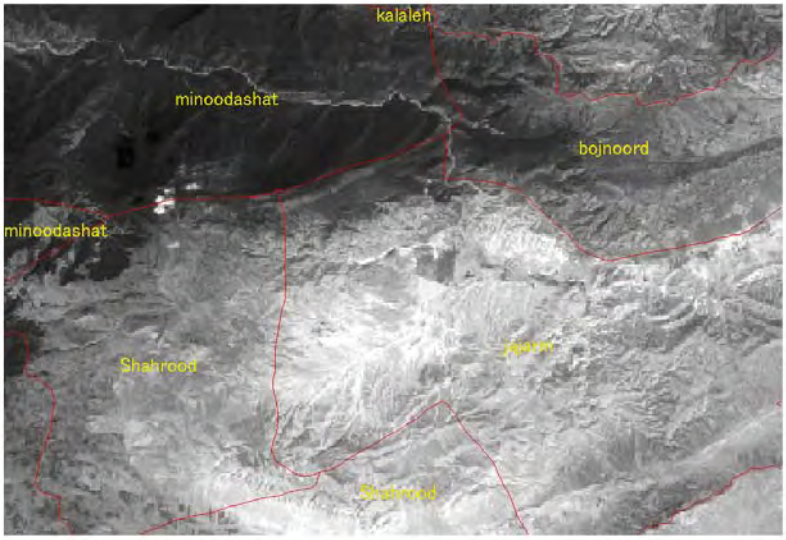

Figure 2.3 Image Map of IRS PAN

2.1.4 Satellite Image – Quick Bird

The Quick Bird image was taken on May of 2005. It was geo-referenced by GPS survey point. It includes both panchromatic and multispectral layers. The panchromatic layer has 61 cm per pixel resolution, and the multispectral layer has 4 bands of 2.44 meters per pixel resolution. This data covers Madarsoo disaster area as shown in follow.

Figure 2.4 Image Map of Quick Bird

2.1.5 Stereo Arial Photo 1:40,000 Scale Panchromatic

The Arial photos were used into interpretation of land classification in middle stream of Madarsoo river. The interpretation work is done by stereoscope, and then transferred the interpretation result into transparency paper based on 25,000 scale topographic map. The image of land classification interpretation map is as follows.

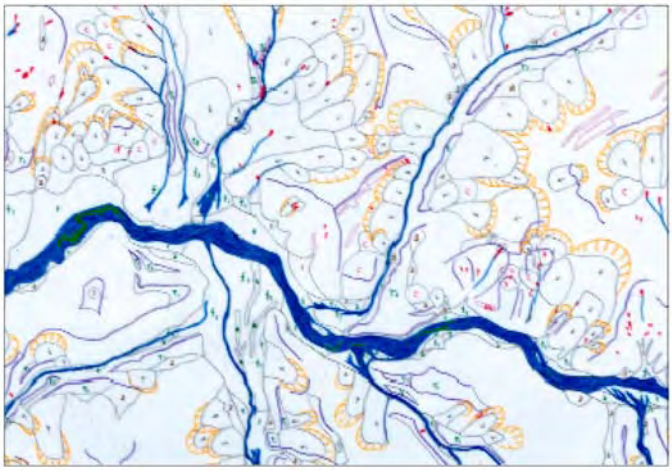

Figure 2.5 Image Map of Land Classification

2.1.6 Topographic Map 1:50,000 Scale

One of the map data source is 1:50,000 scale topographic map. It was designed to be the main data source to establish GIS database. However, after we changed to use 1:25,000 scale topographic map, it plays as only a reference source. The image map of 1:50,000 scale is as follow.

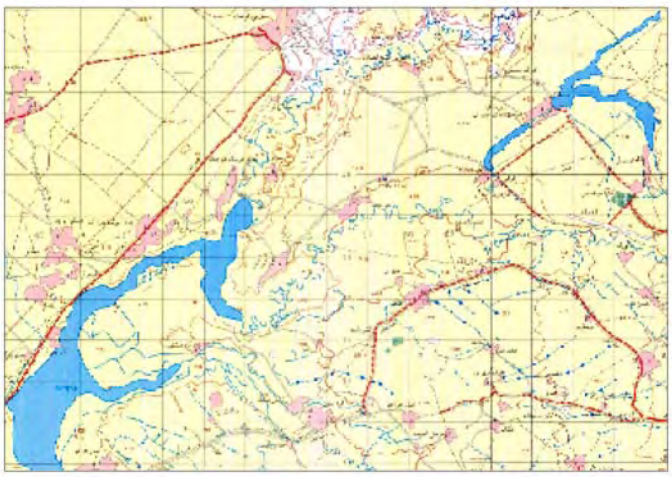

Figure 2.6 Image Map of 1:50,000 topographic map

2.1.7 Topographic Map 1:25,000 Scale

This map data source is the main data source for establishing the GIS database. The image map is shown as follow.

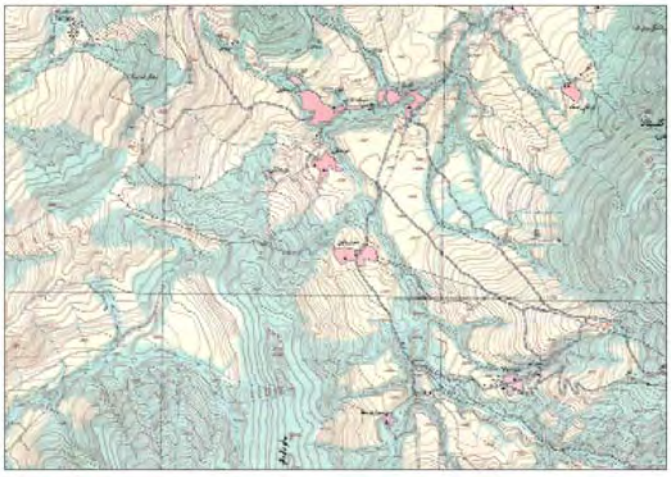

Figure 2.7 Image Map of 1:25,000 topographic map

2.1.8 Geology Map 1:100,000 Scale

There are four map sheets covering the study area. Through the geology map, the geology type, fault, slope data could be easy abstraction. The image map is shown in as follow.

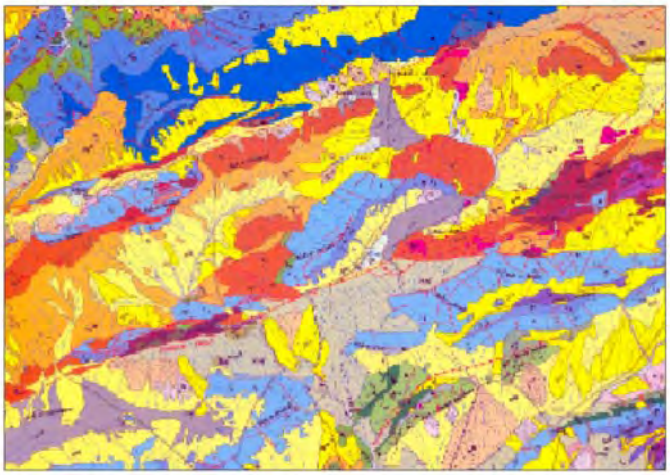

Figure 2.8 Image Map of 1:100,000 Geology Map

2.1.9 GPS Survey Point

Through the study, more than 400 GPS points were surveyed by fieldwork. Most of them are used as Global Control Point for correcting the distortion of satellite image. The following map shows GPS points overlay on Quick Bird satellite image.

Figure 2.9 Image Map of GPS Survey Points

2.2 Adjustment of Coordinate System

All satellite images were geo-referenced and corrected by GPS survey points and 1:25,000 topographic map. All the data sources then combined into UTM coordinate system with Zone 40 and Datum WGS84. Therefore, all the data layers including the vector data that digitized from satellite images and source maps could match well. A high quality GIS database was established.