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PAPER IX

Economic Evaluation

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CHAPTER 1   GENERAL

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 in the Master Plan Study Stage.

Among them, 3 plans are adopted as priority projects in the Feasibility Study stage this time as (1) River Restoration Plan including a part of the Watershed Management Plan, (2) Golestan Forest Park Disaster Management Plan, and (3) Preparation of Hazard Map and the Guidance for Public Awareness including several activities concerning the Floodplain Management Plan and the Flood Preparedness Plan.

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CHAPTER 2   RIVER RESTORATION PLAN

The River Restoration Plan consists of three works as (1) the Watershed Management Plan (WMP), (2) the Sediment Control Works (SCD = Sediment Control Dam works) and (3) the Erosion Control Works (ECD = Erosion Control Dam works). The targeted village and reaches are the Dasht Village and the upstream of the Madarsoo River.

2.1   Identification of Economic Benefit

There are two categories of the economic benefits in this kind of Project as (1) direct benefit and (2) indirect benefit.

2.1.1   Direct Benefit in Watershed Management Works

The direct economic benefit in case of the works for WMP is newly generated agricultural and animal husbandry productivities derived from:

(1)   Terracing and Banquette works to plant Olive, Walnut, Corylus, Peach and Apple are to be planted. Among them, Olive is the major crop.

(2)   Furrow works to plant Atriplex for breeding livestock.

(3)   The works of Changing Dry Farming, Fertilizing in Range Land, Seeding in Range Land, Mass Seeding in Range Land, Planting in Range Land. These are for animal breeding. It means that the productivity of meat will become higher. Sheep, Goat and Cow are the major livestock to breed.

2.1.2   Direct Benefit in Sediment Control Works

The works for SCD are to rehabilitate the existing sediment control dam destroyed caused by past flood/debris flow for mitigating the damages of residential area from sediment flow from the Ghiz Galey River in this study. Accordingly, the direct economic benefit in case of the works for SCD is the amount of following damages to be mitigated:

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

(2)   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

(3)   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 WMP is contributed a little bit because that the works for WMP has also a capability of sediment control.

2.1.3   Direct Benefit in Erosion Control Works

The works for ECDE are the works to stabilize river banks of upstream reaches of the Madarsoo River so that bank erosion does not occur again. 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.

2.1.4   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;

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(1)　　run-off control in case of Watershed Management Works because that the plants have a capability to keep water in their roots,

(2)　　debris flow control in case of Watershed Management Works because that the plants have a capability to keep soil with their roots,

(3)　　conservation of the bio-diversity,

(4)　　keeping rural and pastoral landscape being beautiful,

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

2.2　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 estimated being 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.

2.3　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 a basic concept in detail on economic evaluation indices applied)

2.4　Economic Evaluation

2.4.1　Estimation of Economic Benefit

(1)　　Benefit Derived from Watershed Management Works

The Watershed Management 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 works for WMP:

Table 2.1　　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 banquette, 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

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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 catchments of the tributaries of the Madarsoo River. 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, basic units for estimation of economic benefits to Be Newly Generated Due to Execution of the works WMP are estimated as shown in the following table:

Table 2.2 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

As mentioned above, the economic benefit derived from the works for WMP is the amount of newly generated agricultural productivities and increase of the productivities of animal husbandry. Detail estimation process for these benefits is shown in Annexes 2 through 5.

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.

(2) Benefit Derived from Sediment Control Works

(a) 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

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of land, the amount of damages can be estimated from it by multiplying the damage rate. Annex 5 shows detail of the above factors. As shown in this table, the damage rate was 82 % at 2001-Year flood.

As a result, the amount of Rials 567.0 million per ha 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 per ha 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 per ha.

According to a sediment flow analysis, the benefited area by each return period is made clear as shown in the following table together with an effect with the Watershed Management Works. In this case, the works for WMP is contributed a little bit because that the works for WMP has also a capability of sediment control as mentioned above.

Table 2.3   Benefited Residential Area by Case of Combination of WMP and SCD by Each Return Period

(ha)

Return Period	Flooding Area Without Project	Flooding Area With WM		Sedimentation Damaged Area	
		Remaining Damaged Area	Benefitted Area	Remaining Damaged Area	Benefitted Area
5	5	5	0	0	5
10	11	11	0	0	11
25	19	18	1	0	19
50	22	21	1	0	22
100	25	24	1	0	25

Based on the above figures, the total amount of benefit combined with the Watershed Management Works is resulted at Rials 17,009 million (= 680.3 * 25ha). 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 and/or damaged.

(b)   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) WMP only, (2) SCD.

Using the above figures in the Table 2.4, the annual average damages and economic benefit are calculated as shown in Annexes 6 through 11 and summarized as follows:

Table 2.4(1/2)   Summary of Estimation of Annual Average Flood with Debris Flow Damages and Calculation of Economic Benefit

WMP and SCD under the Present Condition

(Million Rials)

Return Period (Year)	Under the Witout Project Condition	Under the Condition with WMP		Under the Condition with WMP + SCD	
		Remaining Damages	Benefit	Remaining Damages	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**

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Table 2.4(1/2) Summary of Estimation of Annual Average Flood with Debris Flow Damages and Calculation of Economic Benefit

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 Damages	Benefit	Remaining Damages	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: The works on Watershed Management Plan.
SCD: The works on Sediment Control Dam.

As shown in the above table, the economic benefit at present condition is estimated at Rials 2,956 million and that at 2025-Year condition is estimated at6 Rials 4,224 million under the cases of combination of whole 2 works of WMP and SCD works. In this case, the population growth rate is applied as socio-economic changing factor from the present to the future in the residential area.

(3) Benefit Derived from the Erosion Control Works

(a) Damages to Agricultural Products in Case of Erosion Control Works

As mentioned above, 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 total washed out river side agricultural area is to be 18.3 ha in case of 100-year of return period as shown in the following table.

Table 2.5 River Side Agricultural Area to be Washed Out by Each Return Period

(ha)

Return Priod	Without Project	With Project
5	0.5	0.0
10	1.0	0.0
25	2.8	0.0
50	6.7	0.0
100	18.3	0.0

Unit agricultural productivity is estimated at Rials 7,224,000/ha expressed by land value as shown Annex 5. Therefore, total amount of damages is estimated at Rials 145 million (=7.224*(1 + 0.1)*18.3 ha) under the present economic condition. In this case, it is assumed that damages to public utilities as irrigated canals, agricultural road, and so on are to be 10 % of the damages to agricultural area.

(b) Annual Average Damages and Estimation of Economic Benefit

The annual average damages are calculated by means of the Probability Analysis as the same manner with the case of WMP and SCD.

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Using the above figures in the Table 2.6, the annual average damages and economic benefit are calculated as shown in Annexes 12 through 15 and summarized as follows:

Table 2.6   Summary of Estimation 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.

In this case, the increasing rate of agricultural productivity for the 2025-year condition is applied as socio-economic changing factor from the present to the future in agricultural area.

2.4.2   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 16 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:

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$$SPRL = \dfrac{A_gO \big/ CA}{FP_p}$$

Here,   SPRL: a shadow price rate for land,
AgO: amount of agricultural products,
CA: harvested or cropped area (ha), and
FPp: financial price of land to be acquired for the Project.

The amount of Rials 7,224,000 per ha can be inserted for A_gO, that is already calculated as shown in Annex 5. *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 17.

(2)   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 according 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.

(3)   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 contractor should pay insurance: 7.67 % and corporate 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 Annex 18, and summarized as below:

**Table 2.7   Summary of Project Cost and Its Annual Disbursement
with Economic Cost Converted**

(Million Rials)

Item	Total Cost	Disbursement							
		2007	2008	2009	2,010	2011	2012	2013	2014
Financial Cost in Total	79,415	19,291	8,694	18,228	16,086	14,039	2,717	180	180
Economic Cost Converted	68,860	17,414	7,843	15,467	13,335	12,022	2,453	163	163

The annual operation and maintenance cost (OM Cost) is applied at 3 % of the cost for the Watershed Management works, and 0.5 % for River Restoration Plan is applied for the other two works. The amount of OM Cost is a sum of Rials 1,936 million per annum after completion of both the works.

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2.4.3 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.

In this case, full execution may be rather hard for the Watershed Management Plan because that the facilities as terrace and/or banquette should need the tireless maintenance forever until planted fruit trees will become adults. Therefore, it is assumed that execution rate is set at 75 % for the Plan as the original case.

The results are shown in Annexes 19 and 20, and summarized as below:

Table 2.8   Summary of Economic Evaluation Result of the Original Case

Evaluation Indicator	Under the Present Condition	Under the 2025-Year Condition
NPV	81,207	85,754
EIRR	18.71%	19.14%
B/C Ratio	2.89	2.99

(Note) NPV is expressed by "million Rials"

As shown in the above table, the Project indicate a quite high viability to execute by showing the 18.71 % of EIRR under the present socio-economic condition (hereinafter referred to as "at present condition") and 19.14 % under the socio-economic condition of the year 2025 (as "at 2025-Year condition" hereinafter referred to).

2.4.4 Sensitivity Analysis

The economic internal rate of return (EIRR) changes its value depending on the parameters employed for the calculation. Out of these parameters, the construction cost of the Project and its benefit are the most important determinants of the economic analysis. So, case studies are made taking execution rate into account for the Watershed Management Plan as (1) full execution, in other words "In Case of Execution Rate of Watershed Management Plan: 100 %" as Alternative Case 1, and (2) half of execution, in other words "In Case of Execution Rate of Watershed Management Plan: 50 %" as Alternative Case 2 in addition to the Original Case as mentioned above.

From the above viewpoint, a Sensitivity Test of EIRR of the Project at 2025-Year condition is made in 16 combination cases for all the Alternatives including base case of the Original Case as (1) Cost: 10 % decrease, (2) Cost: base, (3) Cost: 10 % increase, and (4) Cost: 20 increase, and (5) Benefit: 10 % deacrease, (6) Benefit: base, (7) Benefit: 10 % increase and (8) Benefit: 20 increase.

Following figures with tables show their results :

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Original Case

In Case of Execution Rate of Watershed Management Plan: 75%

EIRR in Each Case	Benefit			
	-10 %	Base	+10 %	+20 %
Cost -10 %	19.14%	20.50%	21.78%	23.00%
Cost Base	17.84%	**19.14%**	20.37%	21.53%
Cost +10 %	16.71%	17.96%	19.14%	20.26%
Cost +20 %	15.71%	16.92%	18.06%	19.14%

Alternative Case 1

In Case of Execution Rate of Watershed Management Plan: 100%

EIRR in Each Case	Benefit			
	-10 %	Base	+10 %	+20 %
Cost -10 %	22.37%	23.86%	25.27%	26.60%
Cost Base	20.94%	**22.37%**	23.72%	24.99%
Cost +10 %	19.69%	21.07%	22.37%	23.60%
Cost +20 %	18.60%	19.93%	21.18%	22.37%

Alternative Case 2

In Case of Execution Rate of Watershed Management Plan: 50%

EIRR in Each Case	Benefit			
	-10 %	Base	+10 %	+20 %
Cost -10 %	15.27%	16.47%	17.60%	18.68%
Cost Base	14.13%	**15.27%**	16.35%	17.38%
Cost +10 %	13.13%	14.23%	15.27%	16.26%
Cost +20 %	12.26%	13.32%	14.32%	15.27%

Figure 2.1   Sensitivity Analysis of Original Case and Alternative Cases with Tables

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In the most pessimistic case under the condition of the Cost: 20 % increase and the Benefit: 10 % decrease, the resulted EIRR is still keep higher than the applied discount rate of 10 % as 15.71 % as indicated in the above table for the Original Case.

The resulted EIRRs of Base Case and the most pessimistic case in the Alternative Case 1 are 22.37 % and 18.60 % respectively, and those in the Alternative Case 2 are 15.27 % and 12.26 % respectively.

2.4.5　Conclusion

As a result, the EIRR of the River Restoration Plan including it's cost for operation and maintenance is resulted at 19.14 % as the base case at 2025-condition and 18.60 % in the most pessimistic case under the condition of Cost of 20 increase and Benefit of 10 % decrease in the Case of Execution Rate of Watershed Management Plan of 75 % as shown in the above table.

In the Case of Execution Rate of Watershed Management Plan of 100 %, the EIRR is become at 22.37 % as the base case at 2025-condition and 18.60 % in the most pessimistic case under the condition of Cost of 20 increase and Benefit of 10 % decrease as shown in the above table.

Furthermore, even in the most conservative case as the Case of Execution Rate of Watershed Management Plan of 50 %, the EIRR is become at 15.27 % as the base case at 2025-condition and 12.26 % in the most pessimistic case under the condition of Cost of 20 increase and Benefit of 10 % decrease that is still higher than the applied discount rate of 10 % as shown in the above table.

Therefore, it may say the Project has an economic feasibility with enough rooms as a whole from those analyses. Of course, the higher is the better in EIRR. Accordingly, it is strongly requested to promote the execution of the Watershed Management Plan for formulating the River Restoration Plan.

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CHAPTER 3   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 occurs, 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 not accept by 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 occurs.

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.

3.1   Identification of Economic Benefit

3.1.1   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 study, it is assumed that the above mentioned amount of income loss is to be damages to the human life.

3.1.2   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 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 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,

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 as the same manner with the "Chapter 2 River Restoration Plan" above.

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3.3 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).

3.4 Economic Evaluation

3.4.1 Estimation of Economic Benefit

(1) Estimation of Income Level

Most of people who visit to the Golestan Forest may be urban residents from cities. Therefore, the income level of urban residents is needed to estimate. Annexes 21 through 24 shows the average annual urban and rural household net expenditure on food and on non-food, Annex 25 shows average annual Income of urban/rural household, and Annex 26 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 as mentioned above.

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

Table 3.1   Average Income Level per Household in Urban Area of Iran

(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.

The chart shows the income trend with data points from 1998 to 2003 and an extrapolated curve to 2005, with the fitted equation:

$$y = 425,686 \, x^2 - 1,698,363,713 \, x + 1,694,006,404,044$$
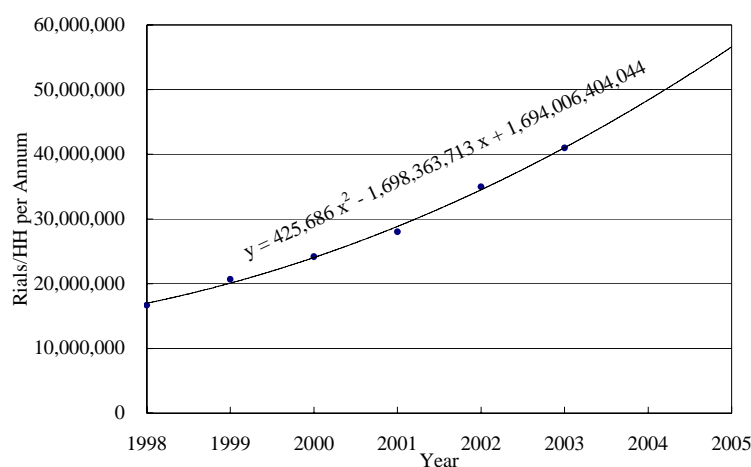
Figure 3.1   Income Trend of Urban Residents

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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 3.2   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	

Source: 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 allmost of them may not entirely enter into the Golestan Forest for recreation purpose.

There is the other information as follow:

Table 3.3   Information on Visitors to Restaurants near the Both Entrances of the Golestan Forest

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

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

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

(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

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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 expected working period: 20 years (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 $\times$ 0.7 (life cost: 30 % should be deducted)$\times$16.804 (Coefficient of New Hoffmannsche Methode) $\times$ 45 families $\times$ 20 years $\times$ 20 %). Following box is a pigeonhole of the said assumption and estimation process.

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 the Golestan Forest National Park:	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:

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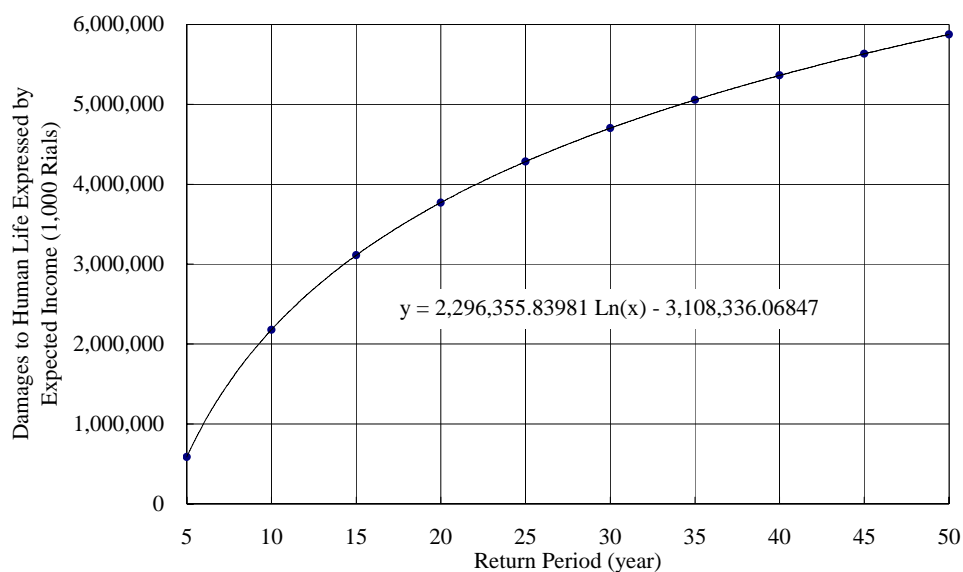
Figure 3.2   Relationship between Return Period and Damages to Human Life Expressed by Expected Income

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 3.4   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) Segment	Cummulative Annual Average Damages (Million Rials)
			Amount	Mean		
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**

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 applied the same rate as 0.90707 as discussed in the previous sub-clause of "Chapter 2 River Restoration Plan".

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(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 "Chapter 2 River Restoration Plan".

(3)   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 "Chapter 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 "Chapter 2 River Restoration Plan".

Based on the above assumptions, the economic costs are estimated as shown in Annex 27 and summarized as below:

**Table 3.5   Summary of Project Cost and Its Annual Disbursement
for Golestan Forest Park Disaster Management Plan**

(Million Rials)

Item	Total Cost	Disbursement				
		2007	2008	2009	2,010	2011
Financial Cost in Total	4,282	0	0	3,303	894	84
Economic Cost Converted	3,359	0	0	2,548	727	84

The annual operation and maintenance cost of 5.9 % consisting of maintenance cost of 2.9 % as a rate of weighted mean and operation cost of 3.0 % is applied for the initial investment cost. The amount of OM cost is a sum of Rials 198 million in terms of economic value. Replacement cost of 80 % of the initial investment cost is applied. The amount of Replacement Cost is a sum of Rials 2,687 million also in terms of economic value. The replacement cost will be needed for every 10 years after completion of the 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 Annex 28 and 29, and summarized as below:

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**Table 3.6   Summary of Economic Evaluation Result
for Golestan Forest Park Disaster Management Plan**

Evaluation Indicator	Under the Present Economic Condition	Under the 2025-Year Economic Condition
NPV	1,367	2,899
EIRR	7.21%	13.70%
B/C Ratio	1.67	2.42

(Note)

NPV is expressed by million Rials.

As shown in the above table, the resulted EIRR at present condition is lower than the applied discount rate of 10 % as 7.21 %, and that at 2025-Year condition are higher than 10 % as 13.70 %.

According to the World Bank[1], the discount rate reflects the rate of fall of the value of consumption over time. So, if the opportunity cost of capital (OCC) in the Golestan Forest Park Disaster Management Plan is assumed to be at 5 % from the viewpoint of basic human needs, it may say that the value of consumption at present will decrease year by year by this rate over the Project life.

Here, in case that the said OCC is applied as the said discount rate[2] of 5.00 %, it may be said that the above mentioned result of the economic evaluation under present condition is sound from the viewpoint of basic human needs.

On the other hand, the said result under 2025-year economic condition shows the Project has economic viability.

3.4.4   Sensitivity Analysis

The economic internal rate of return (EIRR) changes its value depending on the parameters employed for the calculation as mentioned in the previous clause. Out of these parameters, the construction cost of the Project and its benefit are the most important determinants of the economic analysis.

From the above viewpoint, a Sensitivity Test of EIRR of the Project at 2025-Year condition is made in 16 combination cases including base cases as (1) Cost: 10 % decrease, (2) Cost: base, (3) Cost: 10 % increase, and (4) Cost: 20 increase, and (5) Benefit: 10 % deacrease, (6) Benefit: base, (7) Benefit: 10 % increase and (8) Benefit: 20 increase.

Figure with table in the next page shows its result. In the most pessimistic case under the condition of the Cost: 20 % increase and the Benefit: 10 % decrease, the resulted EIRR is slightly lower than the applied discount rate of 10 % as 9.19 % as indicated in the above table.

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[1] William A. Ward and Barry J. Deren with Emannuel H. D'Silva, 1991 "*The Economics of Project Analysis –A Practitioner's Guide –*" EDI Technical Materials, the World Bank.

[2] –ditto–

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EIRR in	Benefit			
Each Case	-10 %	Base	+10 %	+20 %
-10 %	13.70%	15.44%	17.07%	18.60%
Base	12.01%	**13.70%**	15.27%	16.75%
+10 %	10.53%	12.17%	13.70%	15.13%
+20 %	9.19%	10.81%	12.30%	13.70%
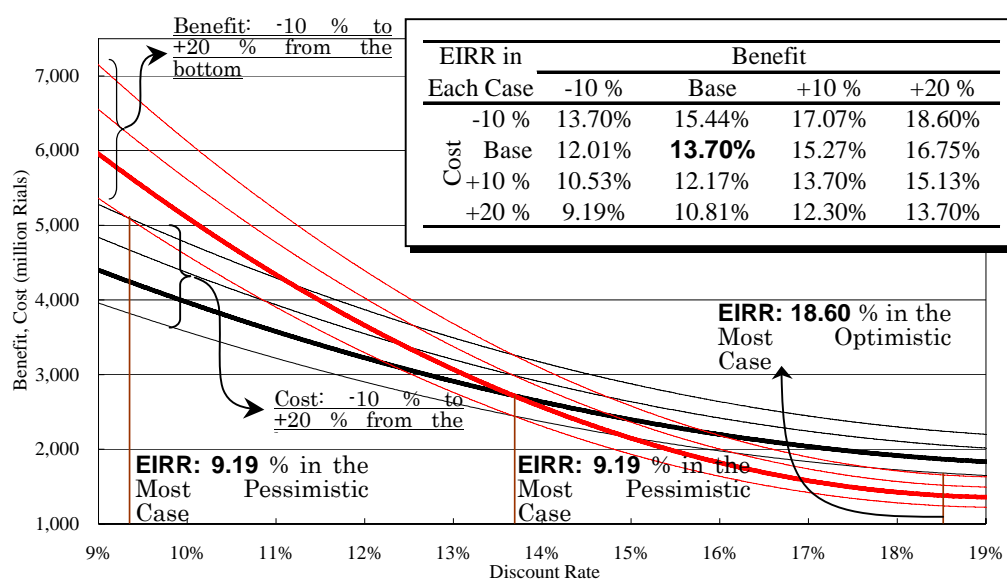
Figure 3.3   Sensitivity Analysis for Golestan Forest Park Disaster Management Plan

3.4.5   Conclusion

As a result, the EIRR of the Golestan Forest Park Disaster Management Plan including it's cost for operation and maintenance, and replacement for warning facilities is resulted at 13.70 % as the base case as shown in the above table, and it may say the Project has an economic feasibility. But, it makes clear that the Project is rather sensitive. In a case that the Benefit will decrease by 10 % together with 20 % increase of the Cost, the EIRRs result at 9.19 %, and it may not be said that the Project has an economic feasibility in those cases.

As mentioned above, it is suggested by such several international financing institutions as the World Bank that an EIRR should be kept at least 5 % for project formation from the viewpoint of basic human needs even such projects are not based on the commercial purposes. And the Project is a pure public works. From this viewpoint, the Project has cleared such hurdle of minimum EIRR with enough rooms. So the evaluation result shows the Project may be sound with the EIRR being high enough from the viewpoint of basic human needs even in the most pessimistic case.

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CHAPTER 4   FLOOD PREPAREDNESS PLAN

This component is as meaning as reading:

(1)   To establish a Flood Forecasting and Warning System,

(2)   To develop a suitable Criteria for Warning to be Announced,

(3)   To develop Hazard Maps,

(4)   To establish a System for Avoidance and/or Mitigation from or of damages of natural disasters as flood and/or debris flow for making smooth activities of evacuation from them based on the Flood Forecasting and Warning System above, Hazard Maps, and Disaster Risk Management Committees in villages located along the Madarsoo River and it's tributaries, and

(5)   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 be cleared 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.

Activities needed for avoiding and/or mitigating damages from natural disasters as floods and/or debris flow may be classified into 2 categories as (1) activities of villagers, and (2) activities of the Government consisting of the central Government and local governments including provinces.

4.1   Flood Forecasting and Warning System

If no any drastic measures are made, the 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 and/or pass through the Golestan Forest to make them do not enter into there when the flood likely occur.

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For this purpose, a systematic flood warning system is one of such measures. the component of the Golestan Forest Park Disaster Management Plan mentioned above is one of plans to establish a suitable Flood Forecasting and Warning System to save human life.

People passing through the Golestan Forest may be classified as (1) pure visitors to the Forest for camping and/or enjoying there, (2) passengers passing through the Forest to go a midland town of Mashad to visit a holly place of Emam Reza for lifting up their hearts, (3) passengers passing through the Forest to go Mashad for their businesses and (4) farmers and/or whole-sellers passing through the Forest to go to Mashad and/or Gorgan or other small cities and/or towns carrying agricultural products from the villages along the Madarsoo Rivers to visit markets there to sell their selling articles.

By one account, 2,000 cars are passing through the Golestan Forest daily. Among them, damages to human life for the people belonging to the classes of (1) through (3) above are already discussed in Clause 2 above for the Golestan Forest Park Disaster Management Plan. However, damages to commercial articles belong to class (4) could not make clear their scales in monetary terms because of lack of statistical data. Anyhow, once the road in the Forest closed by flood warning announcement and/or alarming, all the vehicles can not come enter the Forest.

If it is assumed that the commercial vehicles to carry the agricultural products to markets are 20 % of the total vehicles passing through, the number of commercial vehicles may be calculated at 400 cars per day.

If unit carrying capacity per car is assumed at one ton in average, around 400 tons of agricultural products should be dead stock. This is blood-and-guts matters for farmers. In other words, impertinent and/or non-systematic flood warning and/or alarming bring about serious damages to local economy.

Furthermore, one of factors to promote the Watershed Management Plan is a smooth access to markets because that the fruits, daily products and/or livestock products generated due to execute the Plan should be sold in the markets so that benefit can be returned.

From the above viewpoint, a systematic and reliable flood forecasting and warning system should be promoted to establish for entire villages, towns and cities based on the Golestan Forest Park Disaster Management Plan in this report.

4.2   Suitable Criteria for Warning to be Announced

Of course, the said Golestan Forest Park Disaster Management Plan includes criteria for warning to be announced expressed by certain rainfall. But, this is still temporary, and this criteria should be revised for the future for more making more reliable flood warning and/or alarming to prepare evacuation or to evacuate, so that people's confidence can be kept in the Government.

4.3   Development of Effective and Useful Hazard Maps

In this study, a study on a hazard map is made, and an actual hazard map is made for villagers. But this is also still temporary one because that hazardous area and/or points may be changeable in every floods occur. Most important matters are to find "how to develop" the hazard maps and to grasp by villagers themselves.

There may be 2 approaches to develop effective and/or useful hazard maps. Black spot area, namely flood hazardous area may be found out scientifically, but this is needed a time and fund. So, this approach should be taken by the Government. Once the hazard maps are made, those are immediately delivered to the villagers, so that they grasp the hazard points. The hazard map made in this study is a good example for this purpose. The Government prepared hazard maps should be made comprehensively from the viewpoint of entire villages locating along the Madarsoo River.

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The other approach is to develop by the villagers themselves. Pilot villages, Dasht and Terjernri Villages, are selected in this Study, and the JICA Team guides them to establish a Disaster Risk Management Committees. This is one of ideas.

Usually, the villagers better knows their territories where is hazardous and where is safe to evacuate. So, they can make their own hazard maps including evacuation points. From this viewpoint, the JICA Team guide them to make clear (1) usable properties like generators, vehicles, etc., (2) places of such usable properties so called as "Resource Mapping", (3) hazardous or risky places and safe places to evacuate with evacuation route both under the control of the said Committee as a part of "Disaster Risk Management Plan".

The Government should guide the villagers to develop such organizations to establish effective and useful their own hazard maps by themselves linking with the Government prepared hazard maps. So that, the villagers can grasp comprehensive concept for Disaster Risk Management.

4.4   Establish a System for Avoidance from and/or Mitigation of Damages of Natural Disasters

As mentioned above, the Pilot Villages are selected, and JICA Study Team guides them to select required several members for Disaster Risk Management Committees. And, also the Team guides them to make clear (1) roles of each member, (2) peace time activities, and (3) emergency activities when disaster occurs, and (4) purposes of and preparation for activities, (5) necessary goods and equipment to be procured newly and procurement methods including funding methodology, and (6) communication networks among the Committee members and, the members and the villagers.

Development of such a Disaster Risk Management Committee is one of ideas for avoidance from or mitigation of damages of natural disaster as floods and/or debris flow. The most important matters in developing such committees are to disseminate to whole the villages concerned, and to be linked with flood warning and/or alarming from the Government. One of ideas is recommended in a part of the Golestan Forest Park Disaster Management Plan from the comprehensive viewpoint of the villages locating along the Madarsoo River. So it should be referred to develop suitable systems.

4.5   Training and/or Education for Developing the Public Awareness

During the process of activities of Disaster Risk Management, to have a public awareness of villagers of all the villages locating along the Madarsoo River is a principal matter. People and children living in pilot villages are guided on importance of the Disaster Risk Management in meeting rooms and school by JICA Team in this study. These kind of education should be continuously executed for the future at least once a year.

Especially, basic concept and importance of the Disaster Risk Management should be included in curriculum of schools so that people will understand the Disaster Risk Management from their childhood. And then, they will be forward to participate in the activities for actual Disaster Risk Management.

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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:

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

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)

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[*] 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 rainging 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.

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

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

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.

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ANNEX 2   ESTIMATION OF BENEFIT EXPRESSED BY LAND VALUE FOR WATERSHED MANAGEMENT PLAN

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		
		Renge land			**Atriplex is the major crop** for breeding Livestocks.
Changing Dry Farming		Renge land	140	500	For Animal breeding. It means tha the productivity of meat will become higher. **Sheep, Goat and Cow are the major livestocks to breed.**
Fertilizing in Range Land	Mixing of moderate and steep slope	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	

After Execution of Watershed Management Plan

Total Non-Irrigated Farm Land
  Dasht-e-sheikh Area[1]   1,480   ha
  Ghiz Ghaleh Area[2]   305   ha

Total Range Land:
  Dasht-e-sheikh Area[3]   17,534   ha
  Ghiz Ghaleh Area[3]   6,350   ha

Total Benefit   Dasht-e-sheikh Area[1]   113,220,000   (1,000 Rials)
  Ghiz Ghaleh Area[2]   21,613,489   (1,000 Rials)

Total Benefit   Dasht-e-sheikh Area[3]   4,165   (1,000 Rials)
  Ghiz Ghaleh Area[3]   1,508   (1,000 Rials)

Grand Total Benefit:
  Dasht-e-sheikh Area   113,224,165   (1,000 Rials)
  Ghiz Ghaleh Area   21,614,997   (1,000 Rials)

(Note 1) See Annex 2 for detail calculation in Dasht-e-sheikh Area.
(Note 2) See Annex 3 for detail calculation in Ghiz Ghaleh Area.
(Note 3) See Annex 4 for detail calculation in both the Dasht-e-sheikh Area and the Ghiz Ghaleh Area.

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ANNEX 3   PRODUCTION OF FARM LAND GENERATED DUE TO COUNTER MEASURE AS TERRACING AND BANQUETTE IN WATERSHED MANAGEMENT PLAN FOR DASHT-E-SHEIKH AREA

(A) Terracing Area

Year in Order	Year in Christian Calender	Year in Iranian Calender	Dasht-e-sheikh Area	% in Invest-ment	Number of Trees to be Planted	1st Planting	2nd Planting	3rd Planting	4th Planting	5th Planting	6th Planting	7th Planting	8th Planting	Production Volume in Total (tons)	Income Amount Due to Sell Olive Harvested (Million Rials)
1	2005	1384	10,111	35.14%										0	0
2	2006	1385	3,460	12.03%	7,170									0	0
3	2007	1386	3,152	10.96%	2,453									0	0
4	2008	1387	3,848	13.38%	2,235									0	0
5	2009	1388	5,121	17.80%	2,729									0	0
6	2010	1389	2,717	9.44%	3,631									0	0
7	2011	1390	180	0.63%	1,927	71,695								72	323
8	2012	1391	180	0.63%	128	233,009	24,532							258	1,159
9	2013	1392		0.00%	128	394,323	79,729	22,349						496	2,234
10	2014	1393				555,637	134,926	72,633	27,288					790	3,557
11	2015	1394				716,951	190,124	122,918	88,687	36,314				1,155	5,197
12	2016	1395				716,951	245,321	173,203	150,086	118,020	19,266			1,423	6,403
13	2017	1396				716,951	245,321	223,488	211,485	199,726	62,615	1,278		1,661	7,474
14	2018	1397				716,951	245,321	223,488	272,884	281,432	105,965	4,153	1,278	1,851	8,332
15	2019	1398				716,951	245,321	223,488	272,884	363,138	149,314	7,028	4,153	1,982	8,920
16	2020	1399				716,951	245,321	223,488	272,884	363,138	192,663	9,903	7,028	2,031	9,141
17	2021	1400				716,951	245,321	223,488	272,884	363,138	192,663	12,778	9,903	2,037	9,167
18	2022	1401				716,951	245,321	223,488	272,884	363,138	192,663	12,778	12,778	2,040	9,180

(B) Banquette Area

Year in Order	Year in Christian Calender	Year in Iranian Calender	Dasht-e-sheikh Area	% in Invest-ment	Number of Trees to be Planted	1st Planting	2nd Planting	3rd Planting	4th Planting	5th Planting	6th Planting	7th Planting	8th Planting	Production Volume in Total (tons)	Income Amount Due to Sell Olive Harvested (Million Rials)	Total Amount of Income from Terracing and Banquet (Million Rials)	Execution Rate: 75% (Million Rials)
1	2005	1384	10,111	35.14%										0	0		
2	2006	1385	3,460	12.03%	81,254									0	0		
3	2007	1386	3,152	10.96%	27,803									0	0		
4	2008	1387	3,848	13.38%	25,329									0	0		
5	2009	1388	5,121	17.80%	30,927									0	0		
6	2010	1389	2,717	9.44%	41,156									0	0		
7	2011	1390	180	0.63%	21,835	812,545								813	3,656	3,979	2,984
8	2012	1391	180	0.63%	1,448	2,640,771	278,030							2,919	13,135	14,294	10,720
9	2013	1392		0.00%	1,448	4,468,996	903,598	253,286						5,626	25,316	27,550	20,663
10	2014	1393				6,297,222	1,529,166	823,179	309,268					8,959	40,315	43,872	32,904
11	2015	1394				8,125,448	2,154,734	1,393,072	1,005,121	411,556				13,090	58,905	64,102	48,077
12	2016	1395				8,125,448	2,780,302	1,962,965	1,700,974	1,337,558	218,351			16,126	72,565	78,968	59,226
13	2017	1396				8,125,448	2,780,302	2,532,859	2,396,827	2,263,560	709,642	14,482		18,823	84,704	92,178	69,133
14	2018	1397				8,125,448	2,780,302	2,532,859	3,092,680	3,189,562	1,200,932	47,066	14,482	20,983	94,425	102,757	77,067
15	2019	1398				8,125,448	2,780,302	2,532,859	3,092,680	4,115,564	1,692,222	79,650	47,066	22,466	101,096	110,016	82,512
16	2020	1399				8,125,448	2,780,302	2,532,859	3,092,680	4,115,564	2,183,513	112,234	79,650	23,022	103,600	112,741	84,556
17	2021	1400				8,125,448	2,780,302	2,532,859	3,092,680	4,115,564	2,183,513	144,817	112,234	23,087	103,893	113,060	84,795
18	2022	1401				8,125,448	2,780,302	2,532,859	3,092,680	4,115,564	2,183,513	144,817	144,817	23,120	104,040	113,220	84,915

(Note) Average Number of Trees to Planting: 170 trees/ha
Production: 10 kg/tree to be produced after 5 years.
23 kg/tree increase every year after 5 years to 10 years
Planned Terracing Area: 120 ha in Maximum according to MOJA
Planned Banquette Area: 1,360 ha in Maximum according to MOJA
Average Farm Gate Price: 4,500 Rials/kg

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ANNEX 4　PRODUCTION OF FARM LAND GENERATED DUE TO COUNTER MEASURE AS TERRACING AND BANQUETTE IN WATERSHED MANAGEMENT PLAN FOR GHIZ GALEY AREA

(A) Terracing Area

Year in Order	Year in Christian Calender	Year in Iranian Calender	Ghiz Galeh	% in Invest-ment	Number of Trees to be Planted	Production Volume (kg)								Production Volume in Total (tons)	Income Amount Due to Sell Olive Harvested (Million Rials)
						1st Planting	2nd Planting	3rd Planting	4th Planting	5th Planting	6th Planting	7th Planting	8th Planting		
1	2005	1384	8,373	29.10%										0	0
2	2006	1385	4,768	16.57%	6,185									0	0
3	2007	1386	7,338	25.51%	3,522									0	0
4	2008	1387	3,001	10.43%	5,420									0	0
5	2009	1388	3,223	11.20%	2,217									0	0
6	2010	1389	0	0.00%	2,285									0	0
7	2011	1390	0	0.00%	0	61,848								62	278
8	2012	1391	0	0.00%	0	201,005	35,215							236	1,063
9	2013	1392		0.00%	0	340,162	114,449	54,203						509	2,290
10	2014	1393				479,320	193,683	176,161	22,165					871	3,921
11	2015	1394				618,477	272,916	298,119	72,037	22,851				1,284	5,780
12	2016	1395				618,477	352,150	420,077	121,909	74,265				1,587	7,141
13	2017	1396				618,477	352,150	542,034	171,781	125,679				1,810	8,146
14	2018	1397				618,477	352,150	542,034	221,653	177,094				1,911	8,601
15	2019	1398				618,477	352,150	542,034	221,653	228,508				1,963	8,833
16	2020	1399				618,477	352,150	542,034	221,653	228,508				1,963	8,833
17	2021	1400				618,477	352,150	542,034	221,653	228,508				1,963	8,833
18	2022	1401				618,477	352,150	542,034	221,653	228,508				1,963	8,833

(B) Banquette Area

Year in Order	Year in Christian Calender	Year in Iranian Calender	Dasht-e-sheikh Area	% in Invest-ment	Number of Trees to be Planted	Production Volume (kg)								Production Volume in Total (tons)	Income Amount Due to Sell Olive Harvested (Million Rials)	Total Amount of Income from Terracing and Banquet (Million Rials)	Execution Rate: 75% (Million Rials)
						1st Planting	2nd Planting	3rd Planting	4th Planting	5th Planting	6th Planting	7th Planting	8th Planting				
1	2005	1384	8,373	29.10%										0	0		
2	2006	1385	4,768	16.57%	8,906									0	0		
3	2007	1386	7,338	25.51%	5,071									0	0		
4	2008	1387	3,001	10.43%	7,805									0	0		
5	2009	1388	3,223	11.20%	3,192									0	0		
6	2010	1389	0	0.00%	3,428									0	0		
7	2011	1390	0	0.00%	0	89,061								89	401	679	509
8	2012	1391	0	0.00%	0	289,447	50,710							340	1,531	2,594	1,945
9	2013	1392		0.00%	0	489,834	164,806	78,053						733	3,297	5,587	4,190
10	2014	1393				690,220	278,903	253,672	31,918					1,255	5,646	9,567	7,175
11	2015	1394				890,607	393,000	429,291	103,734	34,276				1,851	8,329	14,109	10,582
12	2016	1395				890,607	507,096	604,910	175,549	111,398				2,290	10,303	17,444	13,083
13	2017	1396				890,607	507,096	780,529	247,365	188,519				2,614	11,764	19,909	14,932
14	2018	1397				890,607	507,096	780,529	319,181	265,641				2,763	12,434	21,035	15,776
15	2019	1398				890,607	507,096	780,529	319,181	342,762				2,840	12,781	21,613	16,210
16	2020	1399				890,607	507,096	780,529	319,181	342,762				2,840	12,781	21,613	16,210
17	2021	1400				890,607	507,096	780,529	319,181	342,762				2,840	12,781	21,613	16,210
18	2022	1401				890,607	507,096	780,529	319,181	342,762				2,840	12,781	21,613	16,210

(Note) Average Number of Trees to Planting: 170 trees/ha
Production: 10 kg/tree to be produced after 5 years.
23 kg/tree increase every year after 5 years to 10 years
Planned Terracing Area: 125 ha in Maximum according to MOJA
Planned Banquest Area: 180 ha in Maximum according to MOJA
Average Farm Gate Price: 4,500 Rials/kg

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ANNEX 5   BASIC DATA/INFORMATION FOR ESTIMATION OF 2001-FLOOD DAMAGES AT DASHT VILLAGE

[I] Damages to Houses and Movables

1. Total number of Households:	330 HHs	4. Construction cost if it is newly constructed:	850,000 Rials/m^2
2. Average floor area of house:	90 m^2	5. Construction cost in total:	76,500,000 Rials/house
3. Number of houses destroyed:	270 houses	6. Damaged amount in total:	20,655,000,000 Rials
		7. Average area of garden:	200 m^2

8. Movables:

Personal Movables	Number of Movables in Total					
	Television	Radio	Refrigerator	Carpet	Closet	Oven/Cooking Heater
	1	1	1	1 set	1	1
Price/unit	2,000,000	500,000	2,000,000	1,000,000	2,000,000	1,500,000

7. Goods and Equipment

Belonging to:	Number of Goods and Equipment in Total					
	Tractor	Motor Cycle	Bycycle	Agricultural Goods and Tools (5% of the others)	Pick-up Car or Van Type Car	Other Type of Vehicles
Personal	25	70	25	Uncountble	5	10 Tracks
Village				×		
Price/unit	40,000,000	3,000,000	250,000	108,312,500	40,000,000	75,000,000

Other Agricultural Tools and Equipment (5 % of the avobe):

Land Value and Damages in Residential Area

Damege Rate:	82%	(=270/330)	
Reasidential Area:	440,000 m^2=	44 ha	
Land Value in Residential Area:		692,945	1,000 Rials/ha
Damages to Houses and Movables:		566,955	1,000 Rials/ha

Land Value and Damages in Agricultural Area

Damege Rate in Irrigated Area: 80% (according to the site information)
Damege Rate in Non-Irrigated Area:

		20%	(according to the site information)
Irrigated Area:		825	ha
Non-Irrigated Area:		1,500	ha
Land Value of Irrigated Area:		7,224	1,000 Rials/ha
Damages to Irrigated Area:		5,779	1,000 Rials/ha
Land Value of Non-Irrigated Area:		723	1,000 Rials/ha
Damages to Non-Irrigated Area:		145	1,000 Rials/ha

[III] Agricultural Products

Cereal/Grain

Products	Cultivated area (ha)	Harvested area (ha)	Production volume (tons/ha)	farm Gate Price (Rials/kg)	Income Due to Sell (Rials/ annum)	Farmers' Cost				
						Labor (Rials/ha)	Seed (Rials/ha)	Fertilizer (Rials/ha)	Irrigation water (Rials/ha)	Others (Rials/ha)
Irrigated Area										
Wheat	400	400	4.00	1,900	3,040,000,000	333,000	750,000	180,000	20,000	50,000
Barley	25	25	4.00	1,700	170,000,000	333,000	750,000	180,000	20,000	50,000
				Annual Income in Total:	3,210,000,000					
Non-Irrigated Area										
Wheat	300	300	1.25	1,900	712,500,000	333,000	750,000	180,000	20,000	50,000
				Annual Income in Total:	712,500,000					

(Note) (1) Labor for taking irrigation water is required Rials 1,000,000 per 3 ha.
(2) Fertilizer is needed at 300 kg per ha.
(3) Others includes an agricultural chemical as pesticide.

Damages to Livestocks

Damage Rate in Range Land:	30% (according to the site information)	
Area of Range Land:	1500	ha
Land Value of Range Land:	792	1,000 Rials/ha
Damages to Range Land incl. Livestock:	238	1,000 Rials/ha

Vegetable   Non to sell.

Flower

Products	Cultivated area (ha)	Harvested area (ha)	Production volume (tons/ha)	farm Gate Price (Rials/kg)	Income Due to Sell (Rials/ annum)	Farmers' Cost				
						Labor (Rials/ha)	Seed (Rials/ha)	Fertilizer (Rials/ha)	Irrigation water (Rials/ha)	Others (Rials/ha)
Irrigated Area										
Sun Flower	400	400	2.00	3,100	2,480,000,000	150,000	75,000	150,000 (1)	20,000	0
				Annual Income in Total:	2,480,000,000					
Non-Irrigated Area										
Sun Flower	400	400	0.30	3,100	372,000,000					
				Annual Income in Total:	372,000,000					

(Note) (1) Labor for taking irrigation water is required Rials 150,000 per ha.

Fruits/Trees   Before 2001-flood/debris flow.

Products	Cultivated area (ha)	Harvested area (ha)	Production volume (tons/ha)	farm Gate Price (Rials/kg)	Income Due to Sell (Rials/ annum)	Farmers' Cost				
						Labor (Rials/ha)	Seed (Rials/ha)	Fertilizer (Rials/ha)	Irrigation water (Rials/ha)	Others (Rials/ha)
Irrigated Area										
Peach	50	50	20.00	120	120,000,000					
Appricot	50	50	20.00	150	150,000,000	150,000	75,000	150,000 (1)	20,000	0
				Annual Income in Total:	270,000,000					

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ANNEX 6   ANNUAL AVERAGE FLOOD WITH DEBRIS FLOW DAMAGES (UNDER THE PRESENT CONDITION) WITHOUT PROJECT IN RESIDENTIAL AREA

Without Project in Residential Area

2005-price Level (Million Rials)

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages (Million Segment	Cummulative Damages (Million Rials)
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	3,402	1,701	1,361	1,361
10	0.1000	0.1000	7,484	5,443	544	1,905
25	0.0400	0.0600	12,927	10,205	612	2,517
50	0.0200	0.0200	14,968	13,947	279	2,796
100	0.0100	0.0100	17,009	15,988	160	2,956

ANNEX 7   ANNUAL AVERAGE FLOOD WITH DEBRIS FLOW DAMAGES (UNDER THE 2025 YEAR CONDITION) WITHOUT PROJECT IN RESIDENTIAL AREA

Without Project in Residential Area

2005-price Level (Million Rials)

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages (Million Segment	Cummulative Damages (Million Rials)
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	4,860	2,430	1,944	1,944
10	0.1000	0.1000	10,692	7,776	778	2,722
25	0.0400	0.0600	18,469	14,581	875	3,597
50	0.0200	0.0200	21,385	19,927	399	3,995
100	0.0100	0.0100	24,301	22,843	228	4,224

(Note) Increasing Rate of number of houses: 1.4   Based on the Population Projection.

ANNEX 8   ANNUAL AVERAGE FLOOD WITH DEBRIS FLOW DAMAGES (UNDER THE PRESENT CONDITION) WITH WMP IN RESIDENTIAL AREA

With WMP in Residential Area

2005-price Level (Million Rials)

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages (Million Segment	Cummulative Damages (Million Rials)
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	3,402	1,701	1,361	1,361
10	0.1000	0.1000	7,484	5,443	544	1,905
25	0.0400	0.0600	12,246	9,865	592	2,497
50	0.0200	0.0200	14,287	13,267	265	2,762
100	0.0100	0.0100	16,328	15,308	153	2,915

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ANNEX 9 ANNUAL AVERAGE FLOOD WITH DEBRIS FLOW DAMAGES (UNDER THE 2025 YEAR CONDITION) WITH WMP IN RESIDENTIAL AREA

With WMP in Residential Area

2005-price Level (Million Rials)

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages (Million Segment	Cummulative Damages (Million Rials)
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	4,860	2,430	1,944	1,944
10	0.1000	0.1000	10,692	7,776	778	2,722
25	0.0400	0.0600	17,497	14,095	846	3,567
50	0.0200	0.0200	20,413	18,955	379	3,946
100	0.0100	0.0100	23,329	21,871	219	4,165

(Note) Increasing Rate of number of houses: 1.4 Based on the Population Projection.

ANNEX 10 ANNUAL AVERAGE FLOOD WITH DEBRIS FLOW DAMAGES (UNDER THE PRESENT CONDITION) WITH WMP + SCD IN RESIDENTIAL AREA

With WMP+SCD in Residential Area

2005-price Level (Million Rials)

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages (Million Segment	Cummulative Damages (Million Rials)
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	0	0	0	0
10	0.1000	0.1000	0	0	0	0
25	0.0400	0.0600	0	0	0	0
50	0.0200	0.0200	0	0	0	0
100	0.0100	0.0100	0	0	0	0

SCD= Sediment Control Dam

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ANNEX 11 ANNUAL AVERAGE FLOOD WITH DEBRIS FLOW DAMAGES (UNDER THE 2025 YEAR CONDITION) WITH WMP + SCD IN RESIDENTIAL AREA

With WMP+SCD in Residential Area

2005-price Level (Million Rials)

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages (Million Segment	Cummulative Damages (Million Rials)
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	0	0	0	0
10	0.1000	0.1000	0	0	0	0
25	0.0400	0.0600	0	0	0	0
50	0.0200	0.0200	0	0	0	0
100	0.0100	0.0100	0	0	0	0

(Note) Increasing Rate of number of houses: 1.4 Based on the Population Projection.

ANNEX 12 ANNUAL AVERAGE EROSION DAMAGES (UNDER THE PRESENT CONDITION) WITHOUT PROJECT IN AGRICULTURAL AREA AT THE UPSTREAM OF MADARSOO RIVER

Without Project in Agricultural Area at the Upstream of Madarsoo River

2005-price Level (Million

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages Segment	Cummulative Damages (Million
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	4	2	1	1
10	0.1000	0.1000	14	9	1	2
25	0.0400	0.0600	22	18	1	3
50	0.0200	0.0200	54	38	1	4
100	0.0100	0.0100	145	100	1	5

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ANNEX 13   ANNUAL AVERAGE EROSION DAMAGES (UNDER THE 2025 YEAR CONDITION) WITHOUT PROJECT IN AGRICULTURAL AREA AT THE UPSTREAM OF MADARSOO RIVER

Without Project in Agricultural Area at the Upstream of Madarsoo River

2005-price Level (Million)

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages (Million Segment)	Cummulative Damages (Million Rials)
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	7	4	3	3
10	0.1000	0.1000	28	18	2	5
25	0.0400	0.0600	44	36	2	7
50	0.0200	0.0200	107	76	2	8
100	0.0100	0.0100	291	199	2	10

(Note)   Increasing Rate of productivity: 2.0   times. Based on the improvement of farmers' intensity.

ANNEX 14   ANNUAL AVERAGE EROSION DAMAGES (UNDER THE PRESENT CONDITION) WITH ECD

With ECD

2005-price Level (Million Rials)

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages Segment	Cummulative Damages (Million
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	0	0	0	0
10	0.1000	0.1000	0	0	0	0
25	0.0400	0.0600	0	0	0	0
50	0.0200	0.0200	0	0	0	0
100	0.0100	0.0100	0	0	0	0

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ANNEX 15 ANNUAL AVERAGE EROSION DAMAGES (UNDER THE 2025 YEAR CONDITION) WITH ECD

2005-price Level
(Million Rials)

With ECD

Return Period (Year)	Exceedance	Difference of Exceedance	Damages (Million Rials)		Damages (Million Segment)	Cummulative Damages (Million Rials)
			Amount	Mean		
1	1.0000	-	0	0	0	0
5	0.2000	0.8000	0	0	0	0
10	0.1000	0.1000	0	0	0	0
25	0.0400	0.0600	0	0	0	0
50	0.0200	0.0200	0	0	0	0
100	0.0100	0.0100	0	0	0	0

(Note) Increasing Rate of productivity: 2.0 times. Based on the improvement of farmers' intensity.

ANNEX 16 CALCULATION OF STANDARD CONVERSION FACTOR (SCF)

Several Conversion Rates

Income Tax for Labor:		**10%**	
Corporation Income Tax:		**5%**	
Type-1	Salary Base Contract	16.67%	For insurance.
		5.00%	For tax.
Type-2	The Case that Goods and Equipment needed is prepared by the Contractor.	7.67%	For insurance.
		5.00%	For tax.
Type-3	Price List Base	1.67%	For insurance by the Contractor.
		5.00%	For insurance by the Government.
		5.00%	For tax.

Shadow Price of Land (Agricultural Area): **0.18061** Based on the land price of irrigated agricultural area and productivity of such land in Dasht Village reported by the Inventry Survey made by JICA Study Team and the additional information gotten from the site survey by the Team.

(Unit: billion Rials)

Year	Import Amount	Export Amount	Import Duties (Custom Duties)	Export Tax	Export Subsidies
2000	22,202	28,102	8,120	0	0
2001	25,179	31,783	11,888	0	0
2002	30,935	38,348	16,967	0	0
2003	172,894	209,267	32,463	0	0
2004	210,654	257,954	35,809	0	0
Total	461,864	565,454	105,247	0	0

Source: Iran Statistical Year Book 1382 (March 2003 - March 2004).   SCF = 0.90707

Note: $SCF = \dfrac{I \quad E}{(I \quad I_{customs})(E \quad E_{tax} \quad E_{subsidy})}$

Where, SCF = standard conversion factor,
I = import amount,
E = export amount
$I_{customs}$ = import duties (custom duties)
E_{tax} = export tax, and
$E_{subsidy}$ = export subsidies.

Shadow Wage Rate for Labor: **0.65263**
(Note-1) Average amount of wage for labor: 1,220,000 Rials/month for the month of 30 days
1,260,000 Rials/month for the month of 31 days
1,240,000 Average according to an Accountant of MOJA.

Income tax: until 1,900,000 Free of tax for this minimum wage level.

More than 1,900,000 Rials/m for example: 2,000,000 As income tax, 10 % of difference between higher amount and minimum wage being tax exempted above.

(Note-2) 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. Therefore, the shadow wage rate of 0.65263 (=1,240,000/1,900,000) is applied for the Project assuming that the Project follow the said Law.

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ANNEX 17　LAND PRICE AND PROPERTIES OF FARMERS

Village	Land Price (Rials/ha)			Average Construct-ion Cost of House (Rials/m²)	Average Floor Area of Resident-ial House (m²)	Income Level per Household (Rials/month)			Typical Movables (Rials)						
	Resident-ial Area (Rials/m²)	Irrigated Area (Rials/ha)	Non-Irrigated Area (Rials/ha)			Minimum Income Level	Maximum Income Level	Simple Average Income Level	Television Set incl. Radio and/or Casset Recorder	Carpet/ Rug	Refri-gerator	Agricult-ural Equipment and Tools incl. Vehicles	Livestock and Poultry	Agricult-ural Stock for Selling and/or for Seedling
1. Garkaz	120,000	80,000,000	30,000,000	150,000	100.00	200,000	1,000,000	600,000	800,000	1,000,000	1,000,000	0	0	1,500,000
2. Khoojeh Lar	20,000	40,000,000	25,000,000	160,000	100.00	800,000	1,500,000	1,150,000	0	0	0	0	0	0
3. Kongour	100,000	80,000,000		800,000	100.00	300,000	3,000,000	1,650,000	0	0	0	0	0	some
4. Gherghiz	200,000	50,000,000	20,000,000	400,000	100.00	300,000	5,000,000	2,650,000	1,200,000	2,000,000	1,500,000	0	0	some
5. Sad-e-Chamram	100,000	60,000,000	30,000,000	700,000	100.00	300,000	1,000,000	650,000	2,000,000	1,200,000	1,500,000	0	0	6,900,000
6. Shahrak-e Jomhuri	100,000	70,000,000	40,000,000	700,000	100.00	500,000	1,000,000	750,000	1,400,000	0	1,300,000	0	0	0
7. Barbar Ghale	60,000	75,000,000	35,000,000	800,000	100.00	400,000	1,250,000	825,000	1,000,000	1,000,000	1,800,000	0	0	1,750,000
8. Haji Ali Eslami	30,000	80,000,000	40,000,000	500,000	100.00	300,000	1,600,000	950,000	2,000,000	1,200,000	1,500,000	0	0	some
9. Kooseh	200,000		80,000,000	500,000	80.00	500,000	800,000	650,000	1,680,000	1,000,000	1,800,000	0	5,000,000	some
10. Gilan Tappeh	80,000	120,000,000		800,000	100.00	600,000	1,250,000	925,000	1,300,000	1,000,000	1,200,000	0	0	0
11. Gharavol Haj Taji	100,000	100,000,000	50,000,000	600,000	100.00	500,000	1,200,000	850,000	800,000	1,200,000	1,000,000	0	0	some
12. Chegher Shir Melli	100,000	100,000,000	70,000,000	600,000	100.00	500,000	500,000	500,000	2,000,000	1,000,000	1,500,000	0	1,200,000	some
13. Ajan Shir Melli	50,000	80,000,000	60,000,000	400,000	125.00	500,000	2,000,000	1,250,000	0	0	0	0	0	some
14. Ajan Ghareh Khoja	25,000	100,000,000	50,000,000	800,000	62.50	500,000	1,000,000	750,000	1,000,000	500,000	0	0	2,500,000	0
15. Ghanjigh Shahrak	50,000	50,000,000	30,000,000	500,000	100.00	800,000	1,000,000	900,000	1,600,000	1,000,000	1,500,000	0	0	0
16. Darabad	100,000	100,000,000	80,000,000	800,000	100.00	200,000	1,200,000	700,000	1,500,000	0	1,000,000	20,000,000	500,000	0
17. Manjeloo	15,000		20,000,000	600,000	100.00	300,000	500,000	400,000	1,500,000	1,000,000	2,000,000	0	0	0
18. Koorang Kaftar	30,000	60,000,000	30,000,000	800,000	100.00	200,000	1,000,000	600,000	1,000,000	500,000	1,000,000	0	0	some
19. Agh Ghamish	50,000	90,000,000	40,000,000	800,000	100.00	500,000	1,200,000	850,000	1,250,000	1,200,000	1,000,000	0	0	11,550,000
20. Loveh		80,000,000	20,000,000	1,000,000	100.00	600,000	1,200,000	900,000	2,000,000	1,000,000	1,300,000	0	1,000,000	0
21. Saleh Abad	200,000	50,000,000	30,000,000	500,000	80.00	450,000	3,000,000	1,725,000	1,000,000	700,000	1,500,000	0	0	0
22. Googel Bozorg	50,000	100,000,000	70,000,000	1,000,000	100.00	500,000	1,500,000	1,000,000	1,500,000	1,200,000	1,500,000	0	1,500,000	18,000
23. Beshli	40,000	100,000,000	50,000,000	1,000,000	70.00	500,000	1,250,000	875,000	1,700,000	0	1,200,000	50,000,000	0	5,100,000
24. Tarjenli	70,000	80,000,000	50,000,000	1,000,000	80.00	400,000	2,000,000	1,200,000	2,500,000	0	2,500,000	0	5,700,000	13,700
25. Tangrah	125,000	60,000,000	50,000,000	500,000	100.00	500,000	1,500,000	1,000,000	2,500,000	1,500,000	2,500,000	0	0	1,250,000
26. Dasht	60,000	40,000,000	4,000,000	850,000	100.00	650,000	1,800,000	1,225,000	1,500,000	800,000	1,500,000	0	0	0
27. Cheshmeh Khan	20,000	20,000,000	15,000,000	500,000	100.00	1,000,000	5,000,000	3,000,000	0	0	0	0	4,300,000	0
28. Nardin	225,000	35,000,000	18,000,000	500,000	100.00	500,000	1,600,000	1,050,000	0	0	0	0	7,400,000	0
29. Dashteh Shadeh Kalpoush	100,000		7,500,000	600,000	100.00	750,000	1,000,000	875,000	0	0	0	0	3,950,000	0
30. Dahaneh	10,000	20,000,000	15,000,000	400,000	100.00	350,000	1,500,000	925,000	0	0	0	0	0	0

Source: "The Social Awareness and Inventry Survey" made by Centre for Sustainable Development (CENESTA) ordered out by JICA Study Team, May 2005.

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ANNEX 18 ESTIMATION OF ECONOMIC COST FOR RIVER RESTORATION PLAN (FOR WATERSHED MANAGEMENT WORKS + SEDIMENT CONTROL DAM + EROSION CONTROL DAM)

(Million Rials)

Item	Total Cost	Disbursement							
		2007	2008	2009	2,010	2011	2012	2013	2014
Construction Cost	72,821	18,484	8,227	16,395	13,954	12,684	2,717	180	180
Watershed Management Works	55,471	18,484	8,227	10,490	6,849	8,344	2,717	180	180
Dasht-e-Shyikh Area	28,769	10,111	3,460	3,152	3,848	5,121	2,717	180	180
Ghiz Ghaleh Area	26,702	8,373	4,768	7,338	3,001	3,223	0	0	0
Riverbank Stabilization Works	8,611	0	0	2,497	4,133	1,981	0	0	0
Construction of Erosion Control Dam	8,611	0	0	2,497	4,133	1,981	0	0	0
Sediment Control Dam Works	8,739	0	0	3,408	2,971	2,360	0	0	0
Construction of Sediment Control Dam	8,739	0	0	3,408	2,971	2,360	0	0	0
Land Acquisition Cost	0	0	0	0	0	0	0	0	0
Administration Cost	868	0	0	295	356	217	0	0	0
Engineering Cost	1,735	607	347	260	260	260	0	0	0
Physical Contingency	3,991	200	120	1,277	1,517	878	0	0	0
Financial Cost in Total	79,415	19,291	8,694	18,228	16,086	14,039	2,717	180	180
Economic Cost Converted	68,860	17,414	7,843	15,467	13,335	12,022	2,453	163	163

(Note)

Administration Cost:	5%	of the Construction Cost.
Engineering Cost:	10%	of the Construction Cost.
Physical Contingency:	20%	of the whole cost from construction cost to engineering cost.
Share Rate of Labor to Construction Cost:	40%	to the Construction Cost.
Standard Conversion Factor (SCF):	0.9071	
Income Tax for Labor:	10%	According to Personal Income Law.
Foreign Portion of Equipment:	80%	of the equipment cost in total.
Import Tax of equipment:	15%	based on the similar project in developing countries (assumed).
Value Added Tax (VAT):	10%	for domestically procured equipment (assumed).
Corporation Income Tax:	5%	According to Corporation Income Law.
Shadow Price of Land (Agricultural Area):	0.1806	
Shadow Wage Rate for Labor:	0.6526	
	0.8671	

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ANNEX 19 CALCULATION OF ECONOMIC INTERNAL RATE OF RETURN (EIRR) FOR RIVER RESTORATION PLAN (EXECUTION OF WATERSHED MANAGEMENT WORKS + SEDIMENT CONTROL WORKS + EROSION CONTROL WORKS) (AT PRESENT ECONOMIC CONDITION IN CASE OF EXECUTION RATE OF WATERSHED MANAGEMENT PLAN OF 75 %)

			Cost for Watershed Management Plan + Debris Flow Control Plan			Benefit							
						Damages to Residential Area incl. Public Facilities			Benefit Derived From Watershed Management Plan				
									Farm Land		Range Land		
Year in Order	Year in Christian Calender	Year in Iranian Calender	Direct Cost	OM Cost	Total Cost	Watershed Management Works (Residential Area)	Sediment Control Dam	Erosion Control Dam	Dasht-e-Sheikh Area 25%	Ghiz Ghaleh Area 33%	Dasht-e-Sheikh Area 25%	Ghiz Ghaleh Area 33%	Total
1	2005	1384	0	0	0	0	0	0	0	0	0	0	0
2	2006	1385	0	0	0	0	0	0	0	0	0	0	0
3	2007	1386	17,414	0	17,414	0	0	0	0	0	0	0	0
4	2008	1387	7,843	501	8,344	0	0	0	0	0	274	118	393
5	2009	1388	15,467	723	16,190	0	0	0	0	0	368	186	554
6	2010	1389	13,335	1,007	14,343	0	0	0	0	0	454	289	743
7	2011	1390	12,022	1,193	13,215	0	0	0	746	170	558	332	1,806
8	2012	1391	2,453	1,506	3,958	41	2,915	5	2,680	648	697	377	7,364
9	2013	1392	163	1,666	1,829	41	2,915	5	5,166	1,397	702	377	10,603
10	2014	1393	163	1,758	1,920	41	2,915	5	8,226	2,392	707	377	14,663
11	2015	1394	0	1,849	1,849	41	2,915	5	12,019	3,527	707	377	19,592
12	2016	1395	0	1,936	1,936	41	2,915	5	14,807	4,361	707	377	23,213
13	2017	1396		1,936	1,936	41	2,915	5	17,283	4,977	707	377	26,306
14	2018	1397		1,936	1,936	41	2,915	5	19,267	5,259	707	377	28,571
15	2019	1398		1,936	1,936	41	2,915	5	20,628	5,403	707	377	30,077
16	2020	1399		1,936	1,936	41	2,915	5	21,139	5,403	707	377	30,588
17	2021	1400		1,936	1,936	41	2,915	5	21,199	5,403	707	377	30,648
18	2022	1401		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
19	2023	1402		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
20	2024	1403		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
21	2025	1404		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
22	2026	1405		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
23	2027	1406		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
24	2028	1407		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
25	2029	1408		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
26	2030	1409		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
27	2031	1410		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
28	2032	1411		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
29	2033	1412		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
30	2034	1413		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
31	2035	1414		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
32	2036	1415		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
33	2037	1416		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
34	2038	1417		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
35	2039	1418		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
36	2040	1419		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
37	2041	1420		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
38	2042	1421		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
39	2043	1422		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
40	2044	1423		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
41	2045	1424		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
42	2046	1425		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
43	2047	1426		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
44	2048	1427		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
45	2049	1428		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
46	2050	1429		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
47	2051	1430		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
48	2052	1431		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
49	2053	1432		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
50	2054	1433		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
51	2055	1434		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
52	2056	1435		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
53	2057	1436		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
54	2058	1437		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678
55	2059	1438		1,936	1,936	41	2,915	5	21,229	5,403	707	377	30,678