(1) Secondary Canals: 81 Routes, Total Length 594.22 km

1) Canals

District	(No. of routes)	Total Length (km)
Haraz West	(14)	101.15
Haraz East	(34)	206.90
Amol West	(16)	127.62
Amol East	(17)	158.55
Total	(81)	594.22

2) Major Canal Related Facilities

(a) Turnout (2nd → 3rd): 287 places
(b) Check : 127 places
(c) Drop : 751 places
(d) Check and Drop : 71 places
(e) Junction : 405 places

(2) Tertiary Canals: 391 Routes, Total Length 1,196.66 km

1) Canals

District	(No. of routes)	Total Length (km)
Haraz West	(65)	175.85
Haraz East	(123)	368.85
Amol West	(97)	305.25
Amol East	(106)	346.71
Total	(391)	1,196.66

2) Major Canal Related Facilities

(a) Turnout (3rd → 4th) : 814 places
(b) Drop : 1,190 places
(c) Check and Drop : 814 places

(3) Abbandan Improvement: 200 places, Total Excavation 18.2 MCM

(4) River Improvement

1) Alesh River : L = 9.9 km, Qd (Design Discharge) = 221-234 m^3/s,
   Flood Protection Levee L = 10.0 km,
2) Babol River : L = 2.0 km, Qd = 664 m^3/s
3) Kari Rud : L = 4.6 km, Qd = 130 m^3/s

(5) Kari Rud Floodway: 1 route, L = 1.5 km, Qd = 80 m^3/s

(6) River Mouth Improvement: 1 place,
Method: Groin & Training Jetty

TABLE 5.3-1 CANAL LENGTH

Districts	Canals	New Canals	Rehabilitation Canal	Total
		(km)	(km)	(km)
Whole Area	Main I. Canals	50.1	10.0	60.1
〃	Main Drains	41.6	9.3	50.9
Sub-Total		91.7	19.3	111.0
Haraz West	Secondary I. Canals	18.4	10.0	28.4
	Secondary I-C-D Canals	-	30.2	30.2
	Secondary D. Canals	9.4	33.3	42.7
	Tertiary I. Canals	30.9	60.2	91.1
	Tertiary D. Canals	47.6	37.3	84.9
Sub-total		106.3	171.0	177.3
Haraz East	Secondary I. Canals	17.0	56.8	73.8
	Secondary I-C-D Canals	1.3	53.9	55.2
	Secondary D. Canals	42.7	35.3	78.0
	Tertiary I. Canals	40.6	197.0	237.6
	Tertiary D. Canals	59.8	46.7	106.5
Sub-Total		161.4	389.7	551.1
Amol West	Secondary I. Canals	21.2	35.0	56.2
	Secondary I-C-D Canals	1.1	1.7	2.8
	Secondary D. Canals	36.7	31.1	67.8
	Tertiary I. Canals	46.0	115.9	161.9
	Tertiary D. Canals	66.2	77.3	143.5
Sub-Total		171.2	261.0	432.2
Amol East	Secondary I. Canals	15.8	34.3	50.1
	Secondary I-C-D Canals	5.7	42.1	47.8
	Secondary D. Canals	24.6	36.2	60.8
	Tertiary I. Canals	62.2	142.6	204.8
	Tertiary D. Canals	69.2	72.8	142.0
Sub-total		177.5	328.0	505.5
Whole Project Area	Main I. Canals	50.1	10.0	60.1
	Main Drains	41.6	9.3	50.9
	Secondary I. Canals	72.4	136.1	208.5
	Secondary I-C-D Canals	8.1	127.9	136.0
	Secondary D. Canals	113.6	135.9	249.5
	Tertiary I. Canals	179.7	515.7	695.4
	Tertiary D. Canals	242.8	234.1	476.9
Total		708.3	1,169.0	1,877.3

(Note) I. Canals: Irrigation Canals, D. Canals: Drainage Canals,
I-C-D Canals: Irrigation-cum-Drainage Canals

5. 4 On-farm Facilities

5. 4. 1 Land Consolidation Criteria and Area Application

The area application of the on-farm development is carried out over the entire Project Area based on the manners, the selection of on-farm improvement level and the application criteria of type-A & B improvement, described in the para. 4. 5. 3 "Application of Land Consolidation Criteria". The results are shown in the following table (for the zone-wise results, refer to Table 5.4-1).

With regard to the selection of on-farm improvement level, the type-A improvement is planned for the 85% of the total proposed paddy field area, and the type-B is for the rest of 15% which are located around the top of the Haraz river basin and the Caspian Sea coastal areas. As for the application of the type-A improvement, 12%, 18% and 55% of the total proposed paddy field area fall under the much, middle and less sloped land type respectively. On the other hand, as for the type-B application, 4% and 11% of the total proposed paddy field area fall under the high and the low land type respectively. (for area application map, refer to Figure 5.4-1)

(Unit: ha)

District	Type-A				Type-B			Grand Total
	T-A1	T-A2	T-A3	Sum	T-B1	T-B2	Sum	
Haraz West	2,400	5,000	1,800	9,200	1,500	0	1,500	10,700
Haraz East	6,100	6,600	9,900	22,600	1,400	0	1,400	24,000
Amol West	300	700	14,000	15,000	0	2,500	2,500	17,500
Amol East	200	1,500	15,900	17,600	0	6,200	6,200	23,800
Total	9,000	13,800	41,600	64,400	2,900	8,700	11,600	76,000
(%)	(12)	(18)	(55)	(85)	(4)	(11)	(15)	(100)

Note) 1. Type-A improvement types: T-A1 (much sloped land), T-A2 (middle sloped land), T-A3 (less sloped land),
Type-B improvement types: T-B1 (high land), T-B2 (low land)
2. Above figures are the aggregates of proposed net paddy field areas which were estimated taking account of 5% land reduction ratio.

5. 4. 2 On-farm Facilities of Sample Design Areas

(1) Salient Features of On-farm Facilities

The salient features of the major on-farm facilities are described herein. These are common features of each sample design area.

1) Farm Road

Two kinds of farm roads, main and lateral farm roads, are planned in the design as follows:

- Main Farm Roads

  These are trunk farm roads which connect villages, villages with farmlands, etc. The effective width is designed to be 3.7 m expecting pick-up trucks to pass each other. The total width is designed at 4.5 m. The pavement is designed as gravel.

- Lateral Farm Roads

  These are farm roads which connect main farm roads with field-lots, etc. The effective width is designed to be 3.5 m expecting combines to pass through. The total width is designed at 4.0 m. The pavement is designed as gravel.

2) Terminal Irrigation Ditch

Terminal irrigation ditches are classified into lateral irrigation ditches and irrigation ditches, and a separate ditch system from drainage is adopted in principle.

- Irrigation Ditches

  These are branching off from a lateral irrigation ditch or a tertiary canal, and commanding field-lots and field-blocks. Structure is an earth ditch (bottom-width 0.3 m, depth 0.3 m, side slope 1 : 1.0)

- Lateral Irrigation Ditches

  These are diverted from a tertiary canal principally, and commanding farm-blocks, etc. Structure is an earth ditch.

3) Terminal Drainage Ditch

Terminal drainage ditches are classified into lateral drainage ditches and drainage ditches, and a separate ditch system from irrigation is adopted in principle.

- Drainage Ditches

  These drain water from field-lots and field-blocks into lateral drainage ditches or tertiary canals. The planning magnitude is 10-year return period. Ditch type is earthen. The following two section types are planned considering the ditch functions:

  Shallow type: The depth of this type is about 60 cm from the field surface so as to drain only field surface water. This type is planned in those paddy fields where the groundwater table is low throughout the year.

  Deep type: In the paddy fields of high groundwater table (within the bounds of possibility of less than 1.0 m), the ditches are deep, about 1.0 m below the field surfaces, for the surface and subsurface drainage.

- Lateral Drainage Ditches

  These drain water from farm-blocks into tertiary canals in principle. The section and function of these ditches are the same as the drainage ditches. However, in the tile drainage areas, the depth of the lateral drainage ditches is designed to be about 1.5 m from the field surface.

4) Farmland System

The present field plots are to be utilized in the type-B improvement. As for the type-A improvement, the reshaping of present plots is planned, and the following land system is to be introduced:

Field-lots; Field-lots are the smallest unit of farmland. The standard long side length is 100 m considering the water management and the working efficiency of farm machinery. As for the short side length, 30 m to 60 m is deemed as a standard from the viewpoint of land slopes and the machinery working efficiency. Consequently, the size of a field-lot is planned to be 30 a to 60 a.

Field-blocks; These are bordered by drainage ditches and farm roads principally. The standard short side length is 100 m, the same as the long side length of the field-lots. The maximum length of long side is about 600 m which is also the maximum length of the irrigation and drainage ditches. Therefore, the area of a field-block is less than 6 ha.

Farm-blocks; As the standard, one farm-block consists of two field-blocks extending along both sides of the drainage ditches. Thus, the area of a farm-block becomes 12 ha at maximum.

(2) Scales of On-farm Facilities

The designs of the type-A & B improvement are carried out on the sample areas. The scales of the designed on-farm facilities are as follows:

1) Type-A Improvement

The preliminary designs are carried out on the following 6 sample areas:

(unit: Item 1-3: ha, Items 4-6: m/ha)

Item	High Land		Middle Land		Low Land	
	Cateposht	Ejbarkola	Eslamabad	Darzikola	MoallemKola	Suteh
1. Total area	85.0	100.1	63.0	97.0	125.7	124.4
2. Facility	6.5	8.3	5.7	7.3	9.5	9.1
3. Paddy	78.5	91.8	57.3	89.7	116.2	115.3
4. Farm road	83.4	87.9	91.5	66.8	74.5	64.7
5. Ditch (Irrig.)	129.8	133.3	113.5	120.0	109.7	117.5
6. Ditch (Drain.)	64.9	83.4	78.6	75.9	72.0	72.8

Note: Densities = (Total length)/(1. Total area).

2) Type-B Improvement

The Preliminary designs for type-B improvement are carried out on the following 2 sample areas:

Item	High Land	Low Land
	Ejibar Kola	Suteh
1. total Area	100.1	124.4
2. Facility	11.0	12.3
3. Paddy	89.1	112.1
4. Farm Road	120.2	97.8
5. Ditch (Irrig.)	132.8	119.5
6. Ditch (Drain.)	110.4	97.2

(Unit: Item 1-3: ha, Items 4-6: m/ha)

Note) Densities = (Total length)/(1. Total area)

5.4.3 On-farm Facilities of the Project Area

The major on-farm facilities of the entire Project Area are arranged based on the aforementioned area application of improvement types and on-farm facilities of sample design areas, and the results are tabulated in the following table. In the table, the densities of farm roads and ditches are of area-wide weighted average figures. Also, these densities are computed on the basis of the proposed net paddy field areas.

District	Farm Road	Ditch (Irrig.)	Ditch (Drain.)	Proposed Paddy Field
	(m/ha)	(m/ha)	(m/ha)	(ha)
1. Haraz West	91.4	133.4	87.9	10,680
2. Haraz East	85.5	130.8	83.2	24,005
3. Amol West	80.5	124.6	82.7	17,463
4. Amol East	84.5	125.7	86.3	23,837
5. Project Area	84.9	128.2	84.7	75,985

Note) Proposed paddy field: The land reduction ratio of 5% is applied on the entire Project Area.

5.4.4 Land Collection and Land Reduction Ratio

(1) Land Collection

The average land holding size of the Project Area is about 1.5 ha, and paddy fields are dominant. On the other hand, the typical size of one plot is around 0.3 ha at present. In balance, the number of paddy plots held by one farm household is estimated to be about 5 places at present. However, it is rather collective due to the conditions of land scattering.

As for the degree of land collection under the land consolidation, it should be determined considering the differences of land conditions, farm management plan, farm mechanization plan, and land repotting plan, and so on. Although there are differences area by area, around 2 to 3 places of land collection are intended for this study.

(2) Land Reduction Ratio with Land Consolidation

The general plans of the sample design areas are prepared using the surveyed topographic maps (1: 1,000 scale), and the land reduction ratios with land consolidation are computed on these areas based on the measured facilities and paddy fields areas. The results are indicated in the following tables.

As mentioned in the area application of improvement types, the type-B improvement is planned on the minor areas, such as around the top of the project area and the Caspian Sea coastal areas. The average ratio of these areas is about 8%. On the other hand, the rest of the major areas are to be improved by type-A, and the average ratio is expected to be about 5%.

In balance, the land reduction ratio of 5% is applied to the land use plan of the project.

(a) Land Reduction Ratios of Type-A Improvement

Items	High Land		Middle Land		Low Land		Weighted
	Kateposht	Ejibar Kola	Eslamabad	Darzi Kola	Moallem Kola	Suteh	Average
1. Present Paddy (ha)	81.5	96.4	60.8	96.3	122.6	121.8	
2. Proposed Paddy (ha)	78.5	91.8	57.3	89.7	116.2	115.3	
3. Land Reduction (%)	3.7	4.8	5.7	6.8	5.2	5.3	5.3

Note) Land Reduction (%) = (1 - (Proposed Paddy) / (Present Paddy)) × 100

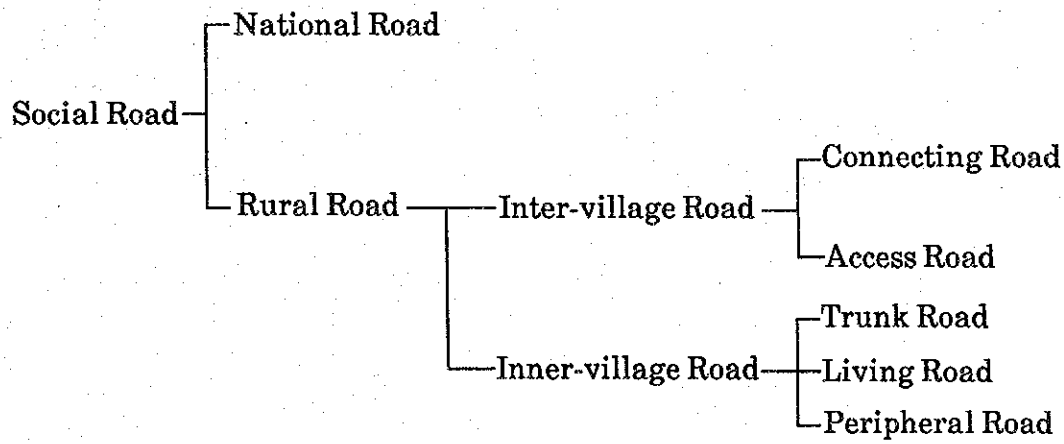
(b) Land Reduction Ratios of Type-B Improvement

Items	High Land	Low Land	Weighted
	Ejibar Kola	Suteh	Average
1. Present Paddy (ha)	96.4	121.8	
2. Proposed Paddy (ha)	89.1	112.1	
3. Land Reduction (%)	7.6	8.0	7.8

5. 4. 5 Relationship Between Networks of On-farm Roads and Social Roads

The terminal irrigation and drainage ditches, farm roads and farmland blocks are improved comprehensively by the project, and consequently agricultural productivity will be increased. In addition, the land consolidation is to contribute to preserving a favorable rural environment. In order to accomplish these purposes, the on-farm facilities together with the existing road networks are required to work cooperatively (the canal systems are improved from the main to on-farm levels consistently).

Then the existing road networks (except for farm roads) in the Project Area are grouped as follows;



Based on this, the relationship between the on-farm facilities and the rural road networks is summarized as follows:

- Inter-village Road;

  The present connecting and access roads have been developed over years, and widened and paved by necessity. In the on-farm development, the main and lateral farm roads are planned considering these road networks. In the planning of the main farm roads, the existing inter-village roads are to be improved as necessary. In addition, the operation and maintenance roads of the secondary and tertiary canals are to be utilized as main farm roads. These project facilities (main farm roads and operation and maintenance roads) are expected to function also as inter-village roads, and to contribute to upgrading the living environment of the Project Area.

- Inner-village Road;

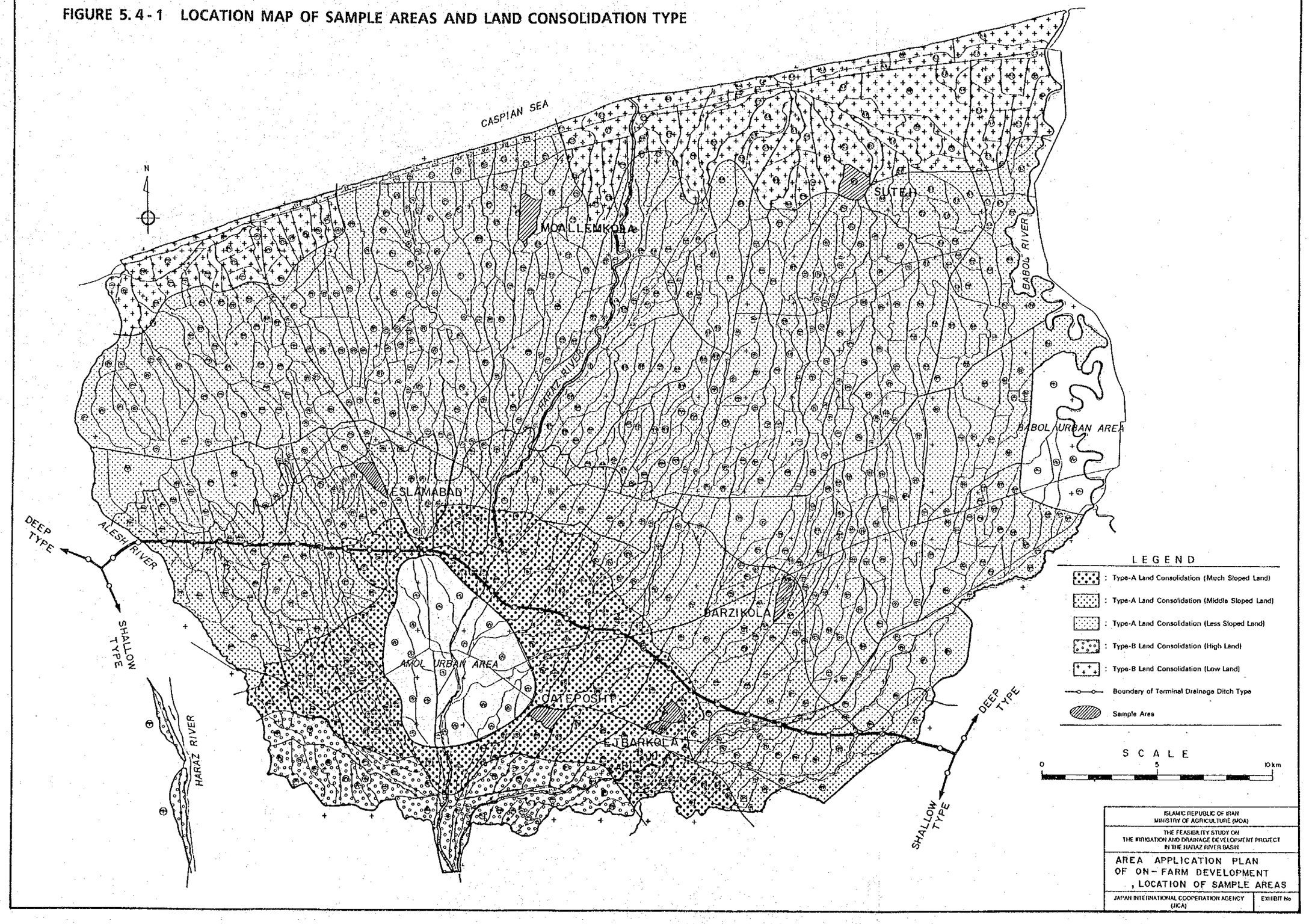
  Generally speaking, living roads are narrower than trunk roads, and the smooth movement of large size farm machinery is not easy. In this case, widening living roads is difficult because of the difficulty of housing relocation. However, the improvement of peripheral roads is possible in the on-farm development, if necessary. By this improvement, the relocation of storage houses and garages to neighboring fields, the solving of blind alleys, the preparation of parking lots, the access to farm roads, inter-village and inner-village roads become possible.

TABLE 5.4-1 ACREAGE BY LAND CONSOLIDATION TYPE

Land Consoli Type		Type-A				Type-B			Total
District	Zone	T-A1	T-A2	T-A3	Sum	T-B1	T-B2	Sum	
Haraz West	HW1	0	0	0	0	623	0	623	623
	HW2	759	1,890	826	3,475	277	0	277	3,752
	HW3	949	1,300	357	2,606	278	0	278	2,884
	HW4	488	796	273	1,557	0	0	0	1,557
	HW5	214	390	207	811	0	0	0	811
	HW6	42	601	112	755	0	0	0	755
	HWU1	0	0	0	0	120	0	120	120
	HWU2	0	0	0	0	61	0	61	61
	HWU3	0	0	0	0	117	0	117	117
Total		2,452	4,977	1,775	9,204	1,476	0	1,476	10,680
Haraz East	HE1	2,467	334	0	2,801	20	0	20	2,821
	HE2	919	374	22	1,315	210	0	210	1,525
	HE3	793	958	236	1,987	205	0	205	2,192
	HE4	506	718	477	1,701	91	0	91	1,792
	HE5	476	1,313	900	2,689	0	0	0	2,689
	Sub-Total	5,161	3,697	1,635	10,493	526	0	526	11,019
	KL1	0	0	0	0	155	0	155	155
	KL2	302	0	0	302	110	0	110	412
	KL3	0	875	1,538	2,413	0	0	0	2,413
	KL4	0	0	1,957	1,957	0	0	0	1,957
	KL5	0	0	2,108	2,108	0	0	0	2,108
	KL6	0	0	1,494	1,494	0	0	0	1,494
	Sub-Total	302	875	7,097	8,274	265	0	265	8,539
	KR1	0	0	0	0	298	0	298	298
	KR2	60	0	0	60	305	0	305	365
	KR3	565	316	0	881	0	0	0	881
	KR4	0	1,662	749	2,411	0	0	0	2,411
	KR5	0	101	391	492	0	0	0	492
	Sub-Total	625	2,079	1,140	3,844	603	0	603	4,447
Total		6,088	6,651	9,872	22,611	1,394	0	1,394	24,005
Amol West	AW1	0	0	804	804	0	120	120	924
	AW2	0	0	629	629	0	64	64	693
	AW3	0	0	1619	1,619	0	624	624	2,243
	AW4	0	0	804	804	0	822	822	1,626
	Sub-Total	0	0	3,856	3,856	0	1,630	1,630	5,486
	AW5	0	0	1,845	1,845	0	136	136	1,981
	AW6	0	40	1,100	1,140	0	0	0	1,140
	AW7	0	156	2,985	3,141	0	0	0	3,141
	AW8	288	178	12	478	0	0	0	478
	AW9	46	289	4,193	4,528	0	709	709	5,237
	Sub-Total	334	663	10,135	11,132	0	845	845	11,977
Total		334	663	13,991	14,988	0	2,475	2,475	17,463
Amol East	AE1	186	458	0	644	0	0	0	644
	AE2	0	727	41	768	0	0	0	768
	AE3	0	270	3,293	3,563	0	949	949	4,512
	Sub-Total	186	1,455	3,334	4,975	0	949	949	5,924
	AE4	0	72	2,259	2,331	0	876	876	3,207
	AE5	0	0	1,640	1,640	0	0	0	1,640
	AE6	0	0	1,843	1,843	0	689	689	2,532
	Sub-Total	0	72	5,742	5,814	0	1,565	1,565	7,379
	AE7	0	0	1,325	1,325	0	530	530	1,855
	AE8	0	0	1,006	1,006	0	0	0	1,006
	AE9	0	0	1,213	1,213	0	0	0	1,213
	AE10	0	0	1,112	1,112	0	0	0	1,112
	AE11	0	0	2,208	2,208	0	3,140	3,140	5,348
	Sub-Total	0	0	6,864	6,864	0	3,670	3,670	10,534
Total		186	1,527	15,940	17,653	0	6,184	6,184	23,837
Grand Total		9,060	13,818	41,578	64,456	2,870	8,659	11,529	75,985

Note : 1) The classification of Type-A&B land consolidation is:
T-A1; Much sloped land (i=1/50 to 1/100), T-B1; High land (i>=1/50)
T-A2; Middle sloped land (i=1/100 to 1/200), T-B2; Low land (i<=1/800)
T-A3; Less sloped land (i=1/200 to 1/800).
2) Above figures are proposed net paddy areas not including those areas of on-farm canals and roads

FIGURE 5.4-1 LOCATION MAP OF SAMPLE AREAS AND LAND CONSOLIDATION TYPE



CHAPTER 6. PROJECT IMPLEMENTATION, OPERATION AND MAINTENANCE

CHAPTER 6. PROJECT IMPLEMENTATION, OPERATION AND MAINTENANCE

6. 1 Project Implementation Plan

6. 1. 1 Methodological Alternatives of Project Implementation

In general, a few alternative methods of project implementation are examined to determine the most feasible one, keeping (1) funding sources, (2) scale of works, (3) periods and seasons of works, (4) staff maneuvering ability of Project Office and contractor, in mind ; but these factors are closely interrelated, complementing and competing with one another. This is why the mutual relationships should be fully assessed, and based on the same optimum way of implementation should be decided.

The works of this project are composed of three different kinds of facilities, i.e., water resources, irrigation / drainage and on-farm. Modernized conditions of agricultural production are not fully equipped until all these components are consolidated. The scale of these facilities has already been stipulated in Chapter 5, and quantitative and qualitative characteristics will be clearly projected as follows in formulating methodology of implementation.

Facility	Quantitative Scale	Qualitative Scale
Water Sources		
Dam	L. not divisible	D. skill/techniques required
Diversion Dams	M. not divisible	D. skill/techniques required
Conveyance/Distribution Facilities		
Canals	L. divisible	fairly D. depending on degree
Structures *	M. divisible	fairly D. depending on degree
O/M F. **	M. divisible	fairly D. depending on degree
On-farm Facility	L. divisible	fairly D. depending on size

Note : * for water distribution/quantification,
** Operation and Maintenance Facilities,
L.; large, M.,; medium,D.; difficult, I.; implementation

For those facilities whose construction works of which are divisible, the ease of the work depends on unit work rate and available working period.

But the minimum unit rate of the former is determined by the function of the facility concerned. The period of construction is usually determined by economic factors, and in this case, an option should be made as to whether works are to be executed by interrupting general production activities for particular items in the works, or by limiting the working period to the off-season of paddy. As far as water conveyance and distribution facilities are concerned, these functions can be maintained during construction by means of temporary structures, and thus it is possible to continue construction work during the cropping season. However, simultaneous execution of land consolidation works and cropping is impossible. Hence it requires temporary lifting of production activities or fallowing if year-round works are to be sustained. However, such a standstill of production activities is in reality hardly reinforced, and this coupled with the lingering rainy spell covering much of the off-season makes working conditions for land consolidation/ on-farm facilities extremely difficult.

There are two major means of implementation, that is, contract basis and force-account basis. The former is considered to be advantageous in consolidating relatively large-scaled facilities such as those proposed in the Project, except for the case where the official agency responsible for project implementation is equipped with a large number of technical staff and construction equipment. Apart from facilities for water resources, conveyance and distribution for which divisible implementation can be applied, certain means to hedge risks likely to arise from delay of completion is necessary, such as articulating specific terms of contract in the clause (such as compensation for reduced yields from delayed works) when a contract system is employed to implement land consolidation works during off-season. This hedging will be exceedingly risky from contractor's point of view, and so the boosting of unit prices for contracts will be inevitable.

Implementation of project through force account utilizes staff and construction machinery for a certain public objectives, and is often employed to implement public works. In the case of improvement of privately owned production base, as seen in land consolidation works, it is required first of all to establish a project implementing agency in order to apply the said system. However, the existing farmers' organization in the Project Area is not matured enough to provide full coordination with force account agents responsible for the works. Nor is it experienced enough to manage the necessary contracts

management in applying contract based works. It follows that the organization will face difficulty in the project implementation without any supportive help by the public agencies concerned.

On the other hand, MOA has attached an additional function to assist on-farm improvement to the Soil and Water Engineering Service Corporation (SWESC) company and ARTSC from the aspect of encouraging land consolidation. While the employment of such a function provides the most realistic means to this end, the existing, above mentioned SWESC and ARTSC are not equipped with the capacity in terms of staff and equipment to meet the implementation of large scale land consolidation.

Taking all of such background into account, it is concluded that a special arrangement should be provided in compliance with the current local situations in the Project Area to implement the project, in particular land consolidation. Namely, farmers' organizations should be established for every terminal unit covering a tract for land consolidation works, and it is the most relevant to establish a public undertaking agency as the partner of such units to undertake consolidation works on a contract basis.

The imperative element in implementing a project is how to appropriate required funds. Public resources can be invested to such public works as facilities for water sources, conveyance and distribution, but they are not applicable to just any consolidation improvement of on-farm facilities in so far as private land holding system is sustained. Extreme difficulty also arises in implementing it on a contract basis with the advanced financing of the total expense by individual farmers or by their organizations, hence there would be no other choice than taking measures of establishing a facility for subsidy or low interest credits or long term installment plan.

Taking all this into consideration, the following are proposed as the ways to implement the project.

1) Water Source Facilities ... contract system through public investment ... year round implementation
2) Water Conveyance and Distribution Facilities ... the same as above ... as a rule, year round implementation
3) On-farm Facilities ... quasi-contract system subsidized by public agencies ... as a rule, off-season implementation

6. 1. 2 Annual Implementation Schedule of the Whole Project

In the light of the conditions mentioned above and the investment efficiency, the implementation period of the project is proposed as Table 6.11/ 12, in which the following procedures are incorporated.

1) Principles and methodologies of implementing the project shall be decided based on the F/S report. Also, legal procedures to materialize implementing organizations, sources of funds and their appropriation are described below and are necessary.
2) According to the decision in 1), F/S or D/D of the facilities for water resource, conveyance and distribution shall be initiated, together with the preparation of topo-map of a scale 1/10,000 and 2,000 for the Project Area.
3) D/D of land consolidation shall be designed based on these topo-maps. Also are supplemented by complementary land surveys, whenever necessary.
4) Land consolidation works shall start in 1995, and is targeted to be completed by 2006.

6. 1. 3 Implementation Plan of Major Facilities Components (MOE)

As for the implementation of project components, water resources, conveyance and distribution are concurrently implemented, of which the F/S of Mangol dam is executed by the MOE as soon as possible.

As regards to D/D and the implementation of the main and branch canals, the command area of the on-going Haraz diversion dam should be given priority. Improvement of water facilities in the middle and down stream areas shall be in tune with the progress of the Amol diversion dam.

As conducted previously, competent consultants shall be employed to design and supervise these components. The construction works concerned shall be contracted to the contractors in sub-blocks divided for the phased construction works.

6.1.4 Implementation Plan for Terminal Improvement (by MOA and Beneficiaries)

Land consolidation and other terminal improvement works should proceed side by side with improvement of farming and expansion / fortification of related supporting organizations. In particular, various improvement of facility and organization are necessary for livestock sector, and quick decisions in this direction is desirable.

Besides, one should bear in mind that the establishment of farmers' organizations in the beneficiary areas, as mentioned below in the para. 6.2.2, is a pre-condition for project implementation, for which the suggested target is to start in 1995 and be completed within 10 years.

As for D/D of terminal improvement works, it is necessary to do by sub-block and the advised procedure is as follows.

1) Based on the experience in CAPIC, an organizing campaign should be initiated in 1994, and D/D be provided for the organized sub-blocks that responded.
2) The improvement works are carried out in sub-blocks of about 100 ha, while D/D is provided for the beneficiary of a tertiary canal (covering 300 - 500 ha).
3) Preparation of project implementation plans, detailed design and construction supervision shall be made by recruited engineering consultants. In order to achieve appropriate execution of the project,

design criteria, standard specification and manual of construction supervision shall be prepared before and or during project execution.

4) Quasi-contract system, which 50% of required construction equipment will be lent by the government to the contractor, will be applied for land consolidation works. In order to implement smoothly those works systems, government agency shall establish motor pool yard for repairing/maintaining equipment in the center of Project Area.

5) A contract of land consolidation works will be made between the governmental agencies who were entrusted by the beneficiary farmer organization and contractor.

6.2 Implementation Organization

6.2.1 Implementation Organization of the Government

As explained in the above para. 5. 1. 3, the project will be implemented under the mutual cooperation of the MOA and the MOE, and that part of the MOE's responsibility will be managed by the Mazandaran Regional Water Board. In case of the MOE, a Project Office will usually be established under the Water Board to superintend the activities of the consultant who will be employed for design works and supervisory services of construction works at the implementation of such kind of projects. It is assumed that similar system will be applied in case of this project.

The improvement works of on-farm facilities which the MOA will be executing or promoting agency is rather different from those past activities of the MOA, viz., the Project Area has already received a comparatively high benefit compared to other regions in the country and, consequently, a large portion of the required project costs are to be borne by the beneficiary farmer. Therefore, it is doubtful if the SWESC and/or ARTSC have sufficient experience in such category of project implementation.

The Project Area is divided into 3 Shahrestans from administrative point of view, but such areal division is not suitable for project implementation because the whole Project Area is covered within one common irrigation system

of the Haraz river basin, therefore the division of Project Area by the covering area of each ARTSC is very difficult.

Moreover, the period of project implementation will be more than 10 years from the viewpoint of scale of works and workability, therefore a specific organization which enables a response to such conditions as mentioned above shall be the executing agency.

Furthermore, the improvement works of on-farm facilities shall be executed under very close coordination with those upstream works such as dam construction, canal improvement, improvement of road networks, etc., therefore the executing agency shall have the function of a coordinating body among the different executing agencies.

Taking the above conditions as well as the required capacity of project implementing agency mentioned in the above para. 6. 1. 1. into consideration, the implementation of project request an executing/promoting agency with following functions:

1) Project promoting function in long-term
2) Coordinating function amongst related organizations to the development in different fields.
3) Guidance function for fortification of farmer's organization as mentioned in the above para. 4. 3. 6.
4) Managerial function over engineering subjects such as planning, designing, etc.
5) Control and supporting function in relation to financial arrangement required for project implementation.
6) Technical managerial/executing function related to field construction works.

It is very difficult to establish a new organization which has such functions as mentioned above but, fortunately, the coordination amongst the different organizations related to development works has been kept in good condition in the Project Area due to the endeavor of persons concerned since the time of Master Plan Study of the project.

CAPIC stands for Caspian Sea Coastal Area Agricultural Development Project Pilot Implementation Center, extending the following activities and functioning. Its establishment was suggested in the text of the Master Plan as the nucleus of accelerating development in the Project area. To this end, MOA procured around 100 ha of farm land in a part of national forest located at the site 15 km in the north from Amol City, at the same time it proposed a project type technical cooperation from the Japanese Government.

The Japanese Government dispatched experts and donated equipment that were planned for five years from 1990, and the cooperation has been very fruitful with the results being the providing of planning, design, supervising implementation, cropping programs for summer and winter crops, cropping instruction, farm mechanization plan and its on-farm demonstration etc..

Moreover, the existence of CAPIC in the Project Area is also considered an advantage, and it is recommended to strengthen and expand the function of CAPIC toward being an organization similar to a regional development authority.

In case establishment of an independent organization for development by means of reinforcing CAPIC, etc. is not accepted, all above mentioned required functions will partially be taken charge of by different organizations such as SWESC, ARTSC and GDA of Mazandaran, etc., but the capacity of those existing organizations are also requested to be reinforced drastically. Especially, the reinforcement and re-training of staff is the most important requirement even in the case of existing organizations, and there are few facilities suitable for re-training of staff required for the development of the Project Area, therefore effective use of CAPIC will be the most feasible approach toward the establishment of required organizations suitable for the project implementation.

Taking all those afore-mentioned factors into account, a recommendable organizational chart for project implementation is shown as Figure 6.2-1.

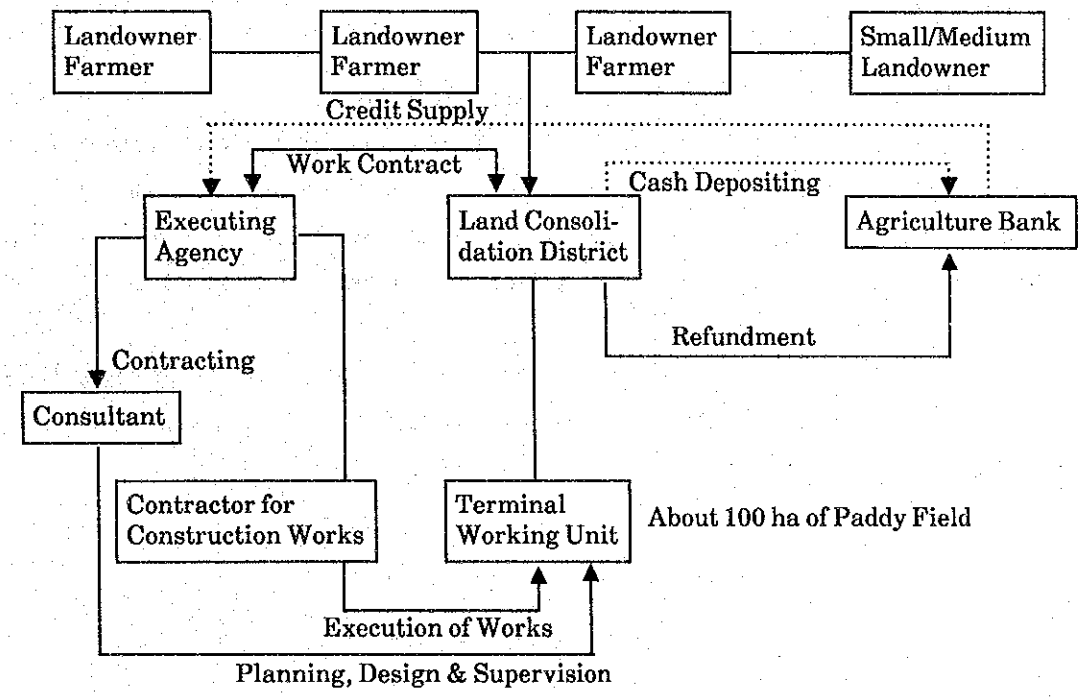
6. 2. 2 Implementation Organization of the Beneficiaries

The participation of beneficiary farmers is unavoidable for the implementation of the project. The required function and activities of farmer's organization are explained in the above para. 4. 3. 6, and the function of land consolidation district will be directly related to the improvement of on-farm facilities which include farmers' own works such as re-leveling and levee making of each plot after the mechanical land leveling.

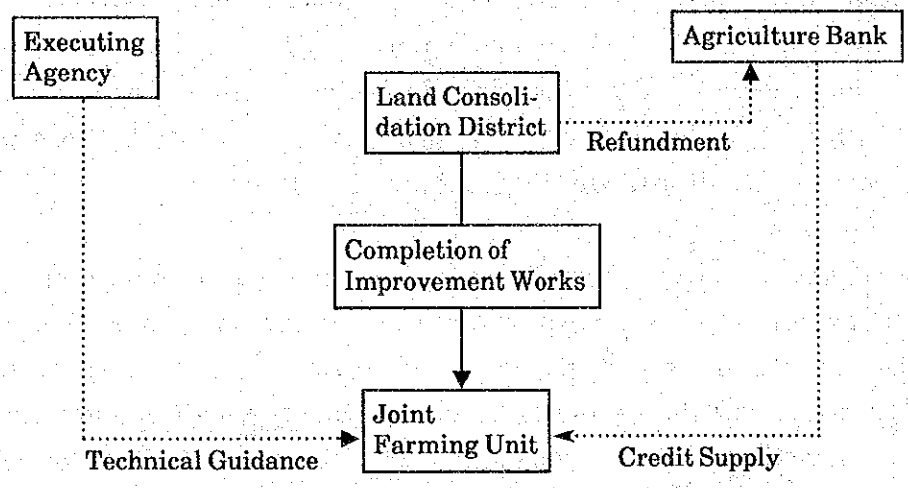
At the formation of such function as land consolidation district, the consent of beneficiary farmer is unavoidable, and the consent shall be obtained upon the understanding of farmers about the changes in their farming system/practice. The pilot projects which are under execution and planning by CAPIC at present will play a very important role for the formation of a land consolidation district.

Taking the above mentioned factors into account, the farmer's organization shall have the following functions;

Function 1.



Function 2.



As shown above, proper support to the land consolidation district which completed the consolidation works is necessary to produce the earliest effects from formation of land consolidation district and execution of the improvement works by means of supply of advantages such as preferential introduction of farm mechanization system, technical guidance on farming practice, etc.

On the other hand, the formation of an irrigator's association is also necessary in the Project Area as another farmer's organization related to water management. The irrigator's association is recommended to be established for the covering area at each of the turnouts to the tertiary canal providing branches at each of the above mentioned land consolidation districts.

The Water Management Corporation is to be established regardless of the establishment of land consolidation district, but in parallel with the construction of the turnouts.

6. 3 Operation and Maintenance Plan of the Facilities

6. 3. 1 Basic Concepts of Operation and Maintenance Plan

The operation and maintenance of facilities under the project is recommended to be as below based on the classification of facilities explained in the above para. 5. 1. 1.

1) Water Control Facilities

To undertake such water management as to satisfy the water demand at the beneficial area. The Mazandaran Regional Water Board will be in charge of the operation and maintenance of facilities, including Haraz and Amol diversion dams.

2) Water Transmission/Distribution Facilities

To establish the water management offices at each diversion dam to divert river flow into the main canals in accordance with the operation rule provided previously. The water intake from the main canal to secondary canal will be controlled by the operation of gate to release previously designated quantity of water in case of the normal water year. Special operation rule shall be provided in case of dry year based on the prevailing water right registered at the Registration Offices.

The control of gates at the diversion facilities is, in principle, to be done based on the periodical water demand estimated from the cropping plan of the year submitted by each of the land consolidation districts after re-arranging the discharge with the water availability of the year.

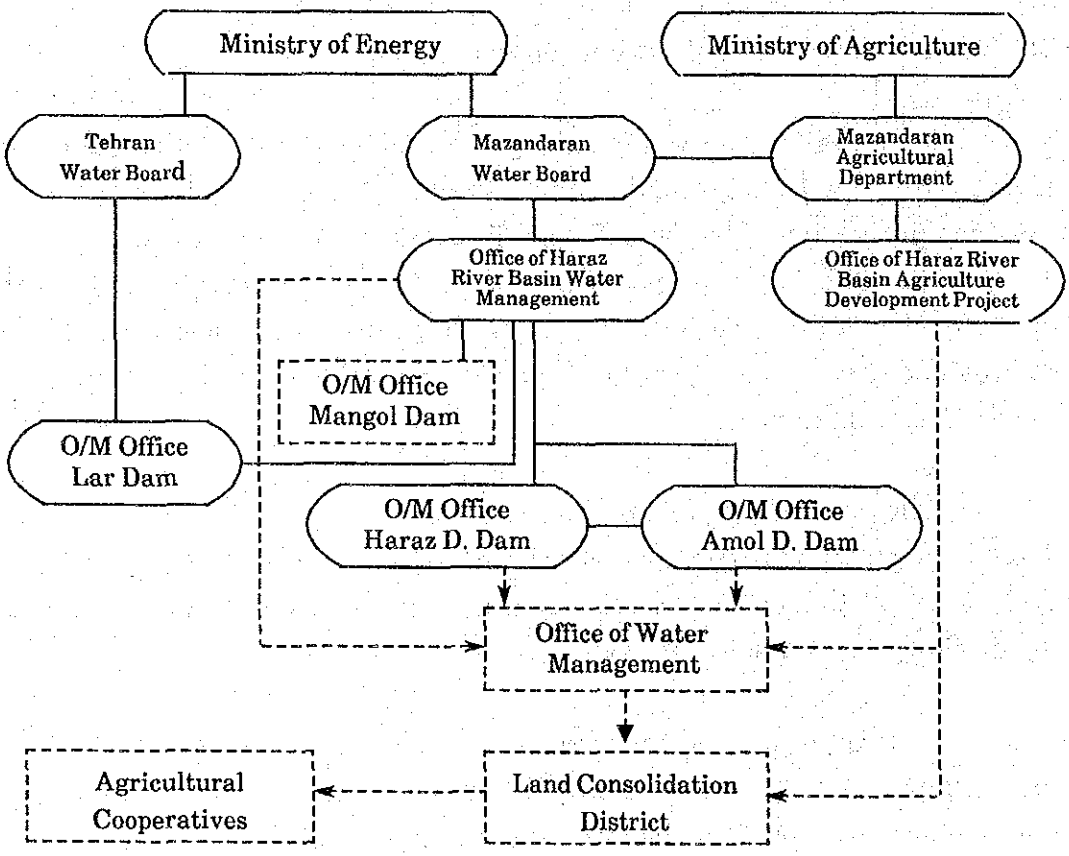
It is recommended that the operation and maintenance of canals up to the turnout to the fourth canal are to be done by the planned Water Management Corporation spending the water fee levied from the farmer. The land consolidation district shall take the responsibility for operation and maintenance of irrigation and drainage facilities after the turnout to fourth canal.

3) On-farm Facilities

The operation and maintenance of all on-farm facilities within a unit land consolidation district are to be done by the land consolidation district concerned.

6. 3. 2 Operation and Maintenance Organization of the Project

As explained in the above para. 6. 3. 1, the project requests 3 categories of operation and maintenance organization of the MOA, MOE and beneficiary farmer, and the inter-relation of those organizations is illustrated as below (for the details, see Figure 6.3-1):

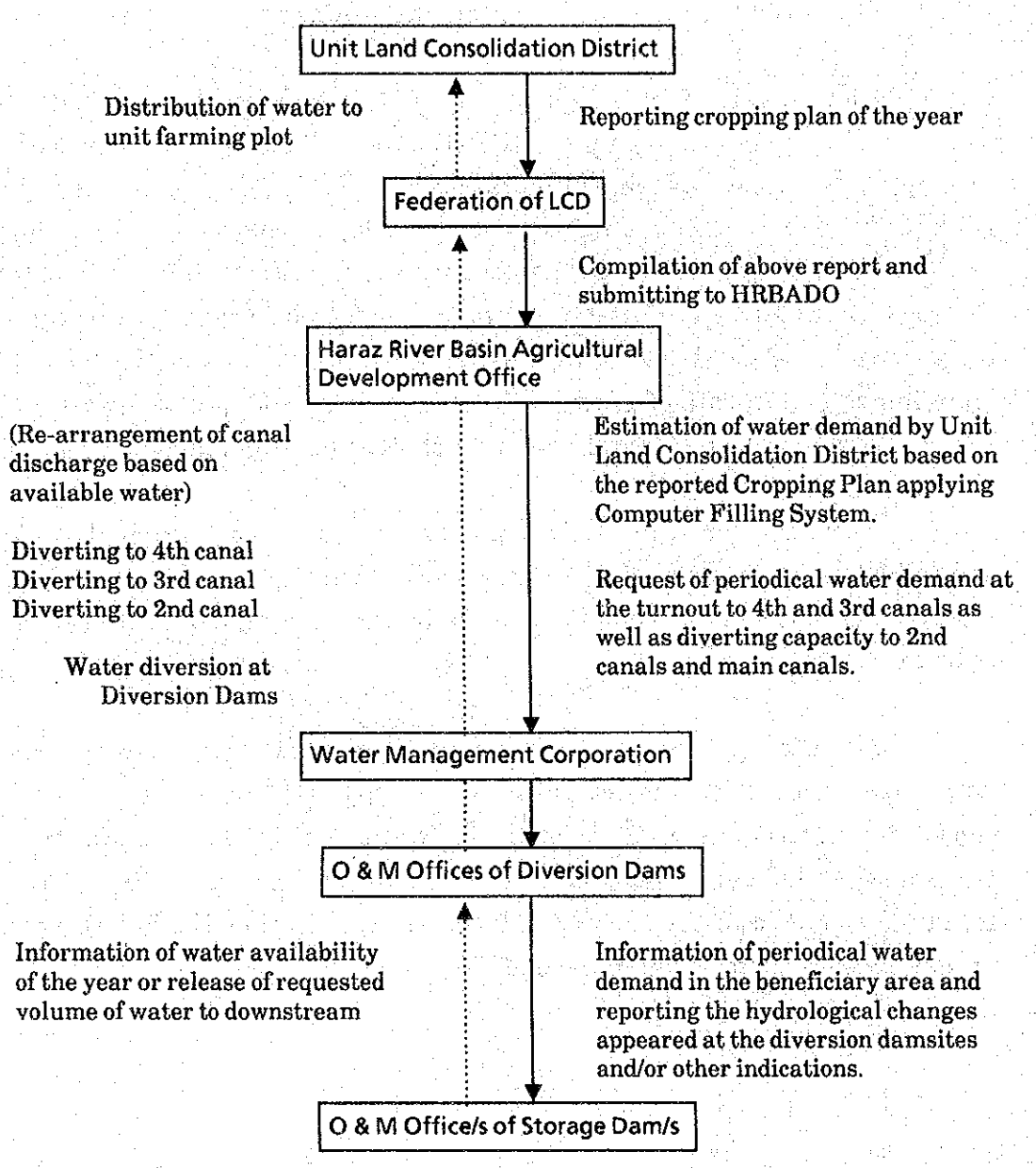


6. 3. 3 Water Management of Irrigation and Drainage

The prevailing plot-to-plot irrigation system will be changed to plot unit water management system at the execution of the project. Therefore the daily water demand by each plot might be estimated and the diverting volume of water to each of the terminal canals will be decided adding proper canal loss to the said water demand. Grasp of daily water demand by plot is actually impossible, therefore the interval water management system of weekly or 10 day period will be applied. Anyway, the grasp of varieties of paddy, their cropping calendar, rate of growth of the year, etc. are required for estimating real water demand which shall be basic factors of water management.

Besides, there are many small areas which can be irrigated by the groundwater such as spring and/or well, therefore some special water management system in a combination of surface water and groundwater is also to be examined.

For the application of aforementioned water management system, very close cooperation and coordination among the above mentioned land consolidation districts, O & M offices of water control facilities and water transmission/distribution facilities. Considering the responsibility of the MOA for guidance and coordination to the farmer's organization, the following water management system is recommended:



As stated in Chapter 4, Irrigation and Drainage Plan, irrigation water supply in the Project Area without Mangol Dam comes around 133 MCM for a normal year and about 317 MCM for a design drought year short of the total requirement. The relationship between the degree of short water supply and affected rice yields, along with the methods of efficient use of water sources are shown in Appendix B. 1. 4 and B. 2. 7. The guidelines for adequate ways of management for irrigation water sources until Mangol Dam is completed are given here, thus striving to bring the projected benefits into effect while efforts are made to minimize the anticipated drought damage.

As regards yield levels of rice, the following increase in yields is expected between the stages of with and without project.

Variety (maturity)	Cropping Intensity	Without Project	With Project			
			Uncompleted Stage of Mangol Dam		Completed Stage of Mangol Dam	
		Yield	Yield (1)	Rate of Increase	Yield (2)	Rate of Increase
	(%)	(kg/ha)	(kg/ha)	(%)	(kg/ha)	(%)
Tarom (early)	37.5	4,135	4,437	7.3	4,668	12.9
Khazar (medium)	37.5	4,741	6,378	11.1	6,700	16.7
Amol-3 (late)	25.0	7,375	7,972	8.1	8,385	13.7
Weighted Mean	100.0	5,547	6,049	9.0	5,359	14.6

short water supply in % (rate of yield drop)		calculation
10%	(drop by 10%) :	$6,049 \times 0.90 = 5,444 = 5,547 \times 0.98$
15%	(drop by 15%) :	$6,049 \times 0.85 = 5,142 = 5,547 \times 0.93$
20%	(drop by 20%) :	$6,049 \times 0.80 = 4,839 = 5,547 \times 0.87$

The above calculation implies that even water shortage by 10% is inevitable in the with-project stage, the anticipated damage as reflected in yield drop comes to as much as 10% of the target yields (1) or so, which is equivalent to 98% of the yield level in the without project stage, in other words no significant difference from the current yield levels is resulted therefrom.

As to how to manage water sources in the with-project uncompleted stage of Mangol Dam, the following are desirable basic principles to determine the concrete ways of their management;

- to roughly forecast the total runoff through the state of water storage in Lar Dam during the period of nursery stage of rice and also by quantifying snow cover within the catchment of the Haraz,
- to estimate cropped acreage by variety and the corresponding quantity of available irrigation water (in the form of surface flow and stored water in abbandans within the irrigation area) by ten-days of the month during the irrigation period,
- to establish the strategical measures to secure irrigation water to supply during pre-heading to flowering stages, or the most sensitive stage when the yields are liable to get affected by water shortage (in a concrete term, to keep rational control in allowing

discharge from Lar Dam as well as to make use of groundwater source as much as possible,

- to organize related administrative authorities to water management and the beneficiary farmers concerned, to establish the system of education/training for improved water management techniques for these personnel,

The use of irrigation water should be rationalized for better and efficient water management taking account of the above listed requirements, in parallel with the reference of the following procedures;

- effective use of abbandans within the Project Area (by raising frequency of utilization), coupled with well-provided storing of surplus surface flow (in the Haraz and other rivers as well as other surplus flow within the Project Area),
- efficient utilization of return flow (by consolidating canals with dual purpose of irrigation and drainage and the following rationalized water management, along with conveying water to abbandans),
- effective use of groundwater
- timely discharge of stored water from Lar Dam (above all, keep effective discharge during the late period of irrigating rice).

In drainage water management, considerable management effect will be expected by means of control of inflow to the irrigation canal networks in the non-irrigation period. In case of introduction of second crops, the farming drainage at the on-farm level, it is recommended to release surplus water in the shortest duration of time as possible.

6. 3. 4 Demarcation of Operation and Maintenance Cost

The Project Area has hundreds of years of cultivating experiencesof paddy using the river flow of the Haraz river. Most of the existing canals have been excavated and maintained by the ancestor who conquered uncountable difficulties, and today, the farmers in the Project Area are endeavoring to receive utmost production from their heritage from their fathers, and maintaining such heritage in good condition to deliver it to their sons. To

divide water impartially, the farmer is employing the Mir-ab who is responsible in water management and operation and maintenance of irrigation facilities.

In such case as seen in the Project Area, the concept of water fee is, naturally, differed by those areas where water resources have been developed with the public investment by means of construction of dam, canal and other facilities. In other words, the public sector has limited right to levy water fee as a share of benefit which is provided by the public sector.

Presently, 25,000 rials/ha of water fee is levied in the Project Area, but it is rather doubtful if the amount is acceptable as a share of public sector against their services. It is not fair if the amount of water fee is easily decided because of comparatively high income of farmer in the Project Area.

From such point of view, the amount of water fee shall be decided by analyzing such factors as mentioned below:

1) Water diverting cost from the river- -difference of cost between the-farmer-do-it case and public sector-do-it on behalf of farmer.
2) Cost of maintenance of Main Canal - -same as above.
3) Cost of water diverting from main canals to tertiary canal through secondary canal - - same as above.
4) Cost of water distribution from tertiary canal to farming plot - - same as above.
5) Benefit produced by the effort of public sector such as reduction of damage due to water shortage, etc.

Such analysis of cost factors will be requested of to the related public sector to examine: (1) quality and quantity of services to the beneficiaries and (2) effort to save expenditure required for operation and maintenance of facilities on one side, and the beneficiary farmer will also be requested to understand the extent of services receiving from the public sector.

6. 3. 5 Facilities and Equipment for Operation and Maintenance

To up-grade the quality and quantity of services to the beneficiary farmer and to sustain such services over a long range of time, proper O & M facilities and equipment are necessary, and the following items are considered as the minimum requirement taking the water management system mentioned in the above para. 6. 3. 3 into account:

1) Facilities to avail appropriate water diverting such as gate, flow measuring device, etc. to be installed to the turnout facilities.
2) Construction machinery required for maintenance and repair of canal structures such as back-hoe, bulldozer, grader, etc.
3) Tele-communication system to transmit required information in due time.
4) Transportation facilities to avail timely operation and maintenance of facilities.

TABLE 6.1-1 PROJECT IMPLEMENTATION SCHEDULE (1/3)

Work Description/Item	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
(A) Construction Works														
1. Pre-Construction Stage														
1.1. Survey & Investigation														
- Aero. Photo & Mapping														
- Ground Survey														
- Geological Investigation														
1.2. F/S & Detailed Design														
- F/S for Mangol Dam														
- D.D. of Mangol Dam														
- D.D. of Amol Diversion D.														
- D.D. of Main Canals														
- D.D. of Secondary Canals														
- D.D. of Tertiary Canals														
- D.D. of River Trainings														
- D.D. of L. Consolidation														
1.3. Const. of Office/M. Pool														
- Main Office for MOE/MOA														
- Motor Pool of Equipment														
2. Construction of Facilitiy														
2.1. Diversion Dam														
- Haraz Diversion Dam	Completed													
- Amol Diversion Dam														
- Mangol Dam														
2.2. Main Canal/Rivers														
- Haraz West Main Canal	Completed													
- Haraz East Main Canal	Completed													
- Amol West Main Canal														
- Amol East Main Canal														
- Kari Rud Main Canal														
- Amol West Main Drain														
- Amol East Main Drain														
- Ferdonkenal Main Drain														
3. Haraz West District														
- Secondary Canal														
- Tertiary Canal														
- Land Consolidation														
- Miscellaneous														

TABLE 6.1-1 PROJECT IMPLEMENTATION SCHEDULE (2/3)

Work Description/Item	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
4. Haraz East District (I)														
- Secondary Canal														
- Tertairy Canal														
- Land Consolidation														
- Miscellaneous														
5. Haraz East District (II)														
- Secondary Canal														
- Tertiary Canal														
- Land Consolidation														
- Miscellaneous														
6. Haraz East District (III)														
- Secondary Canal														
- Tertiary Canal														
- Land Consolidation														
- Miscellaneous														
7. Amol West District (I)														
- Secondary Canal														
- Tertiary Canal														
- Land Consolidation														
- Miscellaneous														
8. Amol West District (II)														
- Secondary Canal														
- Tertiary Canal														
- Land Consolidation														
- Miscellaneous														
9. Amol East District (I)														
- Secondary Canal														
- Tertiary Canal														
- Land Consolidation														
- Miscellaneous														
10.Amol East District (II)														
- Secondary Canal														
- Tertiary Canal														
- Land Consolidation														
- Miscellaneous														

TABLE 6.1-1 PROJECT IMPLEMENTATION SCHEDULE (3/3)

Work Description/Item	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
11. Amol East District (III)														
- Secondary Canal														
- Tertiary Canal														
- Land Consolidation														
- Miscellaneous														
(B) Institutional Development														
1. Preparation of Act for Land Consolidation Work														
2. Campain for:														
Land Consolidation Work														
Livestock Promotion														
3. Establishment of:														
Livestock Breeding Station														
Milk Collecting System														
4. Establishment of:														
Land Consolidation Distnict														
Irrigator's Association														
Joint Farming District														
5. Introduction of:														
Joint Paddy Nusery														
Paddy/Hay Drying System														
Farm Mechnizing System														

Note : Regarding the Mangol Dam constructions, tentative work schedule indicates dotted line in the above table.

FIGURE 6.2-1 ORGANIZATION CHART OF PROJECT IMPLEMENTATION

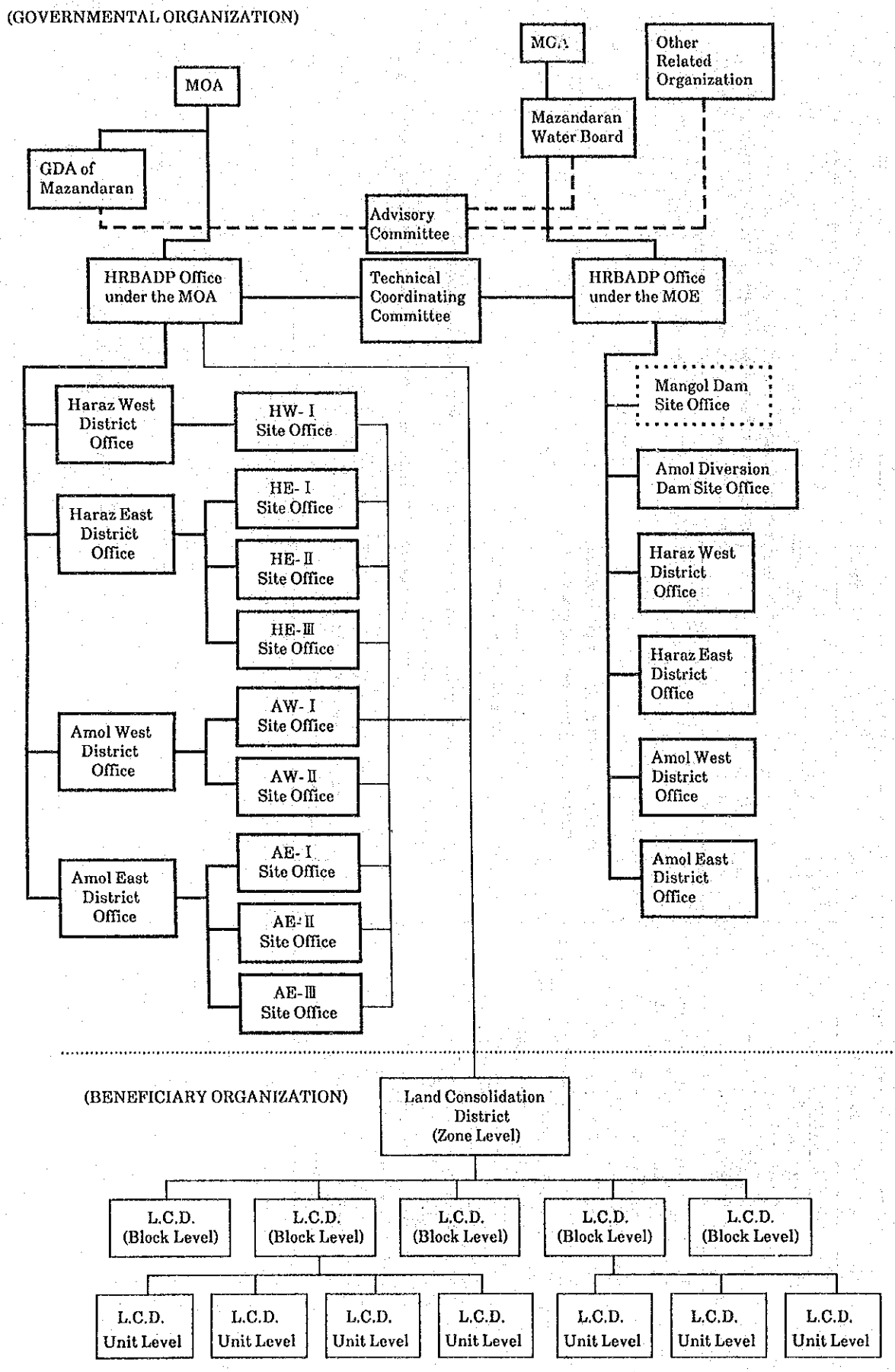
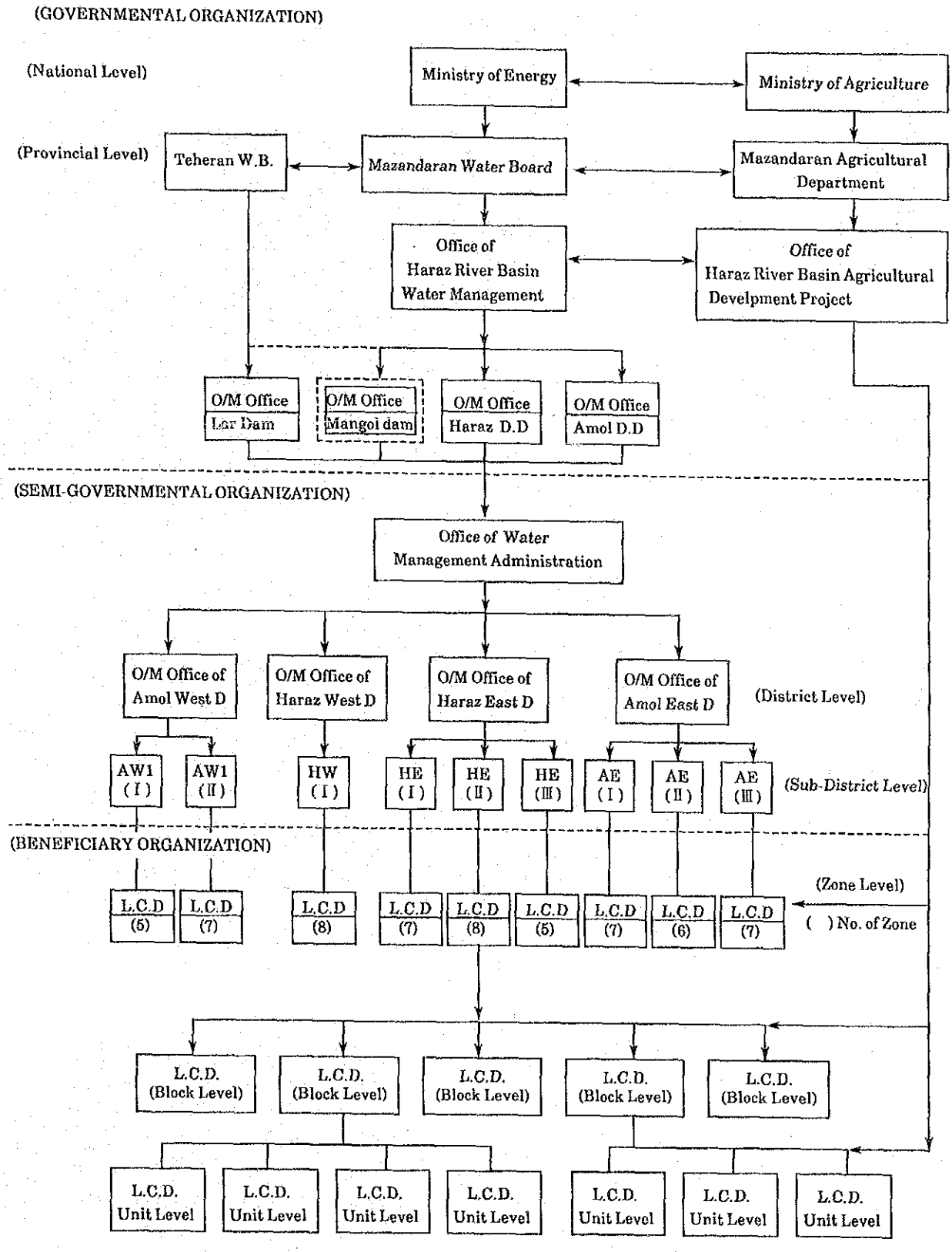


FIGURE. 6.3-1 ORGAINZATION CHART OF OPERATION AND MAINTENANCE



L.C.D : Land Consolidation District

CHAPTER 7. PROJECT COST

CHAPTER 7. PROJECT COST

7. 1 Concepts of the Project Cost Estimates

Contract system will be generally introduced for construction and improvement of necessary facilities for the project. Contract basis will be applied to all the construction works for such structures as water resources, water conveyance, water distribution and drainage which are under responsibility of the MOE. On the other hand, semi-contract basis will be applied to such works as land consolidation that will be proceeded under the guidance of the MOA. In the semi-contract basis, some necessary construction equipment will be lent to the contractors.

Implementation is expected to be completed within 7 to 9 years for each sub-district, taking construction work volume, budgetary arrangement, recruitment of engineering staff and participation of farmers into consideration.

The project cost is composed of such costs as for construction, procurement of equipment, survey and investigation, engineering services, building/motor pool construction, land acquisition and compensation, operation and maintenance equipment, administration, physical contingency, and price escalation etc.

Unit prices of construction works are referring to the prices which are applied to the works by the MOE and other organizations. Unit price is composed of such costs for material, labour, equipment, and overhead, taxes and benefits of contractors.

Exchange rate of foreign currencies is US$1.00 and ¥ 130 yen per 600 rials. Following compositions of local and foreign currency portions are applied in major construction materials;

Major Materials	Composition (%)	
	Foreign Portion	Local Portion
Cement	20	80
Timber	50	50
Concrete Pipe	30	70
Concrete Block	20	80
Reinforcement	40	60
Steel Material	40	60
Fuel	0	100
Aggregates	0	100
Labor	0	100

7. 2 Components of the Project Cost

(1) Construction Cost

Construction cost is composed of following facility costs;

- Mangol Dam: estimated at preliminary level because details of the dam were not investigated in this Study. The cost of dam involves the costs of construction of dam and relocation of the national highway road.
- Haraz and Amol Diversion Dams: estimated by the actual cost for the Haraz diversion dam, but by approximate cost per meter of weir for the Amol diversion dam taking a diversion dam type into consideration.
- Main and Secondary Irrigation/Drainage Canals: involving such costs as earth works (excavation, banking and back-filling), pavement, related structures (turnouts, drops, checks, cross culverts, and syphons) etc. The actual costs have been applied to the main irrigation canals of Haraz West and East.
- Tertiary Irrigation/Drainage Canals: involving the costs of structures same as the secondary canals as above.
- Operation and Maintenance Roads: estimating only pavement cost (gravel pavement), and earth works are estimated in the cost of above canals.
- Improvement of the Rivers and the River Mouth: estimating earth works, revetment and embankment etc.
- Land Consolidation: involving the costs not only for land grading works, irrigation/drainage ditches and farm roads, but for

improvement of abbandans, relocation of shallow wells and installation of tile drains etc.

(2) Procurement Cost of Equipment

For proceeding such land consolidation works successfully to improve the agricultural terminal infrastructures, it is necessary to secure enough construction equipment and to enforce local contractors by governmental assistance. In this regard, the Government is expected to rent equipment to the local contractors to complete the land consolidation works within 7 to 10 years in each District. Necessary numbers of equipment district-wise is as follows;

Necessary Number of Equipment for Land Consolidation

Equipment	Haraz West		Haraz East		Amol West		Amol East		Total
	Const.Y.	Number	Const.Y.	Number	Const.Y.	Number	Const.Y.	Number	
16t Bulldozer SW	7	43	10	62	8	38	8	45	188
0.6 m^3 Backhoe	7	12	10	18	8	11	8	14	55
0.35 m^3 Backhoe	7	7	10	10	8	11	8	13	41
10t Roller	7	23	10	30	8	23	8	27	103
3.7 m Grader	7	19	10	24	8	19	8	22	84

Note: Const.Y ..... Construction Year

(3) Survey and Investigation Cost

This cost involves the costs for detailed topographical survey and geological sounding of the Amol Diversion Dam, route survey (approximately 2,000 km) and geological sounding of canals, photographic survey (scaled at 1/2,000) and cadastral survey of farm land of about 80,000 ha for land consolidation.

(4) Engineering Cost

This cost involves the costs for detailed design of several facilities other than the Mangol Dam (such as canals of about 2,000 km, major structures, and land consolidation of about 80,000 ha etc.) and for supervision of construction works during construction period.

(5) Building/Motor Pool Construction Cost

This cost is composed of construction costs for temporary offices, motor pools and 9 sub-district site offices for the MOE, the MOA and the farmrs' organizations.

(6) Land Acquisition and Compensation Cost

This cost is composed of costs for land acquisition or compensation to the lands which are necessary for canals and roads, or for construction works.

(7) Operation and Maintenance Equipment Cost

This cost is for procurement of equipment necessary for operation and maintenance after completion of the project.

(8) Administration Cost

This cost is composed of personnel expenses, stationery, vehicles and fuels etc.

(9) Physical Contingency

This cost is for such contingencies as cost increases due to unexpected events or differences on construction works. It is estimated at 10% of the construction cost.

(10) Price Escalation

This cost is for price escalation estimated annually at 4.8% for foreign currency portion and at 15.5% for local currency portion taking their price fluctuations into consideration.

7. 3 Project Cost and Annual Disbursement

(1) Project Cost

The table below shows the project costs for the whole Project Area and for 9 Sub-Districts. Details are described in the Tables from 7.3-1 to 7.3-10.

(unit: Million Rials)

Sub-Districts	Construction Cost	Other Costs	Sub-total	Price Escalation	Total
	(1)	(2)	(3)=(1)+(2)	(4)	(5)=(3)+(4)
Haraz West	51,127	25,440	76,567	146,407	222,974
Haraz East (I)	53,441	26,149	79,590	159,924	239,514
Haraz East (II)	31,367	18,436	49,803	100,329	150,132
Haraz East (III)	18,836	10,019	28,855	78,023	106,878
Amol West (I)	21,712	12,584	34,296	80,610	114,906
Amol West (II)	31,347	24,379	55,726	135,584	191,310
Amol East (I)	21,639	13,232	34,871	83,924	118,795
Amol East (II)	24,568	15,873	40,441	95,514	135,955
Amol East (III)	45,582	23,654	69,236	183,583	252,819
Total	299,619	169,766	469,385	1,063,898	1,533,283

(2) Annual Disbursement

Annual disbursement (not including price escalation) of the project cost (without Mangol dam case) is as shown in the table below, and detailed figures are tabulated in Table E.2.2-13 in Appendix E. 2.

(unit: Million Rials)

Year	Foreign Portion	Local Portion	Total
1994	4,930	5,515	10,445
1995	2,133	7,032	9,165
1996	11,164	10,571	21,735
1997	20,456	16,326	36,782
1998	27,622	21,532	49,154
1999	41,863	23,508	65,371
2000	34,026	22,755	56,781
2001	33,861	21,966	55,827
2002	32,450	19,469	51,919
2003	30,362	17,396	47,758
2004	23,811	12,948	36,759
2005	12,534	6,528	19,062
2006	6,011	2,728	8,739
Total	281,176	188,209	469,385

TABLE 7.3-1 PROJECT COST

(Unit: Million Rial)

Cost Item	Without Mangol Dam			With Mangol Dam		
	FC	LC	Total	FC	LC	Total
1. Construction Cost						
1.1 Mangol Dam	0	0	0	306,002	203,998	510,000
1.2 Diversion Dam	1,831	2,749	4,580	1,831	2,749	4,580
1.3 Main Canal	9,104	8,199	17,303	9,104	8,199	17,303
1.4 Secondary Canal	17,097	20,209	37,306	17,097	20,209	37,306
1.5 Tertiary Canal	9,861	15,886	25,747	9,861	15,886	25,747
1.6 Land Consolidation	142,914	64,964	207,878	142,914	64,964	207,878
1.7 River Training	2,997	772	3,769	2,997	772	3,769
1.8 O/M Road	2,887	149	3,036	2,887	149	3,036
Sub-Total	186,691	112,928	299,619	492,693	316,927	809,620
2. Procurement of C.E.	34,100	3,300	37,400	34,100	3,300	37,400
3. Survey/Investigation	2,879	6,121	9,000	2,906	6,180	9,086
4. D/D and Supervision	24,600	32,320	56,920	29,600	34,820	64,420
5. Building/Motor Pool	400	600	1,000	400	600	1,000
6. Land Acquisition	0	15,500	15,500	0	21,250	21,250
7. O/M Equipment	4.500	500	5,000	4,500	50	5,000
8. Administration	9,335	5,648	14,983	24,634	15,846	40,480
9. Physical Contingency	18,671	11,292	29,963	49,269	31,695	80,964
Total (1 ~ 9)	281,176	188,209	469,385	638,102	431,118	1,069,220
10.Price Escalation	422,213	641,685	1,063,898	1,028,692	1,879,372	2,908,064
Total (1 ~ 10)	703,389	829,894	1,533,283	1,666,794	2,310,490	3,977,284

TABLE 7.3-2 PROJECT COST OF HARAZ WEST DISTRICT (HW-I)

(Unit: Million Rial)

Description	Foreign Currency	Local Currency	Total Amount
1. Construction Work			
	(43,010)	(28,673)	(71,683)
1.1 Mangol Dam	0	0	0
1.2 Diversion Dam	379	569	948
1.3 Main Canal	567	253	820
1.4 Secondary Canal	3,913	5,997	9,910
1.5 Tertiary Canal	1,628	4,182	5,810
1.6 Land Consolidation	24,228	8,251	32,479
1.7 River Training	691	102	793
1.8 O & M Road	349	18	367
	(74,765)	(48,045)	(122,810)
Sub-Total	31,755	19,372	51,127
2. Procurement of C. E.	4,774	462	5,236
	(436)	(927)	(1,363)
3. Survey/Investigation	432	918	1,350
	(4,144)	(4,875)	(9,019)
4. Detailed D./Const. Sv.	3,444	4,525	7,969
	(56)	(84)	(140)
5. Building/Motor Pool	56	84	140
	(0)	(3,130)	(3,130)
6. Land Acquisition	0	2,325	2,325
	(675)	(75)	(750)
7. O & M Equipment	675	75	750
	(3,738)	(2,402)	(6,140)
8. Administration	1,588	969	2,557
	(7,477)	(4,805)	(12,282)
9. Physical Contingency	3,176	1,937	5,113
	(96,065)	(64,805)	(160,870)
Total (1 - 9)	45,900	30,667	76,567
	(143,283)	(219,672)	(362,955)
10. Price Escalation	64,731	81,676	146,407
	(239,348)	(284,477)	(523,825)
Total (1 - 10)	110,631	112,343	222,974

Note: Figure in parenthesis indicates the cost of "With Mangol Dam"

TABLE 7.3-3 PROJECT COST OF HARAZ EAST DISTRICT (HE-I)

(Unit: Million Rial)

Description	Foreign Currency	Local Currency	Total Amount
1. Construction Work			
	(44,375)	(29,583)	(73,958)
1.1 Mangol Dam	0	0	0
1.2 Diversion Dam	391	587	978
1.3 Main Canal	906	557	1,463
1.4 Secondary Canal	4,161	5,175	9,336
1.5 Tertiary Canal	1,316	3,087	4,403
1.6 Land Consolidation	25,413	10,599	36,012
1.7 River Training	271	116	387
1.8 O & M Road	380	20	400
	(77,504)	(49,895)	(127,399)
Sub-Total	33,129	20,312	53,441
2. Procurement of C. E.	5,115	495	5,610
	(378)	(804)	(1,182)
3. Survey/Investigation	374	796	1,170
	(4,440)	(5,223)	(9,663)
4. Detailed D./Const. Sv.	3,690	4,848	8,538
	(60)	(90)	(150)
5. Building/Motor Pool	60	90	150
	(0)	(2,877)	(2,877)
6. Land Acquisition	0	2,015	2,015
	(585)	(65)	(650)
7. O & M Equipment	585	65	650
	(3,875)	(2,495)	(6,370)
8. Administration	1,656	1,016	2,672
	(7,750)	(4,990)	(12,740)
9. Physical Contingency	3,313	2,031	5,344
	(99,707)	(66,934)	(166,641)
Total (1 - 9)	47,922	31,668	79,590
	(149,574)	(233,914)	(383,488)
10. Price Escalation	68,486	91,438	159,924
	(249,281)	(300,848)	(550,129)
Total (1 - 10)	116,408	123,106	239,514

Note: Figure in parenthesis indicates the cost of "With Mangol Dam"

TABLE 7.3-4 PROJECT COST OF HARAZ EAST DISTRICT (HE-II)

(Unit: Million Rial)

Description	Foreign Currency	Local Currency	Total Amount
1. Construction Work			
	(34,387)	(22,925)	(57,312)
1.1 Mangol Dam	0	0	0
1.2 Diversion Dam	303	455	758
1.3 Main Canal	744	443	1,187
1.4 Secondary Canal	1,076	1,036	2,112
1.5 Tertiary Canal	1,147	1,441	2,588
1.6 Land Consolidation	15,757	7,955	23,712
1.7 River Training	210	90	300
1.8 O & M Road	334	17	351
	(54,184)	(34,495)	(88,679)
Sub-Total	30,080	19,723	49,803
2. Procurement of C. E.	3,751	363	4,114
	(320)	(680)	(1,000)
3. Survey/Investigation	317	673	990
	(3,256)	(3,830)	(7,086)
4. Detailed D./Const. Sv.	2,706	3,555	6,261
	(44)	(66)	(110)
5. Building/Motor Pool	44	66	110
	(0)	(2,337)	(2,337)
6. Land Acquisition	0	1,705	1,705
	(495)	(55)	(550)
7. O & M Equipment	495	55	550
	(2,709)	(1,725)	(4,434)
8. Administration	990	579	1,569
	(5,418)	(3,450)	(8,868)
9. Physical Contingency	1,980	1,157	3,137
	(70,177)	(47,001)	(117,178)
Total (1 - 9)	30,080	19,723	49,803
	(105,691)	(167,775)	(273,466)
10. Price Escalation	42,898	57,431	100,329
	(175,868)	(214,776)	(390,644)
Total (1 - 10)	72,978	77,154	150,132

Note: Figure in parenthesis indicates the cost of "With Mangol Dam"

TABLE 7.3-5 PROJECT COST OF HARAZ EAST DISTRICT (HE-III)

(Unit: Million Rial)

Description	Foreign Currency	Local Currency	Total Amount
1. Construction Work			
	(17,909)	(11,939)	(29,848)
1.1 Mangol Dam	0	0	0
1.2 Diversion Dam	158	237	395
1.3 Main Canal	92	153	245
1.4 Secondary Canal	1,451	1,378	2,829
1.5 Tertiary Canal	542	971	1,513
1.6 Land Consolidation	8,522	4,841	13,363
1.7 River Training	109	47	156
1.8 O & M Road	141	7	148
	(29,042)	(19,642)	(48,684)
Sub-Total	11,133	7,703	18,836
2. Procurement of C. E.	2,046	198	2,244
	(144)	(306)	(450)
3. Survey/Investigation	144	306	450
	(1,766)	(2,089)	(3,865)
4. Detailed D./Const. Sv.	1,476	1,939	3,415
	(24)	(36)	(60)
5. Building/Motor Pool	24	36	60
	(0)	(1,120)	(1,120)
6. Land Acquisition	0	775	775
	(225)	(25)	(250)
7. O & M Equipment	225	25	250
	(1,452)	(982)	(2,434)
8. Administration	557	385	942
	(2,904)	(1,964)	(4,868)
9. Physical Contingency	1,113	770	1,883
	(37,613)	(26,362)	(63,975)
Total (1 - 9)	16,718	12,137	28,855
	(59,564)	(109,127)	(168,781)
10. Price Escalation	26,787	51,236	78,023
	(97,177)	(135,579)	(232,756)
Total (1 - 10)	43,505	63,373	106,878

Note: Figure in parenthesis indicates the cost of "With Mangol Dam"

TABLE 7.3-6 PROJECT COST OF AMOL WEST DISTRICT (AW-I)

(Unit: Million Rial)

Description	Foreign Currency	Local Currency	Total Amount
1. Construction Work			
	(22,093)	(14,728)	(36,821)
1.1 Mangol Dam	0	0	0
1.2 Diversion Dam	80	120	200
1.3 Main Canal	625	816	1,441
1.4 Secondary Canal	516	568	1,084
1.5 Tertiary Canal	785	996	1,781
1.6 Land Consolidation	11,714	4,864	16,578
1.7 River Training	355	52	407
1.8 O & M Road	210	11	221
	(36,378)	(22,155)	(58,533)
Sub-Total	14,285	7,427	21,712
2. Procurement of C. E.	2,387	231	2,618
	(262)	(557)	(819)
3. Survey/Investigation	259	551	810
	(2,072)	(2,437)	(4,509)
4. Detailed D./Const. Sv.	1,722	2,262	3,984
	(28)	(42)	(70)
5. Building/Motor Pool	28	42	70
	(0)	(1,798)	(1,798)
6. Land Acquisition	0	1,395	1,395
	(405)	(45)	(450)
7. O & M Equipment	405	45	450
	(1,819)	(1,108)	(2,927)
8. Administration	714	371	1,085
	(3,638)	(2,216)	(5,854)
9. Physical Contingency	1,429	743	2,172
	(46,989)	(30,589)	(77,578)
Total (1 - 9)	21,229	13,067	34,296
	(73,259)	(118,974)	(192,233)
10. Price Escalation	32,872	47,738	80,610
	(120,248)	(149,563)	(269,811)
Total (1 - 10)	54,101	60,805	114,906

Note: Figure in parenthesis indicates the cost of "With Mangol Dam"

TABLE 7.3-7 PROJECT COST OF AMOL WEST DISTRICT (AW-II)

(Unit: Million Rial)

Description	Foreign Currency	Local Currency	Total Amount
1. Construction Work			
	(48,233)	(32,155)	(80,388)
1.1 Mangol Dam	0	0	0
1.2 Diversion Dam	174	261	435
1.3 Main Canal	1,226	1,739	2,965
1.4 Secondary Canal	2,081	3,248	5,329
1.5 Tertiary Canal	1,637	2,097	3,734
1.6 Land Consolidation	13,501	3,946	17,447
1.7 River Training	775	114	889
1.8 O & M Road	521	27	548
	(68,148)	(43,587)	(111,735)
Sub-Total	19,915	11,432	31,347
2. Procurement of C. E.	5,456	528	5,984
	(436)	(927)	(1,363)
3. Survey/Investigation	432	918	1,350
	(4,736)	(5,571)	(10,307)
4. Detailed D./Const. Sv.	3,936	5,171	9,107
	(64)	(96)	(160)
5. Building/Motor Pool	64	96	160
	(0)	(3,245)	(3,245)
6. Land Acquisition	0	2,325	2,325
	(675)	(75)	(750)
7. O & M Equipment	675	75	750
	(3,407)	(2,179)	(5,586)
8. Administration	996	572	1,568
	(6,815)	(4,359)	(11,174)
9. Physical Contingency	1,992	1,143	3,135
	(89,737)	(60,567)	(150,304)
Total (1 - 9)	33,466	22,260	55,726
	(140,522)	(239,068)	(379,590)
10. Price Escalation	52,279	83,305	135,584
	(230,259)	(299,635)	(529,894)
Total (1 - 10)	85,745	105,565	191,310

Note: Figure in parenthesis indicates the cost of "With Mangol Dam"

TABLE 7.3-8 PROJECT COST OF AMOL EAST DISTRICT (AE-I)

(Unit: Million Rial)

Description	Foreign Currency	Local Currency	Total Amount
1. Construction Work			
	(23,857)	(15,904)	(39,761)
1.1 Mangol Dam	0	0	0
1.2 Diversion Dam	86	129	215
1.3 Main Canal	794	845	1,639
1.4 Secondary Canal	1,265	1,413	2,678
1.5 Tertiary Canal	331	578	909
1.6 Land Consolidation	10,365	4,934	15,299
1.7 River Training	146	62	208
1.8 O & M Road	257	13	270
	(37,400)	(24,000)	(61,400)
Sub-Total	13,543	8,096	21,639
2. Procurement of C. E.	2,728	264	2,992
	(232)	(495)	(727)
3. Survey/Investigation	230	490	720
	(2,368)	(2,786)	(5,154)
4. Detailed D./Const. Sv.	1,968	2,586	4,554
	(32)	(48)	(80)
5. Building/Motor Pool	32	48	80
	(0)	(1,700)	(1,700)
6. Land Acquisition	0	1,240	1,240
	(360)	(40)	(400)
7. O & M Equipment	360	40	400
	(1,870)	(1,200)	(3,070)
8. Administration	677	405	1,082
	(3,740)	(2,,400)	(6,140)
9. Physical Contingency	1,354	810	2,164
	(48,730)	(32,933)	(81,633)
Total (1 - 9)	20,892	13,979	34,871
	(75,882)	(128,679)	(204,561)
10. Price Escalation	32,242	51,682	83,924
	(124,612)	(161,612)	(286,224)
Total (1 - 10)	53,134	65,661	118,795

Note: Figure in parenthesis indicates the cost of "With Mangol Dam"

TABLE 7.3-9 PROJECT COST OF AMOL EAST DISTRICT (AE-II)

(Unit: Million Rial)

Description	Foreign Currency	Local Currency	Total Amount
1. Construction Work			
	(29,716)	(19,811)	(49,527)
1.1 Mangol Dam	0	0	0
1.2 Diversion Dam	107	161	268
1.3 Main Canal	928	1,037	1,965
1.4 Secondary Canal	1,544	754	2,298
1.5 Tertiary Canal	377	637	1,014
1.6 Land Consolidation	12,203	5,753	17,956
1.7 River Training	181	78	259
1.8 O & M Road	327	17	344
	(45,712)	(28,383)	(74,095)
Sub-Total	15,996	8,572	24,568
2. Procurement of C. E.	3,410	330	3,740
	(262)	(557)	(819)
3. Survey/Investigation	259	551	810
	(2,960)	(3,482)	(6,442)
4. Detailed D./Const. Sv.	2,460	3,232	5,692
	(40)	(60)	(100)
5. Building/Motor Pool	40	60	100
	(0)	(1,970)	(1,970)
6. Land Acquisition	0	1,395	1,395
	(405)	(45)	(450)
7. O & M Equipment	405	45	450
	(2,286)	(1,419)	(3,705)
8. Administration	800	429	1,229
	(4,571)	(2,838)	(7,409)
9. Physical Contingency	1,600	857	2,457
	(59,646)	(39,084)	(98,730)
Total (1 - 9)	24,970	15,471	40,441
	(92,828)	(152,977)	(245,805)
10. Price Escalation	38,466	57,048	95,514
	(152,474)	(192,061)	(344,535)
Total (1 - 10)	63,436	72,519	135,955

Note: Figure in parenthesis indicates the cost of "With Mangol Dam"

TABLE 7.3-10 PROJECT COST OF AMOL EAST DISTRICT (AE-III)

(Unit: Million Rial)

Description	Foreign Currency	Local Currency	Total Amount
1. Construction Work			
	(42,422)	(28,281)	(70,703)
1.1 Mangol Dam	0	0	0
1.2 Diversion Dam	153	230	383
1.3 Main Canal	1,421	1,506	2,927
1.4 Secondary Canal	1,090	640	1,730
1.5 Tertiary Canal	2,098	1,897	3,995
1.6 Land Consolidation	21,211	13,821	35,032
1.7 River Training	259	111	370
1.8 O & M Road	368	19	387
	(69,560)	(46,725)	(116,285)
Sub-Total	27,138	18,444	45,582
2. Procurement of C. E.	4,433	429	4,862
	(436)	(927)	(1,363)
3. Survey/Investigation	432	918	1,350
	(3,848)	(4,527)	(8,375)
4. Detailed D./Const. Sv.	3,198	4,202	7,400
	(52)	(78)	(130)
5. Building/Motor Pool	52	78	130
	(0)	(3,073)	(3,073)
6. Land Acquisition	0	2,325	2,325
	(675)	(75)	(750)
7. O & M Equipment	675	75	750
	(3,478)	(2,336)	(5,814)
8. Administration	1,357	922	2,279
	(6,956)	(4,673)	(11,629)
9. Physical Contingency	2,714	1,844	4,558
	(89,438)	(62,843)	(152,281)
Total (1 - 9)	39,999	29,237	69,236
	(140,975)	(256,887)	(397,862)
10. Price Escalation	63,451	120,132	183,583
	(230,413)	(319,730)	(550,143)
Total (1 - 10)	103,450	149,369	252,819

Note: Figure in parenthesis indicates the cost of "With Mangol Dam"

CHAPTER 8. PROJECT BENEFITS

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8.1 Components of Project Benefits

The project is comprised of two major elements, namely, improvement in irrigation and drainage facilities, and land consolidation, which after implementation will result in improved productivity. The difference between these two elements lies in the domain of benefit, i.e., the benefits brought about by the former covers the entire beneficiary area while those generated by the latter are confined locally to the improved land only. Also, these two components are not completely independent, because implementation of land consolidation alone without the accompanying necessary improvement would result in reduced benefits. Of course the reverse case would provide only results in the renewal of water conveyance system and the benefits would be limited.

The direct benefits can be divided into two parts, i.e., crop benefits and labor productivity. Crop productivity will be improved by the project in two ways; increase in yield and introduction of winter crop or expanded land use with higher crop diversification but minor area ullage due to appropriation of a part of arable land to farm-roads, water channels or field bunding etc. The relationship between works and expected benefits is summarized as follows.

Benefit Type	Reflected From	Benefit Item	Origin of Benefits
Crop Benefits	+ acreage	+ winter crops	L.C. + D.W.
	- acreage	- cropland ullage	L.C.
	+ *yield gain*	+ increased output	I.W. + D.W. + L.C.
Labor Productivity	+ labor saving	- labor cost	L.C. + D.W.
	+ scale merit	- machinery cost	L.C. + D.W.
	- depreciation	+ machinery cost	L.C.

Note: L.C.; land consolidation, D.W.; drainage I.W.; irrigation

8. 2 Benefits from Incremental Production

As stated above, inevitable ullage in cropping area results from land consolidation, the acreage of which is estimated at 5% of currently existing paddy field in the project area, taking the design for the model-pilot plots and also topography, distribution of farm-roads or water channels. It follows that a negative benefit will result from this decrease in rice plot acreage.

Though the production value of rice accounts for about three fourths of the total with-project value, the increment of winter crops is large enough to account for over three fourths of the total net crop benefit as far as the "net" basis is concerned. Here, benefit from livestock expansion is not counted because this sector is out of the project component and deemed as an intangible one.

Another benefit stems from the improved yield levels of rice and berseem. Whose effects were estimated from the results of field trials by Sari Rice Research Station, as given in Appendix C. 2. 5 to C. 2. 7 and E. 3. 3-4.

With-project yields of rice, on the basis of without-dam project, were quantified based on the effects of prevention of fertilizer/chemical loss derived from improvement in plot to plot irrigation, of the optimum planting density and the optimal number of seedlings per hill realized by the employment of transplanters on the consolidated fields. Likewise, those on the basis of with-dam project were estimated by adding the effect of irrigation (or drought prevention) as well as mid-summer drying (this drainage practice is only applicable under water sufficient condition) to the above-mentioned yield levels on the basis of without-dam project. As to that of berseem, only drainage effect (leading to better development of root system) was applied to estimate the target yield.

As a result, yield increment rate of rice varieties on without-dam basis range 7.3 - 11.1% (variable with maturity type), whereas those on with-dam basis yield 12.9 - 16.7% better, while that for berseem remains at 14.3% regardless of whether dam is included or not.

8. 3 Effect of Labor Saving

One of the effects characteristic to land consolidation lies in its labor saving, that is brought about by larger mechanized acreage, larger machinery size (so-called "scale merit") and wider coverage of farm practices by machinery, ultimately leading to higher labor productivity.

The precondition under which larger sized machinery or that for specific purposes like transplanter or combine harvester can be applied is the consolidated field with access farm-roads and improved drainage for better trafficability. In other words, the efficient use of machinery is only secured on the improved plots, where substantial cost saving for machinery use per unit area can be realized.

Labor requirement for rice cultivation per hectare will decrease from 74.3 man-days to 20.9 man-days through mechanization with a system of transplanter -autothreshing combine- larger size tractor. Further, the labor peak during planting and harvesting periods has created a bottleneck inhibiting development of winter cropping, but the saved labor will be available for planting and harvesting winter crops. Nevertheless, a windfall benefit is hardly expected from labor saving only because it requires input costs covering land consolidation works, depreciation and running costs for larger sized farm machinery. The difference in the costs between the present and with-project base for rice production is as follows :

Comparison of Farming Costs per Hectare

Unit : 1,000 Rial/ha

Item Financial or Economic Price	Total Cost		Labor Cost		Machin. Cost		Needed Man-days per ha.
	Fin.	Econ.	Fin.	Econ.	Fin.	Econ.	
Without Project	610	434	520	196	207	174	74.3
With Project	780	683	136	60	538	538	20.9

8. 4 Direct Benefits by Sub-areas

The total tangible project benefits are estimated, on the basis of financial and economic benefits per ha, as follows.

(million Rial)

		Financial Basis	Economic Basis
Total Annual Net Benefit	W.O.P	157,754	87,921
	W.P.	212,872	156,628
	Net Gain	55,518	68,707
Per ha Net Benefit (mean)	W.O.P.	1.973	1.099
	W.P.	2.801	2.061
	Net Gain	0.828	0.962

Note: W.O.P.; without project, W.P.; with project

The figures shown above are broken down by sub-areas taking account of crop composition, breakdown of construction costs and covering area (hectareage). The results are listed in Appendix E.3.

8. 5 Indirect Benefits

Indirect benefits consist of secondary and inevitable or those associated to the direct components. The largest benefit is brought about by the livestock sector, because winter crops are occupied mainly by fodder berseem, and price levels of livestock products have been much higher than those of grains and vegetables, both in the domestic and international market.

The major indirect benefits are listed in the following.

Direct Benefits	Secondary Benefits	Associated Benefits
Increase of Crop Production	Expansion of: Livestock Farming Agri-product Processing Marketing & Transporting Machinery-related Service	Increase of Employment -ditto- -ditto- -ditto-
Increase of Winter Cropping	Increase of Livestock Productivity	Expansion of Regional Economy Supply of Organic Materials in Soil
	Moderation of Seasonal Fluctuation of Labor Demand	Creation of Time for Refreshment throughout Year
Labor Saving	Increase of Off-farm Income	Activation of Regional Economy
(Facilities Improvements)		(Conservation of Water Quality & Environment) (Traffic & Living Convenience)

CHAPTER 9. PROJECT EVALUATION

CHAPTER 9. PROJECT EVALUATION

9. 1 Methods of Project Evaluation

The project aims to provide a structural base for agriculture production through radical improvement to paddy production system, and thus reactivate the current leveled-off paddy production to meet higher demand for rice in the near future. According to this strategy, the evaluation should be based on a projection of long term impact with particular attention paid to labor productivity and land use intensification achieved through improved farming structures.

The evaluation consists of a tangible part, by way of cost-benefit analysis, and an intangible one.

The former compares tangible benefits, derived from the project, with the project cost. In this context, two approaches are necessary, i.e., a financial approach from beneficiary farmers' point of view and an economic one from the stand-point of national interest. The financial approach indicates a basis for project justification on which the farmers concerned are convinced to participate, and the latter offers a clue for official judgment when estimating public interest of the irrigation and drainage works.

In compliance with the content of this study, the range of tangible analysis is limited to crop benefits. Livestock and post-harvest processing, the added value sectors result from increased production, are not included. This is why secondary benefits from crops are not quantitatively estimated, but is included in the evaluation through intangible benefits. It follows that the range of cost-benefit evaluation should be confined to farm-gate delivery for rice production, for berseem delivery to farm feeding-lot after cutting, and for other products delivery to the nearby markets.

Crop benefits from the project comprise of increased paddy production in the improved field after the completion of irrigation, drainage and land consolidation works (applicable to the entire improved paddy area), decreased paddy production attributed to loss of arable land to farmroads, bunds etc, and

increased production of winter crop (the latter two are only applicable to the consolidated land) and cost saved from improved productivity brought about by farm mechanization.

Project cost consists of construction costs, operation and maintenance costs of irrigation, drainage and land consolidation works. Since it is difficult to correspond these three components to individual benefits, a rough comparison is made to clarify the relationship between works and benefits (refer to the Appendix E. 3. 4-1). As a matter of course benefit is further expected in the form of improved local life and marketing convenience. These are evaluated as intangible benefits in the light of the delineation of project range. They can be quantified into tangible ones but it requires specific investigation and analysis.

The following economic analysis deals with tangible evaluation based on economic prices. The possible impacts of change in implementation period, fluctuation in project cost and benefit, and foreign exchange rates on the B/C ratios or IRRs are evaluated by sensitivity analysis. The shadow exchange rate, is not used in the conversion rate for local currency portion. The subsequent financial analysis estimates project benefits per ha as well as per average size farm household, based on current farm-gate prices.

9. 2 Economic Analysis

9. 2. 1 Economic Project Cost and Economic Benefits

The cost components of the project are divided into foreign and domestic currency portion. Applying conversion rates to the latter convert it to economic prices. The economic costs for equipment and machinery for construction and farm production are obtained by applying the current effective official rate for the imports (600 Rial/US $). The economic prices for imported equipment, materials, technology, kerosene etc. are calculated as border prices, or the sum of CIF international prices and inland transportation cost. Similarly, border prices are used for agricultural outputs. The price of berseem in economic terms is derived from the feed value equivalent, and farm-gate prices are employed for vegetables. The list of project benefits in terms of economic price by item of works and crops is given (with corresponding

financial benefits) in Appendix E.3. The degree of contribution by other component crops and labor productivity, as a share of total contribution, are also given in the same table.

9. 2. 2 Economic Internal Rate of Return

Economic benefits and costs, B/C ratios and internal rate of return for the whole Project Area and sub-districts are listed in Appendix E. 3. 5-1.

Since the interest rates of agricultural credits is 9% for farming facility, and 12% for agricultural machinery, inputs, cooperative activities and handicraft, EIRR of the whole project is comparable to the rate of benefits from investment. Also, the usual range of EIRR for international coordinated agricultural projects in Iran is between 6 - 15%, so the economic viability of this project remains in a level similar to those of other international projects.

Case	Project EIRR	Project FIRR
Without-Dam	13.5%	10.1%
With-Dam	9.3%	6.5%

Without Dam	Project B/C (economic)	Project B/C (financial)
Discount Rate 12.0%	1.14	-
〃 9.0%	1.53	1.13
〃 6.0%	2.20	1.63
〃 3.0%	-	2.56

As stated in 4. 4. 5 (5), development of new water resources for the project calls for the construction of a storage dam with a capacity of roughly 300 million m^3 as effective storage during drought years occurring once in ten years according to the result of water balance study covering the planned command area. On the other hand, about 10% of the annual water requirement will be short during ordinary years.

This implies that the construction of Mangol Dam be a major task to be acutely fulfilled, but no detailed survey thereof has so far been carried out to justify the construction project.

This study could identify the necessity of constructing it for the beneficiary of irrigated from the Haraz river, but it does not include technical investigation and study with regard to the dam construction. The anticipated benefits of the said dam are not confined to the effect of irrigation but also the feasibility of creating effects of supplying municipal and industrial water to the metropolitan area of Tehran are also expected, hence it is considered that a comprehensive study for the project be urgently conducted by the MOE.

Since the roughly estimated project cost related with Mangol Dam described in this report is not based upon a scrutinized investigation and technical review, it would be far from proper judgment to use this estimation (on the basis of EIRR = 9.3%) for the feasibility of the dam-project.

Accordingly, as a conclusion of the study with regard to this project, the construction of Mangol Dam is suspended for the time being until a detailed investigation of the dam project is completed. However, the project implementation covering its components other than the dam is envisaged to be significantly urgent, judging from the current situation found in the project area. It will greatly contribute to the development of rural economy because the steadily implemented project will bring about secure benefits through agricultural mechanization and expansion of winter cropping, though a significant leap in rice yields is hardly expected.

9. 2. 3 Sensitivity Analysis

The major influencing factors considered in economic feasibility of the project area are change in construction period, in particular the rate of progress of land consolidation, fluctuation in construction cost and benefits attributable to technical ability and inflation, and fluctuation of different foreign exchange rates used for cost-benefit estimation. One-sided cost rise in agricultural investment without the accompanying price escalation of agricultural products, or the so called cost-price squeeze, has so far never been observed in medium term trends of national economy since 1980s. It follows that the cost increment will certainly be reflected in rising prices of agricultural products, even there exists some time lag between them. Taking this point into account, the time lag between rising price of construction materials or labor costs and that of agricultural products is chosen as a factor for sensitivity analysis instead of

one-sided price escalation in construction cost. The results are given in Appendix E. 3. 6-1.

The analysis indicates that though unexpected paddy failure (stagnant yield growth) and delay in land consolidation works affect to a fairly large degree cost-benefit factors, it does not go beyond the breakeven point where the benefits cannot offset the total project cost.

9. 3 Financial Analysis

9. 3. 1 Financial Situation of the Representative Farm Household

Most of the farm households in the Project Area hold small scale farmland averaging 1.4 ha in Babol and 1.7 ha in Amol and are taken as typical type for the respective area. For each of these types the current balance and expected farm and non-farm incomes with project are shown below.

Project Economy of Farm Household

Farm Size	1 ha	1 ha	2.5 ha	2.5 ha	5 ha	5 ha
Annual Crop Acreage						
Before Project	1.43 ha	1.30 ha	3.10 ha	2.93 ha	5.50 ha	5.35 ha
Increase by Project	0.32 ha	0.33 ha	0.85 ha	0.83 ha	2.00 ha	1.30 ha
Household Income (million Rial/family)						
Before Project	3.0	2.9	5.8	5.7	11.1	11.0
Increase by Project	1.1	0.9	2.2	2.3	4.4	3.4
Surplus After Project	1.4	1.1	3.9	3.9	7.0	6.0
Land Consolidation Charge	0.4	0.4	0.9	0.9	1.8	1.8
Ultimate Surplus	1.0	0.7	3.0	3.0	5.2	4.2
% of Farmers Burden	26%	33%	23%	23%	26%	30%

9. 3. 2 With Project Financial Analysis

From the results as cited above, an increase in net profit per farm, as seen in the above shown Table, can be expected for farming with larger sized machinery on land consolidated by the project. In this case, however, the beneficiary farmers are expected to be burdened by a share, with a part of their expanded incomes, to offset the project cost.

9. 4 Project Cost Sharing by the Beneficiary Farmers

It is considered reasonable for the beneficiary farm households to pay annual installment for burden-sharing to offset project cost (for land consolidation). The amount is shown in Appendix E.3 . This amount is given for a standard farm household, and otherwise is also the rough estimate for the amount per ha, as shown in the same table. For those who participate in land consolidation credit facility should be accessible so that they can share the cost by annual installment. From the analysis it was proved that the annual cost sharing by a beneficiary farmer ranges 23 ~ 33% of his annual surplus, in other words within a reasonable range for burden sharing.

9. 5 Comprehensive Evaluation

As regard to intangible benefits, the following benefits are expected from the project.

(1) promotion of livestock sector, and a combined agronomy and livestock sector,

(2) activation of agro-processing and storage sector,

(3) fostering agricultural marketing and service sector,

(4) utilization of surplus labor force resulted from the project for non-farm sectors aiming at augmenting non-farm incomes,

(5) improvement of rural life, especially in transport brought about by consolidation of farm infra-structure,

(6) conserving natural ecosystem through enhanced manipulation of groundwater recharge and runoff retardation.

Expansion and improvement in livestock sector will be fostered by the increase in acreage under berseem, leading to building of new livestock herds and subsequent augmented output of livestock products. Some of the surplus labor within the farm households can be oriented to and be absorbed by animal husbandry. Also, additional effect such as sustenance of soil fertility can be expected in a farming system combining crop production with livestock.

Furthermore, the increased paddy and vegetables output expand distribution and processing quantities, which in turn will enhance activities in transport, storage and processing, marketing and distribution, and other value-added sectors in the Project Area and thus create a range of labor opportunities. Living conditions will be improved when transportation becomes easy through improved road networks and better trafficability brought about by a higher farmroad density and better drainage.

The Islamic Republic of Iran has ample natural resources to feed her industry. Besides these resources, surplus labor in rural areas can be effectively utilized to develop the industries in the industrial quarters in urbanized areas. Hence, when the domestic economy is further liberalized and global recession recovers labor demand in industries and commerce sector will expand, thereby increasing non-farm household revenues.

Also, an overview of the agriculture in the country, with wide extended desert area, will show that the handicap or constraint comes from scarcity of water resources. Since the Project Area is located amidst the limited favorable zone with ample precipitation, exploitation of the available water resource will create the most efficient, wide spectrum of benefits. However, natural green environment series, which is not necessarily abundant in the country, is a precious treasure both of this region and the whole country. The proposed project is expected to contribute to the development of agriculture while observing duly the conservation of the existing natural environment.

Judging from all these aspects, the proposed project is fully justified in terms of natural, economic, social and technical significance.

CHAPTER 10. CONCLUSION AND RECOMMENDATION

CHAPTER 10. CONCLUSION AND RECOMMENDATION

10.1 Conclusion

10.1.1 Summary of Project Justification

The proposed project is justified from the evaluation process by EIRR, FIRR, B/C of both economic and financial terms and sensitivity analysis, though these methods can not represent an almighty procedure to evaluate development projects. On without-dam basis, the internal rate of return in terms of economic price, cost and benefit ratio lie within reasonable ranges for the project as total and for most of sub-districts. In this evaluation, interest rates of agricultural credits are adopted as a base of opportunity cost for the project.

On the other hand, those values for with-dam basis lie far below as compared with those without Dam basis, though B/C ratios still remain above 1.00. Therefore, the Project is not including the component of Mangol dam construction due to this economic situation and requirement of more comprehensive, detailed study for the confirmation of feasibility on the Mangol Dam.

10.1.2 Conclusion of the Proposed Project

The implementation of the project herewith proposed is duly evaluated feasible according to cost-benefit analysis and project evaluation. It will be timely served to pursue long-term national goals if it is implemented as early as possible because of the following:

(1) The Project Area is so to speak a granary of Iran but the production is being leveled off due to various constraints such as standstill in productivity improvement through mechanization attributable to poor drainage and dilapidation of irrigation facilities as well as typical monocultural cropping. Now the study submitted herewith has identified what are constraints and how they are overcome or improved, with a conclusion that water and land resources

should be more efficiently utilized to maximize total output therefrom, by introducing winter cropping and more reasonable combination of rice varieties in terms of water, land and machinery use, accompanied with compound farming with other sector like livestock. The study also reveals that the way of developing the area is technically justified without any particular difficulty except construction of Mangol dam. This direction is fully in compliance with what are included in the Five Year Plan to expand rice and fodder production to reduce imports and rely more on self-sustenance.

(2) Time seems to have ripened enough now for its implementation because CAPIC has been functioning and there have emerged a number of advanced cadres of farmers who are keen in improving their way of farming towards less hired labor cost or machinery cost, which diversify their agricultural activities as well as enhance land and water use to maximize agricultural production and value-addedness. They can take leadership and initiative to organize the whole beneficiary population to enjoy the benefits expected from the proposed project.

(3) The project will significantly contribute to create labor opportunities within the Project Area, thus improving labor absorbing capacity both through the process of construction works and after its completion in the field of agriculture and related sectors. During the period of world-wide economic recession, additional domestic labor opportunities are more valuable to those who will graduate from school and enter into active labor force or those who repatriate from foreign labor markets. It is also needless to say that exodus of younger generation from the area can be prevented on one hand, while growing difficulty in agricultural practice engaged mainly by aged farm labor can be eased by further mechanization, on the other.

(4) Last but not least is the environmental aspect of project implementation. The proposed project can be implemented without bringing about any serious detrimental or deleterious impact on the natural as well as living environment. In refraining from any artificial works on what have been designated as the protected area for international significance, those who implement the project are observant of any environmental care officially promoted. Even some positive contribution could be expected on environmental conservation from its implementation, because improved water control can reduce load of water pollutant/contaminants in effluent from rice fields and land consolidation works provide farmers with more convenient road/waterway networks in rural

areas. Well consolidated farmland is so to speak a value added to national wealth as compared with natural ground because of higher productivity and ease of controlling water, machinery, transport etc..

10. 2 Recommendations

(1) Major irrigation water sources in the Project Area constitute surface flow of the Haraz river, shallow wells scattered over the area and return flow within the area. A reservoir is required to supplement quantities in short, i.e., 300 MCM for the drought year recurring once in ten years and around 100 MCM for normal and ordinary years that arise from the difference between the irrigation pattern for rice crop and that of runoff discharge of the Haraz, as well as from a change induced by the introduction of more winter crops. An enormous amount of construction cost will be unavoidable for Mangol Dam to be planned in the Haraz basin, judging from its geologic and topographic conditions in the proposed site, also from the cost of relocating the national high way running along the basin. There, the plan should be considerately reviewed from the viewpoint of feasibility of allocating the cost among municipal and industrial water supply to the urban area in and around Tehran, hydro-power generation and irrigation for the Project Area, along with the detailed survey for the feasibility of those implementation.

In this case, relevant measures should be taken to supplement water to meet the water shortage in ordinary years, and also it is imperative to make effort to realize the expected measures through a coherent coordination between the beneficiary farmers and administrative authorities concerned, such as reinforcement of flexible water management for Lar Dam, including limited discharge from the Dam during wet year/season and appropriate discharge during dry year/season, efficient use of abbandans within the project area (with more frequent turns as well as expansion in their storage capacities by dredging), improvement in water management techniques inclusive of timely utilization of groundwater resources during dry periods and their reuse. In this context, and outline of the guidelines for relevant water management is stipulated in Appendix B. 1. 4.