SUPPORTING REPORT

PAPER 6

CONFLICT MANAGEMENT

THE STUDY ON INTEGRATED WATER RESOURCES MANAGEMENT FOR SEFIDRUD RIVER BASIN IN THE ISLAMIC REPUBLIC OF IRAN

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Note: The Contents without any reference source were prepared by JICA Study Team.

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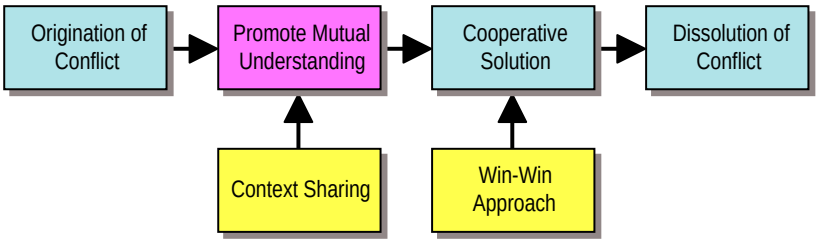
CHAPTER 1. INTRODUCTION

1.1 CONFLICT ANALYSIS AND MUTUAL UNDERSTANDING

Differences of the stakeholders are the origin of the conflict. As each stakeholder sticks to his/her own values, objectives, viewpoints, profits, thoughts, etc. conflicts are originated and it makes the conflict solution difficult as well. Therefore, the first step to the conflict solution is mutual understanding of stakeholders through communication. It should be noted that not only information but also context (background of each stakeholder) which exists behind the conflict should be shared by all the stakeholders with this communication. Information is interpreted through the background of a person. So, information has different meaning when the person has different background. That is why conflict analysis which grasps the background of the stakeholders is indispensable for conflict management. Thus, the conflict analysis was held to grasp the background.

In addition, it should also be noted that conflict is not necessary be solved when the stakeholders come to understand mutually. If resources are scarce or objectives of stakeholders compete against each other (water allocation problem is a typical case), mutual understanding by itself has little power for solution. In such case, stakeholders should find a solution by taking so called Win-Win Approach (See the boxed article below), where stakeholders cooperate each other to maximize each stakeholder's gain. Otherwise, the conflict would continue for a long-time and the total sum of gains as well as one's own gain would be likely decreased. In the Win-Win Approach, stakeholders can foster confidence each other through cooperative communication and then build up an idea of creative solutions.



Source: Hori, Kimitoshi *"Facilitation Skill Training"* 2003, p.113; Modified by JICA Study Team

Figure 1.1.1 Mutual Understanding and Conflict Solution

[Five Modes to be Taken by Human Beings in the Situations of Confrontation]

- Competitive ·····To solve the confrontation with sacrificing (persuading) the opponent and concentrating the benefit to oneself,
- Receptive ·····To solve the confrontation with inhibiting one's request and accept the opponent's request,
- Evasive ·····No to solve the confrontation in the situation with avoiding the situation,
- Compromising ·····To solve the confrontation with reducing the request levels mutually and realizing the benefit partially, and
- Cooperative ·····To solve the confrontation with giving the opponent's standpoint serious consideration mutually and make cooperation (Win-Win Approach can be applied).

Appropriateness depends on the situation for each mode. "Cooperative Mode" may be appropriate for water resources management with applying Win-Win Approach in order to realizing more preferable benefits.

1.2 APPROACH OF CONFLICT MANAGEMENT IN THIS STUDY

Water resources are becoming scarce more and more due to demand increase accompanying with social development. Conditions of surface water runoff and groundwater recharge differ in each basin due to meteorological (precipitation) and geological / topographical conditions. Historically, water conflicts have been continuing between upper and lower reaches or between urban and rural areas, as well as between provinces and countries in the world. Such conflicts have been coordinated with concluding agreements or promoting integrated water resources development. Considering such background of water resources management in general, the following approaches is applied to this Study:

(i) Background of conflicts is grasped by conducting workshops with related organizations, users and others including stakeholders (Conflict Analysis);

(ii) Actual conditions and solutions of the conflict are discussed with presenting case examples on conflict management in foreign countries. In addition, it is proposed and discussed that how the coordination rules among stakeholders are conducted; and

(iii) Coordination principles, which are incorporated in the water resources management plan, are proposed.

With applying this approach, conflict analysis for (i), some of stakeholder meetings for (ii) and local consultation for (iii) were planned and executed in the Study. The flow of these activities in the Study is illustrated below.

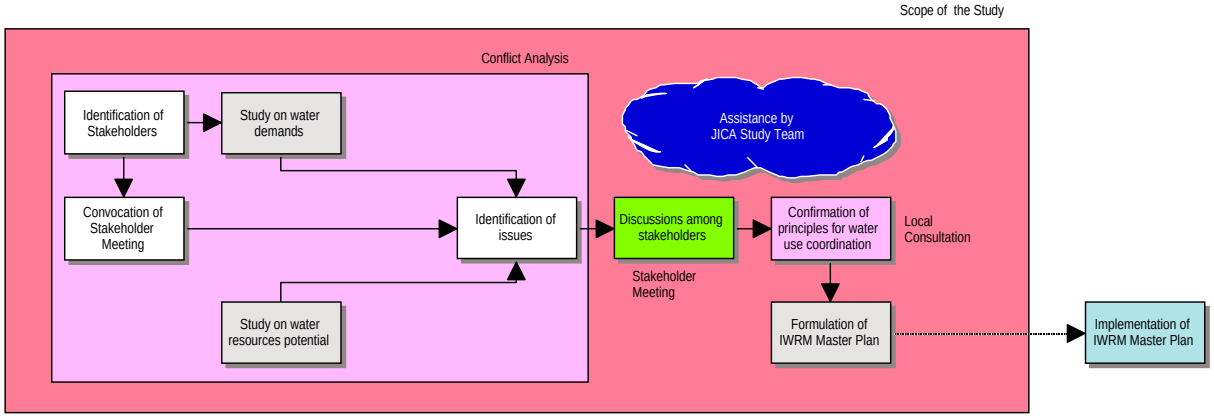


Figure 1.2.1 Flow of Conflict Analysis in Study

CHAPTER 2. ACTIVITIES OF CONFLICT MANAGEMENT IN THIS STUDY

2.1 STAGES OF CONFLICT MANAGEMENT

Based on the ideas mentioned before, consensus among the related Provinces has been pursued with the following stages:

Table 2.1.1 Stages of Conflict Management

Stages	Study Activities for Conflict Management	Time Frame
First Stage: Confirmation of the will to formulate an IWRM To present clearly the image of what water resources would be without an IWRM	It could be thought that there existed a tacit agreement on the necessity for the formulation of the plan because the stakeholder meetings have been held for nine times and each member joined the meeting every time (See **2.2 Stakeholder Meetings**). Although the image of the future water resources was presented in the results of the simulation, such will was not confirmed as a explicit agreement. Then, representatives of the Provinces were required to express their ideas of the necessity for an IWRM when JICA Study Team visited each Province for the workshop for conflict analysis (See **2.3 Workshop for the Conflict Analysis**).	Workshop for the conflict analysis: Jun. - Jul. 2008
Second Stage: Confirmation on the relation between water resources potential and design water demands in the river basin To present water resources potential as a result of scientific estimation in the river basin To present acceptable water demand estimations	Simulation results of the relation between water resources potential and design water demands were presented as the results of the simulation in the stakeholder meetings. It is very difficult to get a simple agreement on water demands because each Province has doubts about the data provided by other Provinces. It was fully explained that the Study has been conducted from the impartial standpoint and the model should be improved by the engineers of the Provinces themselves later in order to be accepted.	Stakeholder Meetings: Feb. and May 2009 Workshop for technical training on the simulation model for the engineers of the Provinces: May 2009
Third Stage: Confirmation on the principles of water allocation	Water use coordination based on the simulation and the setup of the improvement in irrigation efficiency in the future were discussed in the Local Consultation and Stakeholder Meetings (See **2.4 Local Consultation**). It can be a very starting point of the "tentative" agreement among the Provinces. It was reported that legal discussion on water use rights be put on a shelf. (Legal discussions take a long time to be settled and lead a win or loss, resulting in an obstacle in the way of agreement.) An RBO (River Basin Organization) is considered as a place for the discussions for the tentative agreement. It is assumed that periodical discussions will be continued in the RBO after a tentative agreement is made in order to make new agreements (See **Chapter 7 Institutional Strengthening Plan on Water Resources Management and Coordination**).	Stakeholder Meetings: May 2009 Local Consultation in each Province for hearing comments on the draft of the M/P: May 2009

2.2 STAKEHOLDER MEETINGS

2.2.1 Outline of Stakeholder Meetings

1) Objectives

As it is expected that stakeholder meetings (SHMs) promote mutual understanding among the stakeholders by making them gather in one room, and face and discuss each other, not only the contents but also the meeting itself gives important opportunities for conflict management.

2) Methodology/Membership

SHMs were held for discussing the progress of the Study occasionally when the Study reached at some important points. They were chaired by the representatives of WRMC. JICA Study Team assisted holding of SHMs. The members of the SHMs are the representatives of RWCs of target Provinces except Hamedan due to its minimal impacts on the whole water uses in the Study Area in accordance with the initiative of the WRMC. Non-members such as local consultants are invited to the meetings for providing experts' information.

3) Main Discussions

SHMs were held for 9 times so far, and they are summarized as follows:

Table 2.2.1 Summary of Stakeholder Meetings (1/3)

No.	Date	Key Pints of Discussions
1	August 20, 2007	• The SHMs are identical with the steering committee meetings since the stakeholders are the representatives of RWCs, which are responsible for the allocation of water in their Provinces respectively. • Enough time should be spared for the review of the IC/R to the stakeholders or the RWC because the IC/R was drafted very precisely as well as it should be checked from the viewpoint of the compatibility with the guideline, namely "Long-Term Development Strategies for Iran's Water Resources." • Regardless of the above-mentioned, JICA Study Team can start basic studies including data collection, field surveys and the IEE preparation before the agreement is reached on the IC/R. • It should be reminded that data necessary for the models do not exist or their format is different from MIKE-BASIN and MIKE-SHE even if the data exist. • When the Study on the conflict is carried out, the local specialty of each target Province should be fully kept in mind.
2	September 12, 2007	• The Study Team works based on the Scope of Work. Cooperation by all the sides are required so as to finish the Study on time. • Concerning the data collection, necessary data should be clarified in more detailed manner (quantitatively and qualitatively). • The Study Team understands not only the importance of the laws but also the importance of their enforcement. • The Study Team remains impartial to all the stakeholders in the Study. • A simulation model is to be built up with the existing data which have some problems in completeness and accuracy at the first round. The models should be brushed up with the corrections and feedbacks by the Iranian counterparts gradually thereafter. The Study has the technology transfer programs such as workshops and OJTs which are expected to enable the Iranian counterparts to use the models.
3	March 2, 2008	• Necessary data to run the simulation models are not submitted by some RWCs. • According to the National Strategic Steering Committee for Water, the total amount of exploitable water is 5,000 MCM, of which 4,000 MCM has already been exploited on the one hand. The plans proposed by all the related Provinces require 1,800 MCM in total on the other hand. This means that setting priorities is crucial. • Rapid development of the area in the past 30 years has been causing problems. Thus, not only the amount but also the quality of water should be examined in this study.

Table 2.2.2 Summary of Stakeholder Meetings (2/3)

No.	Date	Key Pints of Discussions
4	May 31, 2008	• Simulation for 7.5 billion tons of water demand is to be carried out by the middle of June. Simulation result is expected to indicate water shortage, which may leads to prioritization of dam, demand control and improvement of irrigation efficiency. Simulation for target year 2016 is on going, which is expected to complete by June 2008. • Data which have not been described in MG report: (1) Land use and demand of water are to be collected; (2) Data of efficiency of irrigation is not available for some areas; (3) Satellite image is to be handed over to MG for generation of land use map; (4) Data in E.Azarbaijan and Kordestan have not properly considered in MG report. • Although the Study Team requested the report on economy, it was not submitted. Numbers of permanent staff and temporally staff of RWC is requested by the Study Team to be reported. • The workshop for conflict analysis is to be held in each stakeholder Province sequentially from June 12 to July 6. The word "conflict" in this study should be considered not as "fight" nor "battle" but as "water use coordination among water users."
5	July 12, 2008	• Preliminary results from the study on water demand were presented. • The workshop for conflict analysis finished successfully. The JICA Study Team collected hundreds of opinions and ideas of solutions for water related issues in each Province. • Water quality issues are to be studied further when necessary data are presented from the Provinces. • The Study is to enter the planning stage, based on the results so far. Further cooperation between related Provinces and JICA Study Team to be required to achieve a good outcome.
6	November 9, 2008	• Comments on the Interim Report were made by the related Provinces.
7	February 14, 2009	• The revised results from the study on water demand were presented. • The results from the workshop for conflict analysis were presented. • Comments on the presentations were requested to be sent later in writing.
8	May 6, 2009	• The further revised results from the study on water demand were presented. • The simulation model is being established, comparing with real conditions, but it can not be said that the model completely match the real conditions. It is necessary to improve the model through establishing a data base. • The ground water potential can not be made sure as detailed data of ground water are not acquired in each area. The Study applies a macro approach.
9	May 18, 2009	• Improvement of Irrigation Efficiency: The result is that all the proposed projects could be accepted if the irrigation efficiency was improved to the target level. Efforts and investment are required to achieve the target level. In addition, it is required to examine what would be if the irrigation efficiency remained at the same level in order to propose a realistic master plan. Improvement of the irrigation efficiency should be considered as one of the projects for demand control. • Environmental Flow: Though it is a worldwide trend to setup an environmental flow, it should be considered whether it is really necessary at the cost of other demands in the dry areas like Sefiedrud river basin. Its objective or what is to be conserved should be clarified. • RBO: Establishment of RBO is not enough. What is necessary to functionalize it actually should be clarified. • IWRM: It requires various data and information. It is important that every Province provides data and information and discusses and confirms them together.

Table 2.2.3 Summary of Stakeholder Meetings (3/3)

No.	Date	Key Pints of Discussions
10	September 5, 2009	• Schedule, method, progress of the satelite imagenary analysis were explained to the stakeholders by JICA Study Team and WRMC. It is explained that all the satelite imagenary data were transferred to WRMC on August 13 and it was expected that JICA Study Team would start water usage calculation in February 2010 at latest when landuse map and water demand estimation by agricultural product were finished by WRMC. Objective and contents of the satelite imagenary analysis were accepted by all the stakeholders. • Responses to the comments on Progress Rerport 3 were made by JICA Study Team. Some provinces, which did not make commnets, would send their comments in writung to JICA Study Team at a later date.
11	May 18, 2009	• Maser Plan was revised with the improvement level of irrigation efficiency and was explained. JICA Study Team explained that the level should be set at leaset at the middle point between the level set by WRMC and the present level in order to solve the water confilict between upper and lower reaches. Some probince commented that the present level should be revised because it was very high. • It was explained that Ardebil water transmission had too large impact on the lower reaches from the water intake. The province explained that they were reviewing the water transmission volume. • It was explained that the impact of a hydropower dam to be constructed between Ostor dam and Manjir dam and it was accepted. • Water usage was calculated using the water demand based on the result of satelite imagenary analysis. Although the water demand based on the result of satelite imagenary analysis was larger than that based on agricultural ledger by 10%, which was used in Master Plan, the result of water usage calculation was not so much differ from that in Master Plan. It was explaind and accepted by the stakeholders. • It was agreed that comments on Porgress Report 4 should be sent to JICA Study Team by the beginning of May 2010.

2.3 WORKSHOP FOR CONFLICT ANALYSIS

2.3.1 Outline of Workshop for Conflict Analysis

1) Objectives

The workshop is held for grasping the situations of water uses in the target Provinces,

(i) To find the background of the conflicts on the water allocation among the target Provinces,

(ii) To make each water users increase the knowledge of other water users in the Province to foster confidence among the water users, and

(iii) To develop the agenda of the stakeholder meetings.

2) Methodology

A group discussion was conducted by the representatives of organizations/groups related to water use in each Province. The representatives were selected by RWC. Although the selection would affect matters of the discussion, the selection was not strictly controlled by JICA Study Team in order to avoid the reduction of the participants because the time and place of the workshop were limited. It can be said that the discussion was developed more actively with clarifying consciousness on problems and trends of interests in each Province as a result.

The workshop was coordinated by the facilitator team (two Iranian specialists with a conflict management specialist of JICA Study Team). The facilitator team visited the target Provinces for the workshop and its coordination form the previous day. The Iranian specialists were the members of an NGO which had experience of similar workshops. Although the length of workshop time was planned to be a half day so that all the participants would be able to join up to the end of the workshop, the workshop lasted until afternoon. The discussion was carried out with employing the method of Stakeholder Analysis of Project Cycle Management (PCM) revised by the Study Team.

In the workshop, participants were required to discuss problems concerning water use, proposals for their solution and other issues related to water use such as:

- What do you think of the Master Plan for Integrated Water Resources Management of Sefiedrud River Basin?
- What do you think are the problems on water use and their importance/priority?
- What do you think are the solutions for such problems on water use?
- What do you think are the criteria of water allocation among Provinces?
- What rule should be established for water use?

The participants were required to observe the following rules in order to carry out the discussion in a well-organized manner. These rules conform to those of group discussion in PCM workshops.

WORKSHOP RULES

1. If you have an opinion, write it down on a small piece of paper with the felt pen and put the small piece of paper on the designated place.
2. Write only one opinion on one small piece of paper. If you have more than one opinion, write them separately on different pieces of paper.
3. The total number of your opinion may be capped at a certain number because of the time limitation. In such case, you have to prioritize your opinions.
4. Opinions put on the designated place should be removed only when all the participants agree to remove.
5. **It should be definitely noted that the results of this workshop will solely be used for the drafting of the Integrated Master Plan of Water Resources Management for Sefiedrud River Basin.**
6. **It should also be definitely noted that you will NOT acquire any rights nor bear any duties for the reason of the opinions expressed in this workshop.**

2.3.2 Program of Workshop

The workshop takes a half day or about four hours for each stakeholder Province with the following program.

_____ Province Regional Water Company (RWC)

PROGRAM OF CONFLICT ANALYSIS WORKSHOP FOR
SEFIEDRUD RIVER BASIN WATER RESOURCES MANAGEMENT

Date: 2008
Time: 8:30 - 13:30
Place: Conference room of RWC

1.	8:30 - 8:50	Registration
2.	8:50 - 9:00	Opening by the Representative of RWC
3.	9:00 - 9:15	Explanation about JICA Project and the Workshop of Conflict Analysis by the Facilitator Team
4.	9:15 - 9:30	Introduction of the Participants
5.	9:30 - 11:30	Workshop
6.	11:30 - 11:45	(Break)
7.	11:45 - 13:15	Workshop (continued)
8.	13:15 - 13:30	Confirmation of the Workshop Results by the Facilitator Team

2.3.3 Schedule of Workshop

The workshop sessions were held in each Province following the preparation meeting with the persons in charge of the RWC of the Province in the following schedule. Program, method and workshop place were discussed and confirmed in detail in the preparation meeting.

Table 2.3.1 Schedule of Workshop

Date	Day of Week	Activity
June 10, 2008	Tue	Preparation meeting in East Azarbaijan
June 11, 2008	Wed	Workshop session in East Azarbaijan
June 17, 2008	Tue	Preparation meeting in Ardebil
June 18, 2008	Wed	Workshop session in Ardebil
June 21, 2008	Sat	Preparation meeting in Kordestan
June 22, 2008	Sun	Workshop session in Kordestan
June 24, 2008	Tue	Preparation meeting in Qazvin
June 25, 2008	Wed	Workshop session in Qazvin
June 28, 2008	Sat	Preparation meeting for Tehran
June 29, 2008	Sun	Workshop session in Tehran
July 1, 2008	Tue	Preparation meeting in Gilan
July 2, 2008	Wed	Workshop session in Gilan
July 5, 2008	Sat	Preparation meeting in Zanjan
July 6, 2008	Sun	Workshop session in Zanjan

2.3.4 Results of Workshop

1) Outline of Participants

Although about 20 persons at maximum had been requested to join the workshop in each Province in order to deepen the discussions in the planning stage, around 30 persons actually participated in the workshop in each Province.

In classification by organizations, numbers from RWCs are devastating and some came joined from MOJA and DOE. Other than governmental organizations, universities and private consulting firms are noticeable. In addition, although very limited, some persons from Agricultural organizations, NGOs, a news agency joined in some Provinces.

Considering by Province, the number of participants in Kordestan is relatively large. Since such occasions as public hearing or something like that coming from Tehran are very limited there, they prepared for the workshop very ardently.

Table 2.3.2 Breakdown of Participants

Organizations	East-Azarbaijan	Ardebil	Kordestan	Zanjan	Gilan	Qazvin	Tehran
RWC	16	12	20	13	16	13	21
MOJA	2	2	5	5		1	1
DOE	3	3	1	1			
M of Natural Resources	1	1			2	1	
Rural Water and Wastewater Company	1	4	5	2		2	
Organization of Industries and Mines	1	1		1			
Meteorological Organization				1	1		
Office of Governor		1	2		1	3	
University/ Institute	1	1	1		2	2	1
Consultant		2		1	6	2	1
NGO				1	1		
Agricultural Organization				1		2	
News Agency						1	
Unknown			1	1		3	2
Total	25	27	35	27	29	30	36

2) Outline of Discussions

a) Opinions on IWRM

In general, participants expressed the similar ideas on IWRM in each Province. Namely, water resources are shared in efficiency and equity with considering environment and ecological conservation. Efficiency here means realization of the maximized productions with optimal resource allocations. It is relatively easy to decide since the results can be grasped quantitatively in a single measure. On the other hand, equity does not mean the allocation of equal amount of resources but the realization of social justice with considering social and cultural situations. What the social justice is depends on the social and cultural backgrounds. As mentioned in the characteristics of the Provinces, each Province has its own social and cultural conditions. It is very difficult to reach a consensus of this matter by the Provinces.

Environmental consideration was presented as a key to IWRM in all the Provinces, which corresponds to the fact that the environment is itemized in the discussions of water related problems in all the Provinces.

In addition, those opinions are proposed as information sharing, cooperation of related organizations among the Provinces, requirement for the establishment of an integrated organization, which show the participants' concern that the present situations where relevant authorities manage water resources without coordination among the Provinces from the viewpoints of organizations and functions.

b) Issues on Water

Firstly, participants were required to individually propose water problems as much as possible. Then, such problems are categorized into some groups and finally, such groups were prioritized in the group discussion.

Noticeable issues presented, which relate to the whole basin, are as follows:

- Lack of appropriateness in water management due to intervention of politicians
- Lack of reliability in data and statistics
- Lack of an organization for integrated management
- Abandonment of cultivation and migration to cities by a large number of farmers
- Inefficient water use in the lower reach Province / Excess water use in the upper reaches
- Lack of appropriate function in the environmental impact assessment system
- Lack of reflection of user opinions on decision-making
- Impact on the lower reaches due to the pollution in the upper reaches
- Decrease in the level of water table and water quality of the groundwater
- Inappropriate water price setting

The results of categorization and prioritization of proposed water issues are as follows:

Table 2.3.3 Priorities of Water Related Problems

Order	East-Azarbaijan	Ardebil	Kordestan	Zanjan	Gilan	Qazvin	Tehran
1	Policy-Making and Management	Water Needs -Drinking, -Industry, -Environment. -Agriculture	Policy-Making and Management	Surface and Ground W	Agriculture, Fishery, Aquaculture	W Supply	Policy-Making and Management
2	Social and Economic Issues	Social and Economic Problems	W Supply -Surface W -Ground W	Drinking W and Hygiene	Drinking W and Sanitation	Environment	W Resources Development
3	Environment	Water Resources -Surface W -Ground W	Agriculture and Natural Resources	Environment	Economic and Social Problems	Policy-Making and Management	Environment
4	Natural Resources	Management and Policy Making -Laws and Regulations -Management and Decision Making	Economic and Social Issues	Agriculture	Industry and Development	Economic, Social and Cultural Problems	Water Supply
5	Laws and Regulations		Environment	Industry	Security	Laws and Regulations	Laws and Regulations
6	Information and Data Infrastructure		Laws and Regulations	Social and Economic Issues	Management and Policy Making		Economic and Technical Issues
7	Industry and Mining Sector			Management and Policy Making	Economic and Social Problems		
8				Drought and Climate Change			
9				Natural Resources, Irrigation and Food			

c) Proposal of Solutions for Water Issues

Solutions of the noticeable water issues mentioned above were proposed as follows:

Table 2.3.4 Proposals of the Solutions for Water Issues

Noticeable Water Issues	Proposals for Solutions
Inappropriate water management resulted from politicians' intervention	To establish a integrated water management body where representatives of stakeholders and NGOs To employ public opinions
Unreliability of data and statistics	To establish a data collection network and a information exchange center To produce accurate statistics data
Lack of integrated management body	To establish an administrative organization for integrated management To train engineers working for integrated management To formulate a integrated river basin management plan
Farmers' abandonment of cultivation and migration to cities	To implement poverty programs to reduce poverty of farmers (Example: construction of dams to supply enough water and to create employment) To formulate a strategic plan for the development of Province
Inefficient water use	To employ a trans-Provincial approach in water resources management To change to agricultural products requiring less amount of water use To improve irrigation efficiency To construct a comprehensive data bank for water demand To hold workshop for optimal water consumption To implement water recycle
Malfunctioning of the EIA system	To clarify the responsibilities of related administrative agencies and their legal framework To change laws into more realistic ones / to improve methods To prioritize EIA over project implementation
Closed decision-making	To promote resident participation and raise awareness To provide information through mass media To organize users' associations To revise laws for promoting participation
Water pollution in the upper reaches and its affect on the lower reaches	To construct a full-fledged water treatment plant for wastewater To implement water quality monitoring and establish a data bank To secure the minimum water flow in the lower reaches
Decrease in the level of water table and water quality of the groundwater	To limit the exploitation of wells To implement water quality monitoring and establish a data bank To change the uses of ground water to surface water
Inappropriate water tariffs	To make water tariff based on costs for water supply To consider economic value (opportunity cost) of water

d) Proposed Criteria of Water Allocation

Criteria proposed in each Province are basically summarized to (1) focus on water demand, (2) focus on water supply, (3) economic efficiency of water use, (4) relation to the national plan (objective), (5) social consideration, (6) environmental consideration, and (7) others as shown below.

Table 2.3.5 Proposed Criteria of Water Allocation

Category	Proposed Criteria
(1) Focus on water demand	Population, structure of industries, land use, agricultural/livestock products, cultivated area
(2) Focus on water supply	Water resource potential, topography, climate, alternative water resources
(3) Economic efficiency of water use	Agricultural productivity, efficiency of water use
(4) Relation to the national plan (objective)	Production of national strategic products, Long-Term Development Strategies for Iran's Water Resources
(5) Social consideration	Severity of poverty, problems on employment/society
(6) Environmental consideration	Conservation of environment/ecology

e) Proposal of Necessary Rules

The following proposals are noticeable through the discussions, especially those on water problems in all the Provinces.

- To develop laws and regulations for integrated water management and to establish an organization to implement them

- To develop rules for promoting cooperation or resolving confrontation among the Provinces
- To examine measures for effective implementation of laws and regulations

Please see **Annex-1** for all the opinions presented in the workshop.

2.4 LOCAL CONSULTATION

The Local Consultation was held in each Province with taking much time. Details are explained below.

2.4.1 Plan of Local Consultation

1) Objectives

The local consultation was held for explaining the outline of the draft Master Plan of Integrated Water Resources Management for Sefidrud River Basin prepared by JICA Study Team and hearing comments on the draft Master Plan from representatives of related organizations in order to finalize the Master Plan with such comments. The results of this consultation to solely be used for the finalization of the Master Plan, and the participants do not acquire any rights nor bear any duties for the reason of the opinions expressed in this consultation.

2) Participants Invited

Representatives of organizations related to water including governmental authorities, NGOs, universities, agricultural associations and so on in the Province were invited to the consultation. The number of participants in each Province was required not to exceed 30 in order to make discussions effective. A participant list was prepared by the Regional Water Company of the Province.

3) Place for Consultation

The place for the consultation was prepared by the Regional Water Company of the Province. JICA Study Team visited each related Province to hold the consultation session.

4) Schedule

Though each consultation session was planned to take a half day (morning), it was extended to the afternoon or held again on the next day in some Provinces. The schedule is shown below:

Table 2.4.1 Schedule of Local Consultation

Date	Day of Week	Province
May 2, 2009	Sat	Kordestan
May 4, 2009	Mon	East Azarbaijan
May 5, 2009	Tue	Qazvin
May 9, 2009	Sat	Gilan
May 11, 2009	Mon	Ardebil
May 13, 2009	Wed	Zanjan
May 16, 2009	Sat	Teheran

2.4.2 Results of Local Consultation

1) Participants

The reason why the number of participants in Kordestan is a few is that the date was changed with East-Azarbaijan in a few days before due to the latter's schedule. It is noticeable th at the number of consultant is many in Qazvin.

Table 2.4.2 Breakdown of Participants

Organizations	East-Azarbaijan	Ardebil	Kordestan	Zanjan	Gilan	Qazvin	Tehran
RWC	18	26	17	17	23	20	28
MOJA				3		3	
DOE				1		1	
University/ Institute	2	5		2			
Consultant	1	1		1		11	1
Unknown						1	
Total	21	32	17	24	23	36	29

2) Discussions

Main discussion points are summarized by Province as follows:

Table 2.4.3 Main Discussion Points by Province (1/2)

Province	Main Discussion Points
East-Azarbaijan	• Agreement by politicians is necessary for the establishment of RBO. It is important to show the benefit to the local area when the lobbying is made to the politicians. • Various criteria for the selection of water resources development plans were proposed. They should be decided with the agreement by the related Provinces. • Irrigation efficiency cannot be improved du to socio-economic conditions. Such conditions should be informed to WRMC by each Province. • Estimation of industrial and municipal water demands were presented by Mahab Ghodss through WRMC. • Irrigation is assumed to be modernized at once where the plan had been made in the model. • Five-year drought is employed since five-year or ten-year is generally employed in the world and it is efficient to employ five-year here. • Accuracy of groundwater examination is not so high because of the shortage of data. • Participation of users in planning should be considered in the RBO which is proposed to establish.
Ardebil	• It was understood that the improvement of irrigation efficiency takes huge cost. • Study results were reported not on Provincial basis but on reach basis. • Improvement of irrigation efficiency was examined not only with high rates designated by WRMC but also with lower rates which are more realistic. • As the river system is too much complicated near the river mouth at Caspian Sea, it is difficult to set the checkpoint of the simulation there. • Social factors (abandonment of cultivation by farmers) were not included in the model as the data are not enough. • Since the proposal of Ardebil water transfer plan was too late, it was not included in the Master Plan but the examination of its effects will be made.
Kordestan	• Sensitive analyses with various conditions in simulation should be made by the proposed RBO. • Assumptions of irrigation efficiency were made with the consultation with agricultural experts. • As the scope of work is to prepare the maser plan of water resources management, a detailed plan of irrigation efficiency improvement is not included. • As the simulation model was constructed with a macro approach, its results do not necessarily applicable to a local situation. • Demand of the Province does not seem to be underestimated in the national document.

Table 2.4.4 Main Discussion Points by Province (2/2)

Province	Main Discussion Points
Zanjan	• As the river system is too much complicated near the river mouth at Caspian Sea, it is difficult to set the checkpoint of the simulation there. • There are rich water resources including groundwater in the lower reaches, which were considered in the Study. • Zanjan has a water quality problem- salinization, which is very difficult to solve. • On setting the environmental flow, water use abandonment caused by it should be fully considered. • Improvement of irrigation efficiency should be monitored every year with a systematic setup. • Each Province is preparing a new water resources development plan even now. Such plans should be examined by the proposed RBO after JICA Study.
Gilan	• Improvement of irrigation efficiency was examined not only with high rates designated by WRMC but also with lower rates which are more realistic. • Details of the simulation model were explained for enough time in the technology transfer seminar. • As the simulation model was constructed with a macro approach, its result does not necessarily applicable to a local situation. • Distortion of plans due to the interference by politicians is expected to be avoided by the proposed RBO. • (Selection of drought year / statistical approach of the planning was explained.) • Water quality problem coming from the upper reaches (salinization) should be examined by the proposed RBO.
Qazvin	• SEA and IEE were made in the Study and the results were reflected in the Master Plan. • Participation of farmers in RBO will be proposed. • Accuracy of groundwater examination is not so high because of the shortage of data. • Alamout water transfer plan was incorporated in the Master Plan. • Gilan Province has rich water resources. It should be considered that their water needs be fulfilled by their resources first. • Demand for municipal water was presented by Mahab Ghodss through WRMC. • Participation of MOJA is necessary for the improvement of irrigation efficiency. • Improvement of irrigation efficiency was examined not only with high rates designated by WRMC but also with lower rates which are more realistic. • Reuse of water was included at 10% in the plan.
Tehran	• All the local rivers were taken into consideration. • Improvement of irrigation efficiency was examined not only with high rates designated by WRMC but also with lower rates which are more realistic. • Although MOE does approval work of water resources development, RBO is necessary for reaching consensus by each Province. • In drought period, dams in the upper reaches cannot impound enough water so that does not effect the lower reaches according to the simulation results. • As the simulation model was constructed with a macro approach, its result does not necessarily applicable to a local situation. • Relation with RBO and the Caspian Sea and Ulmie Lake Basin Office should be clarified. • Participation of MOJA is necessary for the improvement of irrigation efficiency. • Participation of related Authorities (DOE and MOJA) in RBO is necessary. • In terms of water quality, EC and salinity concentration was examined but other parameters were not examined due to lack of data. • IEE was conducted in the Study, which considered wild lives which use water sources. • Use of treated water was not included in the Study but its necessity will be proposed.

Please see **Annex-2** for all the Q and A made int the consultation.

3) Summary of Results

This is the second time of JICA Study Team visiting each Province for collecting comments so that it was conducted smoothly by officials of RWCs. In addition, it can be said that participants understood the meaning and significance of the Study to a large extent since they did ardent discussions and gave us questions and requests. The participants made detailed technical questions especially on the simulation model, which they have much interest in.

CHAPTER 3. BACKGROUND AND MATTERS OF CONFLICT

3.1 CHARACTERISTICS OF THE RELATED PROVINCE

The related seven Provinces can be divided into the upper reach group (East-Azarbaijan, Ardebil, Kordestan, Zanjan), Gilan which is located in the lower reaches, and others (Qazvin and Tehran) from the geographical viewpoint. Provinces in the upper reach group have the common characteristics about ethnicity and languages that non-Persian speaking ethnicities including Azarbaijani or Kurdish share the majorities in the Provinces as well as their natural characteristics such as highlands or mountainous area. On the other hand, Persian speaking ethnicities share the majority in the other Provinces.

However, the upper reach group in turn can be divided into East-Azarbaijan, where industries and commerce have relatively developed, and the Provinces where agriculture and stock raising are dominant, including Ardebil, Kordestan and Zanjan. Also, the non-upper reach can be divided into Gilan where agricultural production, especially rice is highly large, Tehran where industry is overwhelming, and Qazvin which is located between of the two. Recently, a large number of factories and people have been moving from Tehran to Qazvin.

Gilan Province shows some distinguishable characteristics among the related Provinces. It is located in the lower reaches as well as the largest production area of rice which is a principal food and a strategic agricultural product of Iran. (It was seen that a large amount of rice produced in Gilan was stocked in the cafeteria of RWC in East-Azarbaijan.) Its climate is mild and moist and its scenery of paddy fields resembles very much that of rural areas in Japan.

Zanjan and Kordestan were established by being separated from Gilan, where they originally belonged. Zanjan expressed most strongly their disbelief of the data which are used in the Study and aggrieved feelings against Gilan. Although Kordestan expressed dissatisfaction against other Province, undisguised feelings naming Gilan were not presented there.

Although the autonomy of Provinces is not high as Governors and high government officials are appointed by the central government, non-Persian speaking ethnicities dominate in population in some Provinces and a couple of Provinces had history of becoming independent even for a very short time. In addition, the Provinces think that they have received smaller investment and economic development so far. It can be deemed that the Provinces have potential dissatisfaction about the policy of the central government. The central government needs prudence on deciding a policy which affects the Provinces. It should be absolutely avoided that a decision ignites a flame of nationalism.

Considering above-mentioned characteristics of the Provinces, they can be grouped as follows:

Table 3.1.1 Grouping of the Related Provinces

		Overwhelming in Agriculture and Stock Raising	Industries and Commerce Developed
Majority is Non-Persian Speaking Ethnicities	Upper Reaches	Ardebil, Kordestan, Zanjan	East-Azarbaijan
Majority is Persian Speaking Ethnicities	Lower Reaches	Gilan	—
	Other	—	Qazvin Tehran

In the conflict analysis, participants were required to individually propose water problems as much as possible. Then, such problems are categorized into some groups and finally, such groups were prioritized in the group discussion. There cannot be seen any noticeable relations between the priority of water problems and geographical positions (upper/lower reaches).

"Policy-Making and Management" is itemized as a big issue of water problems in all the Provinces but its priority order differs by Province. Although it is ranked at the first in three Provinces (East-Azarbaijan, Kordestan and Tehran), some Provinces ranked at lower orders. Five Provinces itemized "Laws and Regulations" but they ranked it at the lower order. Three out of the five Provinces ranked "Policy Making and Management" at the first priority. It can be analyzed that the participants

think that problems should be solved flexibly in the field of political administration because the legislation of necessary management or regulation would take a longer time.

"Environment" was itemized in all the Provinces. Environmental problems seem to be recognized significant by the participants.

"Fisheries and Aquaculture" and "Security" were itemized in Gilan, and "Information and Data Infrastructure" in East-Azarbaijan. These titles are not seen in other Provinces and show that the characteristics of those Provinces.

3.2 CONFLICTS AMONG PROVINCES

Provinces in the upper reaches require water allocation based on the potential of future development on one hand. The lower reach Province expressed that the existing use of water should be highly esteemed on the other hand. The confrontation about the water allocation is clarified in this point. If the upper reach Provinces implement the water resources development plans to increase the water use without taking any measures, the inflow to Manjil Dam will be reduced and the irrigation water also will be reduced in the lower reach Province. Thus, it is quite obvious that the agricultural production in turn will be reduced in the lower reach Province. In addition, it is also concerned that the water quality in the lower reaches would be degraded due to the reduction of river flow in the lower reaches. As industries have not been developed so much in the surrounding areas of the upper reaches, the most serious problem on water quality is the increase in salinization. Its cause is marlite lying in the upper reaches. The water quality problem, however, is not so serious comparing with the water allocation problem for the time being and it can be a clue for leading the Provinces to cooperation among them or IWRM. Sedimentation of the river is not recognized so much as a problem among Provinces.

As a result of the conflict analysis, it is clarified that the Provinces do not take a cooperative actions because they think that water resources are not allocated fairly among themselves. The reasons why they feel unfair are as follows:

- Each Province insists different criteria of fairness to justify its argument; and
- Each Province has some mistrust in other Provinces so that it cannot accept the argument of other Provinces.

It is necessary to making coordination from the viewpoint of IWRM to solve the confrontation and promote water resources development plans with cooperation.

CHAPTER 4. IDEAS OF CONFLICT SOLUTION

4.1 BASIS OF ANALYSIS

Before going to examine conflict solution, basic ideas are to be confirmed here. Firstly, the conflicts among the Provinces are those discussed in the above section. Secondly, what the minimum requirement in the process of solving the confrontation is "At least no one positively insists disagree in a condition where interests of parties are confronted." This is required to guarantee that the stakeholders have seats at the negotiation table whatever the negotiation results in. If the stakeholders still continue to join the negotiation hereafter, it can be expected that the results would improve thanks to the development of the discussion as well as the change in internal or external situations. As is mentioned in **1.1 Conflict Analysis and Mutual Understanding**, if the allocation of scarce resources is the objective of the confrontation, mutual understanding by itself has little power for solution. In such case, stakeholders should find a solution by taking so called Win-Win Approach where stakeholders cooperate each other to maximize each stakeholder's gain (or to minimize the expected reduction of gain for each stakeholder).

Thirdly, what the agreement is made about is going to be considered. It is no meaning to agree about a water allocation plan among relevant Provinces without clarifying the conditions where the plan is reasonable or sustainable. Each Province should agree how it uses water under such conditions. In this meaning, what the agreement is made about is the "coordination" of fair water use, which is not just an "allocation" among Provinces; the reduction of Province A's water use does not necessarily mean the increase of Province B's water use. In other words, it is the rule of water use (especially agricultural water) coordination with fulfilling various constraints including the national objectives and sustainability. This has a high affinity for an "IWRM" plan as a result. As each Province insisted the necessity of an IWRM plan in the workshop held in 2008, a water use coordination plan which is logically incorporated in the IWRM seems to be less resistible by the Provinces.

Finally, a characteristics or cause of the conflict of Sefidrud River Basin is going to be considered. Although stakeholders normally consist of water users in various fields including Provincial consumers as well as relevant governmental agencies, they are limited to RWC of relevant Provinces. RWC has various authorities for water use and it can be deemed as a representative of the Province for the matter of coordination of water allocation among Provinces. In such situations, although a water resources development plan of a Province requires an approval of WRMC, it cannot effectively control Provinces as a result. The central government or WRMC should bring the situation under control by doing proper actions such as an advice, persuasion and administrative order if necessary.

Why did such situation come about? As one of important reasons, the leadership of the center may not be necessarily enough and Provinces have some mistrust in the center and other Provinces, which leads to a problem of governance, preventing proper execution of river basin management policy as a result. It is necessary to design an institution which mitigates the mistrust among the stakeholders such as establishment of a permanent consultation body and a mechanism for fostering a sense of community. In addition, it is also required to external assistance for developing capacity to exercise proper leadership of WRMC to Provinces on the basis of an IWRM plan which is to be formulated.

The basis of analysis on consensus building has been confirmed so far. Details of the confrontation are to be confirmed and their measures are to be analyzed hereafter.

4.2 ANALYSIS OF CONFRONTATION AND MEASURES

As a result of the analysis of issues on water presented in each Province, it is clarified that the Provinces feel that water resources are not allocated fairly among themselves. The reasons why they feel unfair are (1) Each Province insists different criteria of fairness to justify its argument; and (2) Each Province has some mistrust in other Provinces so that it cannot accept the argument of other Provinces. Key points of such confrontation can be analyzed as follows:

Table 4.2.1 Analysis of the Confrontation

Key Points of Confrontation	Ideas of the Upper Reach Provinces	Ideas of the Lower Reach Province	Example of Validation
1) Equity/Social Justice	It is equitable to increase the income in the upper reaches by developing agriculture and industries because its income is lower than the national average.	The income of the farmers in Gilan has already decreased due to water shortage. Further decrease in the income would lead to social unrest.	According to par capita GRDPs of the Provinces, they are lower than the average of the Country, and there is a difference among them, but it is not necessary due to the difference between the upper and the lower reaches.
2) Rights of Water Use	Those who have water sources have the right to use the water primarily.	Those who have been using the water for more than 40 years have a vested right for the water use.	The UN International Watercourse Convention does not clarify the priority of vested right. A theory insists that a vested right can be violated with the condition of compensation for pursuing equity.
3) Economic Efficiency (Productivity)	The land in the upper reach area is fertile and has the potential for developments. Water use in the lower reach area is inefficient.	Gilan is the optimum land for producing rice, which is a strategic agricultural product.	There is a large difference in productivity due to the difference of products.
4) Reliability of Information/ Data	Information and data provided by the lower reach Province are not reliable.	Information and data provided by the upper reach Provinces are not reliable.	Present water demands based on the analysis of satellite imagery is about 10% larger than those based on the statistics but the sufficiency rate in each area has no significant difference.

Tehran and Qazvin stand and see the confrontation because they have different topographical conditions and prioritized water allocation conventionally.

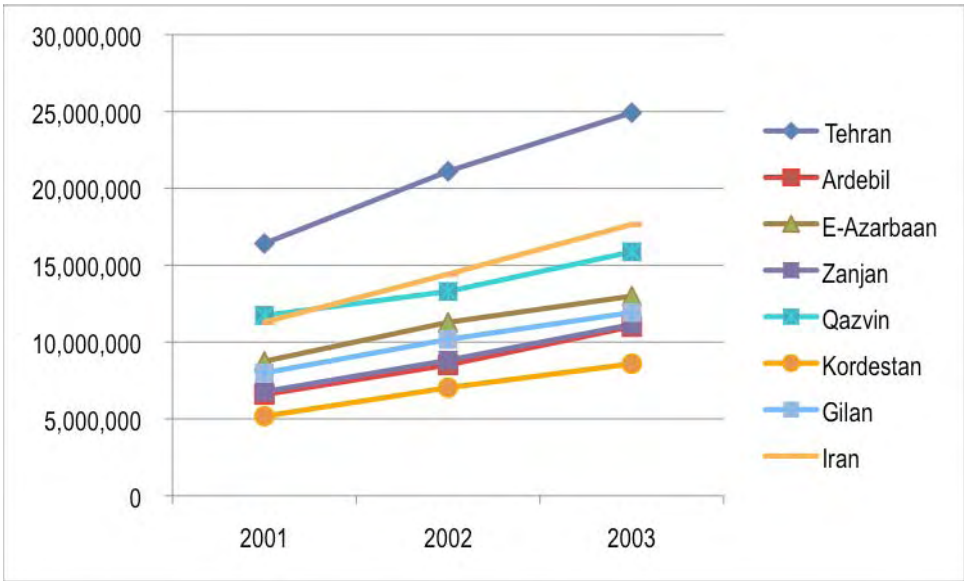
Measures for coping with such points of confrontation are examined in the following sections.

4.2.1 Equity/Social Justice

As mentioned in **4.2.2 Rights of Water Use**, the objective of the requirement of equity is not to attain a formal equality but to realize the social justice. The confrontation comes about because each party insists its own justice only. Is it called a justice that you have to harm someone else's justice to attain your justice? You have to rethink whether you have other ways to attain your justice which do not harm someone else's. All the parties have to consent with each other to progress together while the severity of this point come to be actually mitigated in the water use coordination which is reasonable or sustainable.

Per capita GRDP for each Province is shown below. No Province exceeds per capita GDP of Iran except Teheran. With excluding Tehran and Qazvin which surrounds it, per capita GRDP of East-Azarbaijan, the largest one is 1.5 time larger than that of Kordestan, the smallest one. But it can not necessarily be said that there is clear difference between that of the upper reaches and the lower reaches.

Unit: Rials



Source: Iran Statistical Year Book 1385 and statistics of each Province

Figure 4.2.1 Per Capita GRDP of Each Province

4.2.2 Rights of Water Use

It is exactly the confrontation between the priority of upper reaches and the vested right. It is inevitable that such confrontation on rights be put on the shelf in order to improve the situations with avoiding very difficult matters and all the parties start discussions aiming at improving situations better than present ones (or reducing deterioration) for all of them as much as possible. However, as such ideas that reduce the allocation to the lower reach Province unilaterally cannot be accepted by them, compensating measures would be required if such ideas are discussed.

Table 4.2.2 Compensating Measures

Measures	Example
Substantive conservation of the present allocation	• To keep the same amount of production with less water by implementing projects which improve irrigation efficiency • To introduce kinds of crops or cropping methods which require less water • To implement projects which develop water sources within the Province
Cover of the reduction with other things/forms	• To provide subsidies from the national treasury • To promote public works and industries to create employment and cover the reduction of the income • To levy water charge on the upper reach area (It is very difficult for the upper reach Provinces to accept this idea but it is worth considering because they allege that the economic efficiency of water be higher there.) • To transfer the products from the upper reaches to the lower (ditto)

For the allocation of scarce resources whose total endowment is reducing, keeping status quo is rather difficult. Each member enters cooperation in order to minimize the deterioration from the present situation in such case.

"Convention on the Law of the Non-navigational Uses of International Watercourses" (hereinafter referred to as "International Watercourse Convention" or IWC) can be a good reference for the consideration of the rights on water use coordination among Provinces located in Sefidrud River Basin. This convention is adopted by the General Assembly of the United Nations in 1997. It is not yet in force as the number of the ratifying countries has not reached to the designated number.

IWC stipulates the following principles for the utilization (including water resources development, the same shall apply hereinafter) of water in an international river:

1) Equitable and reasonable utilization (Article 5, IWC)
2) Participation in utilization (Article 5)
3) Obligation not to cause significant harm (Compensation shall be made if significant harm is caused) (Article 7)
4) Promotion of cooperation among related countries (Article 8)
5) Regular exchange of data and information (Article 10)

Principle 1) is always questioned about the confrontation with Principle 3). It is a typical case that the water resources development in the upper reaches based on the request of equity affects the flow of the lower reaches. Although in the course of drafting IWC it was disputed which should prioritized between Principle 1) and 3), the final settlement was that either one can be prioritized from the standpoint you take. Prof. Stephen McCaffrey, Pacific University, views that the conditions such as compensation for Principle 3) result in that Principle 1) shall be prioritized. (Stephen McCaffrey. The UN Convention on the Law of the Non-Navigational Uses of International Watercourses: Prospects and Pitfalls, World Bank Technical Paper, 1998) Therefore, pursuing equity can be preferred to vested right with fulfilling the conditions such as compensation from the viewpoint of Prof. McCaffrey

The word "Equitable" or "Equity" does not mean a pro forma equality, but means a balanced situation where conditions of each country are taken into consideration. In terms of water utilization, it does not require that each country use the same amount of water, but that each country can utilize an amount of water based on its conditions. IWC requires taking into account all relevant factors and circumstances, including (Article 6):

a) Natural conditions (geography, hydrology, climate, etc.)
b) Social and economic needs
c) Population
d) Effects of water use
e) Existing and potential use
f) Cost of conservation, protection, development and economic use
g) Availability of alternatives

(These examples were presented in the workshop of stakeholder analysis.)

Now it's time for examining "Equity" as a criterion which was strongly insisted in all the Provinces. Water allocation cannot be justified only with an agreement among relevant Provinces. The agreement should consider various conditions which constraint water utilization. For example in an extreme case, an agreement that each province can use water indiscreetly was made, it would obviously cause depletion of water resources, destruction of ecosystem, resulting in the losses of users (including future generations, in the broad sense of the term). Therefore, such constraint should be considered at the same time on discussing "Equity." Otherwise, it would be nonsense. That's why Article 5 of IWC requires "reasonable" (especially, optimum or sustainability). It can be said that Principles 2) to 5) are the means (institutions) for securing principle 1) in effect.

Therefore, constraints, which make water allocation reasonable, should be clarified when water allocation is made. Provinces should reach an agreement on water utilization based on such constraints. What should be agreed is the "coordination" of water utilization in this sense. (It is not an "allocation" among relevant Provinces because the reduction of water allocation to Province A is not automatically an increase to Province B.) Establishment of a river basin organization (RBO) is necessary to secure such coordination. Important functions of the RBO should include Principles 2), 4) and 5). The constraints clarified in JICA Study so far are sustainability (water resources potential, conservation of water environment, etc.) and the national objectives (designation of strategic product, priority set in Long-Term Development Strategies for Iran’s Water Resources).

After constraints are clarified, then indicators of equity will be the issue. Indicators will be used for the evaluation of equity. As employed indicators differ, evaluation results will differ. Therefore, matters on water utilization will be changed to the matters on employment of indicators. Then, Principle 3) and factors itemized in Article 5 are examples of the indicators. It should be noticed that IWC does not stipulates the order of priority for the factors.

Criteria proposed in the workshop for conflict analysis by each Province are basically categorized to (1) focus on water demand, (2) focus on water supply, (3) economic efficiency of water use, (4) relation to the national plan (objective), (5) social consideration, (6) environmental consideration, and (7) others.

Since categories (4) Relation to the national plan (objective) and (6) Environmental consideration are considered to be constraints for water use coordination, criteria are narrowed to (1) Focus on water demand, (2) Focus on water supply, (3) Economic efficiency of water use and (5) Social consideration.

In terms of category (2) Focus on water supply, the area size of the river basin which falls in Provincial area, for example, is not suitable from the viewpoint of integrated water resources management which treats water cycle in the river basin as a whole. In addition, (5) Social consideration is not easy to quantify. On the other hand, categories (1) Focus on water demand and (3) Economic efficiency of water use are easy to quantify and suitable for the purpose of water use coordination in the integrated water resources management. Thus, applicable criteria are (1) and (3) for the purpose of the Study.

In addition, which item is the most suitable one in category (1) should not be discussed by relevant Provinces because they cannot reach an agreement. Such discussions can be avoided by fulfilling their water demands of Provinces and the criteria is satisfied as a result. In this case, discussions on (5) Social consideration can also be avoided.

Resulting from the discussions so far, the applicable basic rule of the water use coordination can be presented as follows:

Under the constraints including sustainability, water should be allocated in a manner that i) demand of each Province are fulfilled as much as possible or ii) productivity is maximized as a whole.

It should be confirmed that water has a physical characteristic that it flows basically from upstream to downstream. So, water cannot allocate so discretely as a pie can be cut into pieces. Although it can be allocated discretely if water is pumped up and transmitted, it is not realistic. Therefore, water should be allocated between upper reaches and lower reaches first and then it is allocated among upper reaches; there is only Gilan Province in the lower reaches.

Now the above underlined basic rule is to be examined. In terms of ii) productivity, the maximum production cannot necessarily be achieved due to the reason described in the previous paragraph. Additionally, the rule should be decided among the Provinces in the second step for how the maximized products should be allocated among the Provinces. It means that the issue on how to allocate water will be changed to how to allocate products. Thus, this rule presents a reference on how much the value will be produced as a whole river basin when all the related Provinces enter a full cooperation.

As of i) demand fulfillment, water demands are categorized into a) municipal b) industrial and c) agricultural water and National Water Resources Development Strategy requires the water allocation with the priority of a), b) and c). This can be deemed as constraint to allocate water this order. As the volumes of a) and b) is extremely small compared to c), the issue becomes a coordination to fulfill the agricultural demand as much as possible; the environmental flow for the spawning of sturgeon is included in the constraint. Finally, the realistic rule for water use coordination came to be as follows:

Principally, agricultural water demand is fulfilled as much as possible with fulfilling several constraints including the national objectives and sustainability.

JICA Study Team explained a basic idea of the results of the Study to the participants of the local consultation as follows:

Water use in the upstream of the Manjil as well as in the downstream could be balanced with its potential until long-term target year of 2031 due to improvement of irrigation efficiency. In other words, the development potential could already reach the development limits unless water conveyance and distribution system in the existing irrigation areas are improved.

Many participants in Provinces insisted that the improvement of irrigation efficiency set by WRMC was very severe, considering their present conditions. JICA Study Team replied that the Study employed not only the scenario with a target set by WRMC but also a scenario with an intermediate level target, which deemed more realistic and showed that it is indispensable to implement the water resources development projects as well as irrigation efficiency improvement at least in the intermediate level in order to utilize sufficient water by both sides, downstream and upstream areas of the Manjil Dam, without severe conflicts. This result was basically accepted by all the relevant Provinces and they will make an effort to attain the target.

In case that the water saving target including improvement of irrigation efficiency is not attained, targeted sufficiency rates cannot be fulfilled. In such case, cooperation among the Provinces is required to minimize the deterioration from the present conditions and also required are establishment of a river basin organization for securing the said cooperation and the efforts toward confidence building by accumulation of cooperative actions in every day matters.

4.2.3 Economic Efficiency (Productivity)

The scope where the criterion is applied is different since the upper reach Provinces apply it within the river basin while the lower reach Province applies it to the whole nation. If the production of rice is based on the national strategy, it should be prioritized within a reasonable extent. However, the upper reach Provinces would never accept it if the lower reach Province makes no effort to improve the efficiency of water use with resting on the fact "national strategy." In addition, if the rice production is a national strategy, provision of subsidies from the national treasury should be considered. Compensating measures discussed above may also be useful for this point.

By comparison of estimated agricultural productivities in irrigation area, that in the upper reaches is more than 10 million Rials per ha and that in the lower reaches is around 0.6 million Rials. This is because that the upper reaches produces much alfalfa which can sell in high price while the lower reaches produces much rice which is relatively low price. The same thing resulted for the productivity for water use per MCM.

Table 4.2.3 Estimated Agricultural Productivity of Irrigation Area in the River Basin

Zone	A	B	C	D	E	Total
Provinces in Zone	Kordestan	Zanjan, East-Azarbijan	Ardebil, Upper Reaches of Gilan	Qazvin, Tehran	Lower Reaches of Gilan	—
Rice Production Area (ha)	0	2,093	2,145	1,212	208,782	214,232
Alfalfa Production Area (ha)	20,802	42,281	13,966	1,377	29	78,455
Estimated Productivity per ha* (million Rials/ha)	13.2	14.7	13.9	12.0	0.6	7.6
Estimated Productivity per MCM* (million Rials/MCM)	705.6	840.0	969.9	996.3	45.7	508.7

Note） *: Estimation by JICA Study Team. Other figures are quoted from statistics of Iran.
Estimated net income: Paddy 0.57 million Rials/ha, Alfalfa 22.78 million Rials/ha.

4.2.4 Reliability of Information/Data

It is very difficult to reach consensus because each party has doubts about the data provided by the other party. The following should be explained enough to the related Provinces to accept.

- Each province shall make an effort to get its own data understood by other Provinces;
- It is planned that the simulation model is provided to WRMC at the end of the Study and trainings on the operation of the model were implemented to engineers of the related Provinces in May 2009. The related Provinces are to be required to improve the model with using data which they think reliable by themselves after the completion of the Study; and
- It is strongly recommended that a statistic agency independent from any Provinces be established in order that the statistical data including agricultural land use is fairly produced. Otherwise, it can be recommended that the river basin organization (RBO), which is proposed in the Study, verify the data provided by the Provinces.

CHAPTER 5. COORDINATION RULE AMONG STAKEHOLDERS

5.1 MAJORITY RULE AND CONSENSUS BUILDING

Majority rule has been widely used in a decision-making process of a group as a democratic way. This rule, however, may leave forty-nine percent of the people unsatisfied with the decision in the worst case. On the other hand, consensus building approach aims at gaining approval from the people as many as possible, although not necessarily a unanimous one. The table below compares the two methods.

Table 5.1.1 Majority Rule and Consensus Building

	Majority Rule	Consensus Building
Decision Rule	Approval by the majority (= 51%) of the members	Approval by the members as many as possible. (Not necessarily a unanimous one to avoid a disturbance of the process by a minimum number of members)
Typical Tool of Decision	Voting / Debate	Facilitation / Win-Win approach
Time for Decision	Voting time itself does not take a long time. But it may take a long time to reach voting as majority rule presupposes discussions and agreement to decide between proponents and opponents before voting, to secure the democratic process. In addition, implementation of the decision may take a long time if the number of opponents is large.	It takes a long time to reach a decision. Implementation of the decision is expected to be smooth and quick because the number of opponents is small.
Cost for Decision	Cost for decision-making itself is low but it may cost a lot when the decision is implemented.	Its initial cost is high because a specialist of facilitation is required.
Applicability	Widely applicable	Its applicability is limited. For example, it cannot be applied to such issues related to one's belief and human rights.

Win-Win approach is recommended to apply for solving the confrontation among the Provinces.

5.2 ANALYSIS OF CONSENSUS BUILDING APPLYING WIN-WIN APPROACH WITH SIMPLE MODEL

Here is an example of Win-Win approach by which it is presented how a confrontation can be overcome utilizing a simple model. It should be noticed that the conditions of the discussion is simplified to make the logic understood easily. It is needless to say that various conditions should be considered for the application to an actual case.

Conditions of the Model

- Players: (1) Upper reaches and (2) Lower reaches
- Options of the players' action: (1) To agree and (2) To disagree
- A water resources development plan and an IWRM Plan can progress only when the both players choice to agree. Thus, if at least one player choices to disagree, the water resources development plan is not implemented and the water allocation is kept at the same as before, and also the IWRM Plan is not implemented which presupposes cooperation and collaboration between the both players.

5.2.1 No Compensation Case

In order to get the stakeholders have seats at the negotiation table, it is necessary to convince them that they will get the same or larger benefit with building consensus than those without the consensus. Profit/loss is summarized for with-consensus case and without-consensus case as follows

Table 5.2.1 No Compensation Case

Player	Agree/Disagree	Profit/Loss
Upper Reaches	Agree	The dam constructions will progress and **the water allocation will increase.**
Upper Reaches	Disagree	The dam constructions stay halted and the water allocation stays the same.
Lower Reaches	Agree	The dam constructions will progress and **the water allocation will decrease**.
Lower Reaches	Disagree	The dam constructions stay halted and the water allocation stays the same.

As is shown in the table above, it is difficult to get the lower reach stakeholders at the negotiation table without giving compensation to them as they suffer losses one-sidedly. Therefore, it is necessary to give compensation to the losses the lower reaches suffers. There are two types of compensation; that made internally and that by a third party. Profit/loss is summarized for with-consensus case and without-consensus case considering internal compensation in the following section.

5.2.2 Internal Compensation Case

Table 5.2.2 Internal Compensation Case

Player	Agree/Disagree	Profit/Loss
Upper Reaches	Agree	The dam constructions will progress and the water allocation will increase. **They will give compensation.**
Upper Reaches	Disagree	The dam constructions stay halted and the water allocation stays the same.
Lower Reaches	Agree	The dam constructions will progress and the water allocation will decrease. **They will get compensation.**
Lower Reaches	Disagree	The dam constructions stay halted and the water allocation stays the same.

In the case above, the lower reaches can reach an agreement easily. On the other hand, it is difficult to get the upper reaches to the negotiation table since they will not accept the compensation from the upper reaches to the lower reaches, considering that there exists a confrontation between them. Profit/loss is summarized for with-consensus case and without-consensus case, considering external compensation in the following section.

5.2.3 External Compensation Case

Table 5.2.3 External Compensation Case

Player	Agree/Disagree	Profit/Loss
Upper Reaches	Agree	The dam constructions will progress and the water allocation will increase.
Upper Reaches	Disagree	The dam constructions stay halted and the water allocation stays the same.
Lower Reaches	Agree	The dam constructions will progress and the water allocation will decrease. **They will get compensation from the third party.**
Lower Reaches	Disagree	The dam constructions will progress and the water allocation will increase.

In the case above, both parties can easily get the negotiation table since nobody in the river basin will not suffer losses. The third party who makes compensation is usually the central government. If its financial condition cannot allow compensation, external donors can support it.

In addition, compensation is not necessary pecuniary one. It can be one that something finally compensates the income of the lower reaches and can be accepted by them. For example:

- Implementation of a development plan (attraction or modernization of industrial/commercial business)
- Investment in improvement of agricultural productivity (construction of irrigation facilities, etc.)
- Technical assistance (efficient water use, examination of alternative water sources, and water balance simulation)

The compensations mentioned above are not only benefits of the lower reaches but also of the upper reaches, so they promote the consensus building further. This JICA Study can be interpreted as a kind of such compensation which has been implemented by the third party on ahead.

Since the lower reaches are the most important area which produces rice that is the strategic product of Iran, investment in improvement of agricultural productivity can be a first compensation. In addition, such indirect measure can also be an idea that increase in tax revenue resulting from the implementation of a development plan, which in turn will be invested in improvement of agricultural productivity.

5.2.4 Time Factor

It has been assumed so far that water allocation stays the same if no agreement reaches. However, if they make no agreement and the comprehensive water resources management is not implemented, water allocation will virtually reduces for both parties because they suffer losses of time benefit and environmental damages including progress of water pollution, destruction of ecosystem and soil erosion will increase as time passes. If it is widely known that the river basin has such time bomb, the lower reaches will have more and more disadvantages as time passes although the upper reaches also have some environmental problems. Profit/loss is summarized for with-consensus case and without-consensus case, considering a time factor as follows:

Table 5.2.4 Considering Time Factor

Player	Agree/Disagree	Profit/Loss
Upper Reaches	Agree	The dam constructions will progress and the water allocation will increase.
Upper Reaches	Disagree	The dam constructions stay halted and **the substantive water allocation will gradually decrease (smaller)**.
Lower Reaches	Agree	The dam constructions will progress and the water allocation will decrease.
Lower Reaches	Disagree	The dam constructions stay halted and **the substantive water allocation will gradually decrease (larger)**.

In the case above, it would be possible to encourage the both parties to reach an agreement early with avoiding loss of time value and implementing an IWRM including environmental management as the driving force. A combination of the time factor and compensation examined before may encourage the lower reaches to reach an agreement much earlier. How early the lower reaches select the agreement option depends on that how they evaluate or recognize the speed of the effective reduction comparing with the reduction of water allocation. Thus, the environmental management of the integrated river basing management is very important for the consensus building.

5.2.5 Conclusion

The optimum choice for the lower reaches is to reach an agreement in earlier time. (The same can be applied to the upper reaches considering the time factor even though it is not so urgent to

them.) It should be noticed that this choice does not mean a one-sided compromise for the lower reaches. They would rather take a tactics of winning better conditions where they will take an initiative of the negotiation and realize better conditions in the agreement by applying this choice as soon as possible before the lower reaches finish a preparation for the negotiation. In addition, if an agreement is made at an earlier stage, the upper reaches would compromise to the extent of the loss of time value and effective reduction of water use due to environmental deterioration. On the other hand, it is advisable that the upper reaches do not blame the lower reaches but take a tactics of leading the negotiation by making a proposal which the lower reaches can easily agree with. It should be noticed that an important thing is not whether the Win-Win Approach is applied but how the initiative can be demonstrated in such negotiation on terms and conditions.

5.3 PROPOSAL OF COORDINATION PRINCIPLES TO BE INCORPORATED IN WATER RESOURCES MANAGEMENT PLAN

It was clarified that water use in the upstream of the Manjil Dam as well as in the downstream could be balanced with its potential until long-term target year of 2031 due to improvement of irrigation efficiency. Thus, in order to implement water resources development without the confrontation among the Provinces, the basic rule is that the proposal of new water resources development plan should be accompanied by the plan of water saving including an irrigation efficiency improvement plan, which keeps the water resources development within the water resources potential. Thus,

- New water resources development plan should be accompanied by a plan for water saving;
- Above-mentioned plan should be verified not to reduce present sufficient rates of other Provinces significantly in association with the water saving plan by the simulation model, etc. with involving all the relevant Provinces.
- Each Province shall continuously make an effort to save water including the improvement of irrigation efficiency and the results shall be monitored every year.

Detailed capable volume of water resources development should be examined by the simulation model built by JICA Study Team, which is expected to be elaborated by engineers gathered from each Province. From this viewpoint, a cooperative system among Provinces is required to be strengthened in the future.

CHAPTER 6. POINTS FOR FUTURE CONFLICT MANAGEMENT

6.1 MAJOR ACHIEVEMENTS

As the foregoing study funded by Gilan had faced strong criticism from other Provinces, it was expected that JICA Study to be conducted by the third party which is neutral toward all the Provinces would promote cooperation among them. At the beginning of JICA Study, however, the Study team was misunderstood as private consultants hired by WRMC because the stakeholders were not familiar with ODA granted by a foreign country. Thus, the meetings held at Provinces were started with the explanation on Japanese ODA and JICA to be understood properly in addition to the Study itself. In stakeholder meetings, JICA Study Team tried to make easy-to-understand explanation to every Province and respond carefully to each question presented by the representatives. Other members of the Study Team than the conflict management specialist went to each Province and made interviews directly to persons in charge as well as conducted field surveys with local engineers. Additionally, in terms of the simulation model, technology transfer workshop was held in a concentrated manner for the invited engineers from all the relevant Provinces. It was kept in mind that the Study activities as a whole would be conducted to improve relationship with local persons concerned. It can be judged that the Study Team earned confidence that they were impartial to the stakeholders to a certain extent. Further, satellite imagery data were provided by JICA. They were strongly requested by the Iranian side because they can exclude arbitrariness of Provinces on land use survey. That such neutral data could be reflected to the Study contributed to the results of the conflict management.

More than three years have passed since the Study started and stakeholder meetings were held for many times. Discussions were made with the attendance of all the relevant Provinces except a rare case that a very important event was held coincidently in the Province.

Activities of conflict management include earning confidence as neutral for each member of the Study Team with carrying out his/her responsibility continuously as well as those conducted directly to the stakeholders by the conflict management specialist. It is deemed that earning confidence of the stakeholders contributed to the results of continuous attendance by all the stakeholders. Neutral data is surely important, considering that the provision of satellite imagery data for clarifying the land use surely contributed to the results. But it should also be noticed that the Iranian side finished the data processing in the deadline although it had been concerned that it would be delayed very much as the shooting by the satellite had been delayed due to bad weather. Since the both sides had already established confidence, it can be said that the Iranian side tried to keep and promote such relationship. Such achievements mentioned above as well as other major ones can be summarized as follows:

- The Study succeeded in gaining confidence from the stakeholders;
- Such momentum has been gathered that each Province tries to cooperate for solving the problem;
- Background and matters of the conflict has been clarified;
- Solution of the conflict was examined and proposed: water use in the upstream of the Manjil Dam as well as in the downstream could be balanced with its potential until long-term target year of 2031 due to improvement of irrigation efficiency; and
- Coordination rule among the stakeholders has been proposed.

6.2 RECOMMENDATIONS

As mentioned above, the confidence of the Japanese and the Iranian side has been established and the stakeholders began to develop a confidence at present. At least no members proposed to dissolve the stakeholder meeting. In addition, some Provinces are making new water resources development plans, which requires an opportunity for coordination among Provinces hereafter. The stakeholder meeting can still play a significant role for solving the conflict on water resources. Thus, considering the Study results, it is recommended that the stakeholder meeting be developed for promoting cooperation among the stakeholders as a mechanism of water use coordination among the

Provinces and promotion of consensus building as well as a core of the future river basin organization which will be a main body of IWRM. The enhanced stakeholder meeting will be held quarterly for example to debate policies, strategies, data-sharing protocols, basin-wide modeling, and other systems issues and operating procedures that have impacts across administrative boundaries, as well as any existing or potential areas of conflict. The future river basin organization will be developed by making the stakeholder meeting as a nucleus. Although details of organization are discussed in later Chapter, basic directions of development, namely vertical and horizontal ones are mentioned below.

Vertical development means the deepening of discussion matters. Following matters should be discussed for implementing the IWRM plan, going beyond proposals and coordination for the Study as done before.

- To collect and analyze the data on water, other resources and environment
- To prepare hydrological/water quality monitoring
- To examine a water resource development plan
- To examine necessary fund
- To formulate an implementation plan for the Master Plan
- To operate the simulation model
- To build consensus on tentative rule for water use coordination among relevant Provinces
- To review urgent cooperation system in drought period and its provisional implementation
- To plan and execute capacity development for government officials tentatively

Horizontal development means the expansion of participants. Presently, official members are representatives of RWCs and some local consultants are invited to present technical information. Improvement of irrigation efficiency was found to be a very important factor as a result of the Study. Therefore MOJA is required to participate in the meeting, which is a main body of tertiary or lower irrigation channels. In addition, Ministry of Environment from the viewpoint of environmental flow maintenance and Ministry of Health from the viewpoint of water quality would be necessary for the meeting. Further, representatives of users such as farmers should be considered.

CHAPTER 7. INSTITUTIONAL STRENGTHENING PLAN ON WATER RESOURCES MANAGEMENT AND COORDINATION

7.1 RIVER BASIN ORGANIZATION (RBO)

7.1.1 Basic Concept of RBO

The present system of water related organizations is inappropriate for the integrated water resources management because each RWC devotes itself to the management within its own boundary and at the national level there is no organization which focuses on coordinating the activities of RWCs in the Sefiedrud river basin. Establishment of RBO, which is in charge of the water resource management from the viewpoint of the whole river basin, is an effective way for integrated river basin management.

According to a report of the World Bank, "Integrated River Basin Management Briefing Note 1, 2006," RBOs have three typical models, namely 1) river basin coordinating committee/council, 2) river basin commission, and 3) river basin authority. The characteristics of the three models are summarized in Table 9.3.11.

Table 7.1.1 Three RBO Models (1/2)

Model	Assumptions/Preconditions	Organizational Setups
River Basin Coordinating Committee/Council	• The existing agencies within the river basin are operating effectively. • Most of the important data networks are in place and good quality data and information is being generated. • Most of the high priority water projects have been constructed. • Competition for resource use between the states or provinces in the basin and the major uses within each of these has bee resolved.	• It would comprise ministers or senior representatives of the main water-related agencies from each of the states, provinces, prefectures, or other entities operating within the basin. • It would meet, for example, every three months, to debate policies, strategies, data-sharing protocols, basin-wide modeling, and other systems issues and operating procedures that have impacts across administrative boundaries, as well as any existing or potential areas of conflict. • As it does not have any executive powers, it cannot override the roles and activities of the member organizations. • It can also be uses as the first step in the development an ongoing form of coordination.
River Basin Commission	• Significant development options are still to be considered in the river basin • Conflicting uses are significant • Information and policies still need further development to ensure equitable sharing of resources and to limit the harmful impacts of resource use. • Water resource planning and management practices are not well detailed - either to facilitate further development or to limit development to restore desired environmental values in the basin. • Simulation models, systems and the underlying data and information are not readily available, or need further development.	• It would normally be a much more formally constituted body than the committee/council model. • It would be comprised of a board of management or group of commissioners who set objectives, goals, policy, and strategic direction. • It would be supported by a technical office of water, natural resources, and socioeconomic planning and management experts. • In some cases, there may be a Ministerial Council that presides over the commission to provide ultimate authority. • Daily operations for water resources management normally would be left to the existing agencies, unless these tasks are not being done effectively. • It would set the bulk water shares that each state/province is entitled to divert and would monitor water uses at the higher state/provincial level.

Table 7.1.2 Three RBO Models (2/2)

Model	Assumptions/Preconditions	Organizational Setups
River Basin Authority	• It was more common about 50 years ago, when there was more large-scale development of water resources systems for urban, industrial, or agricultural expansion. • In some African courtiers, where less than 10 % of the water resources potential has been developed, this model remains relevant and the river basin commission model may not be the optimum choice. • This model would not be the best arrangement for basins which are historically, geographically, and politically very complex.	This model usually takes one of the following two forms: • Multi-disciplinary organization with specific development tasks to under take such as hydropower development or navigation. Examples: Tennessee Valley Authority (USA), Snowy Mountains Authority (Australia) • An organization that absorbs virtually all the water resources functions of other agencies in the basin, rendering it very large and powerful. The authorities resembled large private companies.

Note: Names of the RBOs in actual cases are not necessarily the same with the above Models although they have the same organizational arrangements.

Source: World Bank, 2006. "Integrated River Basin Management Briefing Note 1"

The roles and functions of RBOs vary with the way of their formation and purposes. In addition, they will usually evolve with RBOs' development in a time frame of their activities. Such evolution is shown in the expansion of functions of the following five groups.

Table 7.1.3 Functional Stages in the Evolution of RBO

Functions	Initial RBO	Adult (auto adaptive) RBO	Mature RBO
Group 1: Water (and natural resource) data collection and processing, systems modeling, water and natural resources planning, stakeholder consultation & issue clarification	▲	▲	▲
Group 2: Project feasibility, design, implementation, operation and maintenance, raising funds, ongoing community consultation and awareness raising	▲	▲	▲
Group 3: Allocating and monitoring water shares (quality and quantity and possible natural resources sharing), cost sharing principles		▲	▲
Group 4: Policy and strategy development for economic, social and environmental issues, community awareness and participation			▲
Group 5: Monitoring water use and shares, monitoring pollution and environmental conditions, oversight and review role for projects promoted by RBO partners, monitoring and assessing the health of the basin's natural resources, mentoring the sustainability of resource management, review of strategic planning and implementation of modification plans			▲

Source :UNDP, 2008. "Performance and Capacity of River Basin Organizations"

7.1.2 Proposal of RBO for Sefidrud River Basin

1) Objectives of the Establishment of RBO for Sefidrud River Basin

Fundamental issues of the present situations of the Sefiedrud River Basin are identified based on the Study results as the necessity of 1) basin-wide coordination of water resources management including water resources development, utilization and conservation in accordance with a master plan authorized by all related Provinces, 2) water use coordination reasonably accepted among related Provinces in accordance with the master plan and 3) enhancement of reliability of data and information used in the master plan. Thus, establishment of the RBO for Sefiedrud River Basin shall be proposed with the following objectives:

- Coordination and formulation of the implementation program of the IWRM,

- Utilization, upgrading of the basin model as decision making support tools, and evaluation of the newly proposed plan using the model,
- Coordination on water allocation plan and consensus building, and
- Coordination on conflicts including drought and water related accidents and taking prompt action with remedial/countermeasures

2) Caspian Sea & Urumie Lake Basin Office

Caspian Sea & Urumie Lake Basin Office (CUBO) was established in 2008 with the purpose of coordinating water resources issues within the basins. Thus, CUBO has a close relationship with the RBO of Sefiedrud and such relationship should be clarified. The jurisdiction of CUBO covers all the river basins in the northern part of Iran, which covers 12 Provinces and includes Sefiedrud river basin. CUBO started a coordination work of water allocation of Atrak river with three stakeholder Provinces (Gorestan, North Khorasan and Semnan) in 2009 by establishing a committee, which is similar to Sefiedrud's. The General Director of CUBO began to participate in the Stakeholder Meeting of Sefiedrud from 2009 and is waiting for the results of the JICA Study.

According to the General Director of CUBO, it should be kept in mind that the coordination of water allocation takes a very long time and it should be conducted on step-by-step basis. In addition, the Iranian Government is being streamlined and it is not a good idea to establish a totally new organization.

3) Organizational Setup of RBO with River Basin Coordinating Committee Model

The RBO should employ the river basin commission model with some modification with the following reasons (please refer to the models of RBOs):

- Construction of large dams are still under consideration in the river basin;
- Coordination of water use allocation among related Provinces are significant;
- Improvement of the data and information system is required; and
- The simulation model prepared by the Study Team should be improved after completion of the Study with close cooperation among related Provinces.

As the above-mentioned World Bank report describes, if the existing water-related organizations in the basin are operating well, there is no need for the RBO to take over their operations and management roles and functions directly in this model. The RBO conducts coordination and planning across the whole basin and further develops and operates the tools, systems, and models to be used there.

However, it would be very difficult to start with the basin commission model with considering the present conditions of related organizations and the policy of the streamlining of the Government. Therefore, the RBO for Sefiedrud should start with the coordinating committee model by changing the name of the Steering Committee/Stakeholder Meeting, consisting of representatives of RWCs in the related Provinces and being presided by WRMC with the following tasks:

- To make an implementation plan of the Maser Plan of IWRM prepared by the JICA Study Team,
- To make a plan for the operation of the simulation model prepared by the JICA Study Team,
- To share data/information among the Provinces,
- To make basic rules in the IWRM: required minimum (monthly) flow for maintenance including water utilization and environmental needs, water allocation plan, etc.,
- To make water management rules during drought time, and
- To make a plan of employing participatory approach for the water users such as farmers.

The organizational structure of the RBO is proposed in the following figure. In terms of the central government, representatives of MOJA, Ministry of Environment and Ministry of Health will join in addition to WRMC.

As of local level, it is necessary to add representatives of MOJA, Ministry of Environment, Ministry of Health and farmers as important user in addition to WRMC.

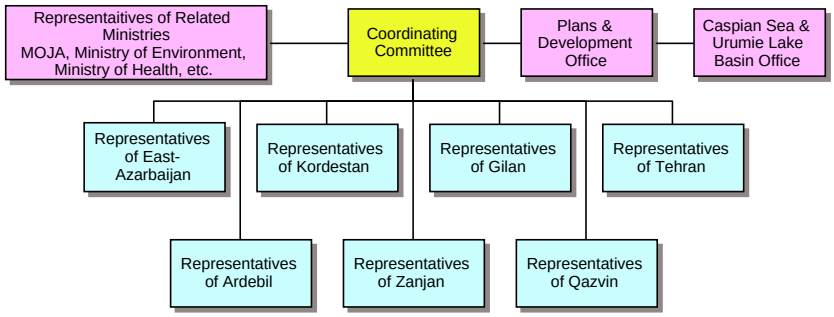


Figure 7.1.1 Organizational Structure of RBO with Coordinating Committee Model

4) Transformation of RBO to River Basin Commission

In enough years after the establishment of the Coordinating Committee RBO, its transformation to the Basin Commission Type should be considered in the Coordinating Committee. For such transformation, the Committee is required the following tasks:

- To discuss the details of the RBO (membership, tasks, budget, etc.),
- To explain the necessity and details of the RBO to related Provinces, and
- To draft of an agreement of the RBO among the related Provinces.

It is preferable that the agreement of the RBO is concluded by the Governors of the related Provinces and the Minister of MOE. The organizational structure of the RBO is proposed as follows:

Table 7.1.4 Components of RBO with Basin Commission Model

Component	Functions	Membership
Council	• To make policies and strategies of the RBO and IWRM for Sefidrud River Basin • To authorize significant decisions of the Joint Committee which affect the majority of the related Provinces	Governors of related Provinces and Minister of MOE
Joint Committee	• To decided matters which affects situations of two or more Province(s) • To authorize significant decisions of Working Group • To authorize the budget of RBO	Heads of RWCs, MOJA, Ministry of Environment, Ministry of Health and WRMC
Secretariat	• To support and coordinate of activities of other components • To prepare draft of budget of the RBO • To coordinate capacity development of RWC staff for IWRM • Contact point of the RBO	Staff sent from RWCs and WRMC
Working Group	• To make an implementation plan of the Master Plan in cooperation with RWCs in the related Provinces • To coordinate the implementation of the Master Plan • To utilize and upgrade the simulation model • To coordinate the water use of related Provinces • To improve data and information systems for IWRM	Basically the same members as the Coordinating Committee with expanding the number of members
Technical/ Policy-Making Advisory Group	• To make advice to other components from expert viewpoints	Academic experts from universities or research institutes for water resources management

Figure 7.1.2 Organizational Structure of RBO with Basin Commission Model

5) Capacity Development for IWRM under RBO

Capacities are now considered to be composed of knowledge, skills and motivations in individuals, and supporting systems of organizations where such individuals are working and circumstances where such organizations are located including rules and customs. Thus capacity development is promoted with the following dimensions:

- Human resource development and the strengthening of managerial systems,
- Institutional development, and
- The creations of an enabling environment with appropriate policy and legal frameworks.

In terms of human resource development, the RWC staff is required to carry out the following tasks with enough capacities for IWRM under the guidance of the RBO:

- Operation and maintenance of meteo-hydrological and water quality monitoring system
- Formulation of telemetry upgrading system plan, and operation and maintenance of the system after the completion
- Configuration of database system archiving the monitored data and its data sharing procedures
- Utilization and upgrading of the basin model, and evaluation of the newly proposed plan using the model
- Assistance of rules preparation and coordination among the RWC for consensus building
- Assistance of holding the public hearing workshop to realize the projects through people's agreement

6) Financial Setup for RBO

The total cost of the activities of the RBO should be borne by the related Provinces in accordance with their shares of water allocation. It is proposed that a fund be established in order to stabilize the financial base of the RBO with raising contributions from the related Provinces, the national treasury and bulk users including large manufacturing companies, utility companies and so on.

Financial planning and accounting are carried out by the Secretariat of the RBO and it reports financial statements to the Joint Committee annually.

7.1.3 Legal Framework for RBO

The roles and powers of the RBO must be clearly stipulated in addition to how it interact with existing agencies. The specific implementing regulation should be developed to establish the proposed RBO in the stage of the River Basin Commission. Since it relies upon the existing regulations for water resources management and agencies, the implementing regulation should include the following stipulations to conduct IWRM by coordinating the activities of RWCs.

Table 7.1.5 Implementing Regulation of RBO

Article	Examples of Contents
Preliminary	Purpose/objectives, definitions, geographic coverage/area of operations, principles
Institutional Framework	Membership, functions, rules and procedures, decisions and resolutions
Investigation, Measurement, and Monitoring	Setting water quantity and water quality Provincial targets, requirement for RWCs to notify of proposed projects of significant impact, requirement for the RBO to advise of potential impacts
Water Resources Planning and Management (quantity and quality)	Procedures and processes, integrating quantity and quality, participation by RWCs, types of plans
Construction, Operation, and Maintenance Powers and Responsibilities	Basin-wide and inter-Provincial projects, non-interference in Provincial operational activities, power to authorize and license inter-provincial projects and key hydraulic structures
Water Allocation and Sharing (Water Use Coordination)	Sharing among Provinces and the environment, setting Provincial water shares, defining environmental obligations and allocations, specifying hydropower and navigation obligations, monitoring use of shares/water accounting, procedures for temporary and permanent transfer of water shares, drought flow management
Flood Management	_
Catchment Management	Setting catchment planning guidelines (non-point source pollution planning), review and endorsement of plans
Estuary and Coastal Zone Management	_
Finance and Budgeting	Annual budgets, establishing and managing a River Basin Water Resources Fund, source of funds, operating rules, projects that can be financed, evaluation procedures, auditing of fund
Dispute Resolution	_
Public Awareness, Education, and Participation	_
Reporting	"State of Environment" reporting, annual performance reporting
Legal Powers and Ability to Prosecute for Violation of Regulation	_
Schedules	_

Source: World Bank, 2006. "Integrated River Basin Management Briefing Note 2"

7.1.4 Road Map of RBO

It should be clarified how the organizational arrangements be established and evolved for the starting point of the discussion on the RBO. An example of road map of the establishment and evolution of the RBO is shown in Table 9.3.13.

Table 7.1.6 Road Map of RBO

Number of Years after JICA Study	Organizational Set-up	Objective of Activities	Detailed Activities
0 - 5	Expansion of Stakeholder Meeting (Initial)	Preparation of River Basin Coordinating Committee	• To include representatives of MOJA, Ministry of Environment and Ministry of Health in the members • To collect and analyze the data on water, other resources and environment • To prepare hydrological/water quality monitoring • To examine a water resource development plan • To examine necessary fund • To formulate an implementation plan for the Master Plan • To operate the simulation model • To build consensus on tentative rule for water use coordination among relevant Provinces • To review urgent cooperation system in drought period and its provisional implementation • To execute capacity development for government officials tentatively
5 - 15	Establishment of River Basin Coordinating Committee (Adult)	Consensus building on a permanent rule for water use coordination among relevant Provinces and preparation of River Basin Commission	• To include representative of users such as farmers • To examine water resource management with a participatory approach • To execute dissemination for users • To execute hydrological/water quality monitoring • To examine cost share among relevant Provinces • To study establishment of the fund • To review the Master Plan • To modify the simulation model • To establish and execute urgent cooperation system in drought period and its provisional implementation • To review capacity development for government officials
15 -	Establishment of River Basin Commission (Mature)	Implementation of IWRM	• To formulate common strategies for economic, social and environmental problems in the river basin and to monitor its joint implementation • To implement water resource management with a participatory approach • To establish a fund • To upgrade the simulation model • To review the permanent agreement on water use coordination among relevant Provinces • To review urgent cooperation system in drought period

Annex – 1
OPINIONS IN CONFLICT ANALYSIS WORKSHOP

Annex - 1

OPINIONS IN CONFLICT ANALYSIS WORKSHOP

Table of Contents

CHAPTER 1. EAST AZARBAIJAN

1.1 VIEWPOINTS OF THE WORKSHOP PARTICIPANTS ABOUT INTEGRATED MANAGEMENT OF THE GHEZELOZAN-SEFIDRUD BASIN

Integrated management of water resources means:

- Determining the potential share of each stakeholder in a given basin
- Scientific evaluation of status quo for the purpose of more precision in decision-making
- Observance of the rights of downstream stakeholders by upstream stakeholders
- Promoting unanimity among governmental organizations
- Taking account of the views of farmers
- Adopting a comprehensive approach to the conditions of each region
- A kind of land use planning
- Implementing plans by taking account of all stakeholders' rights
- Management of water and soil resources at the same time
- Adequate attention to 3 main issues: economic productivity, social equity in decision-making, and environmental protection
- Considering existing rights of all customary water right holders as well as ensuring their potential rights
- Observing principles of sustainable development through paying heed to benefits of all the stakeholders
- Ensuring the long-term provision of water needed by industry and drinking water through precise definition of water resources and uses;
- Taking account of water supply efficiency and planning for its promotion;
- Using different criteria for prioritizing the projects (industry, agriculture and tourism)
- Paying attention to all sorts of needs existing in the basin
- Adopting a systematic and comprehensive approach based on water resources, potentials and needs in order to realize sustainable development and justice
- Observance of qualitative and quantitative rights of customary water right holders
- Taking account of social, cultural, economic and participatory indicators in each region for prioritizing the allocation of water resources
- fair distribution of water based on development potentials of each region and the principles of sustainable development
- Trans-sectoral management of water resources
- Taking account of all authorities involved such as Jihade Agriculture Ministry, Water and Sewage Department, etc
- Unification of parallel legislation at trans-regional level
- Coordination between regional and national policies
- Paying attention to project evaluation indicators, especially economic indicators
- Evaluation of water projects by all executive bodies in the province

1.2 PROBLEMS

1.2.1 Policy-Making and Management

- Lack of an integrated water management policy
- Failure in timely delivery of water to users
- Negative mentality of users about managers
- Lack of adequate research on integrated management
- Lack of information exchange between stakeholder groups
- Baseless claims for water
- Lack of planning for recourses and their use
- Lack of appropriate policies and regulations
- Lack of coordination between regional water companies
- Lack of coordination between the Ministry of Energy and other relevant bodies
- Lack of coordination between users and water companies
- Sector-oriented approach towards the use of water
- Inadequacy of macro policy making
- Lack of evaluation indicators for prioritizing water provision
- Impact of personal views in prioritizing water provision
- Lack of an equal approach to problems by different provinces
- Low productivity of irrigation in downstream

1.2.2 2.2. Social and Economic Issues

- Large-scale immigration to cities as the result of lack of sustainability in livelihoods of farmers engaged in dry-farming
- Lack of knowledge of users on optimum ways of using water
- Reluctance of farmers in using pressured irrigation system
- Providing water (for drinking and industry) for users outside the basin
- Failure in timely resolution of problems of customary water right holders
- Tensions resulting from failure in resolving water-related problems
- Adequate upstream residents' access to water versus inadequate downstream residents' access to water
- Reluctance of private sector in investment in deprived regions and accumulation of investment in large cities
- Low speed of watershed management in upstream as the result of inadequate funding
- Low productivity of irrigation, transfer and distribution of water because of inadequate funding
- Waste of water
- Local prejudice regarding using the basin's water resources
- Capacity-building problems

- Lack of an appropriate culture regarding use of water

1.2.3 Environment

- Construction of dams in the basin before the approval of environmental impact assessments
- Strong competition for constructing more dams
- Severe soil erosion
- Government's failure in allocating adequate budgets for combating erosion
- Low quality of Ghezelozan River's water
- Discharge of rural and urban sewage into water
- Lack of enough studies on land-use
- Failure of the Department of Environment in formulating a long-term development plan for the region leading to the failure of the functioning of other sectors
- Over-growth of resource exploitation without paying attention to the principles of sustainable development
- Making new plans without paying attention to those under implementation in the downstream
- Incomprehensive and partial approaches in some provinces without paying attention to environmental considerations
- Lack of ecotourism facilities in Ghezelozan vicinity
- Discharge of agricultural drainage into Ghezelozan River

1.2.4 Natural Resources

- Low speed of watershed management in upstream due to inadequacy of information
- Failure in the timely provision of water to modern irrigation projects in downstream
- Overgrazing of livestock
- Sedimentation in dam reservoirs
- Low productivity (consumption rate of 90% for agriculture sector)
- Wastage of water in downstream
- Inadequate allocation of water to agricultural lands leading to low productivity
- Geological conditions
- Limitations of surface and underground water resources as the result of drought and climate change

1.2.5 Laws and Regulations

- Inadequate laws and regulations for protecting water, soil, pastures and dams
- Inadequate laws and regulations for protecting the stakeholders
- Absence of a number of organizations in the basin water allocation system

1.2.6 Information and Data Infrastructure

- Lack of enough data and information on surface and underground water resources
- Lack of a research center on water-related issues

- Lack of a reliable information bank on water-related issues
- Failure in estimation of long-term water needs of different sectors
- Lack of informed experts for conduct of studies
- Inadequate knowledge and information of provincial experts regarding the basin's capacities and potentials
- Inadequate studies on land use planning
- Lack of network for monitoring water resources
- Inadequate public awareness of the demand
- Lack of a network of measurement stations in the basin

1.2.7 Industry and Mining Sector

- Failure in predicting future needs of provinces' mining potential
- Failure in optimum use of water in the basin and increase of irrigation efficiency
- Failure in the estimation of long-term needs of industries

1.3 SUGGESTIONS

1.3.1 Policy-Making and Management

- Establishing a trans-provincial and trans-regional committee (or other institution) comprising the representatives of all the stakeholders for the management of water resources in the basin
- Creation of the administrative structures necessary for the integrated management of the basin
- Organizing water consumption
- Adaptation of the integrated management of water resources and land use planning
- Using the developed countries' experiences
- Paving the way for the participation of grassroots organizations and NGOs in the water management
- Scientific evaluation of the status quo of the basin's water resources
- Adopting trans-regional approaches in the management and exploitation of water resources
- Training the experts engaging in the integrated water management
- Defining the unified management of the basin before the application of the integrated management;
- Taking account of the capacity of downstream lands in the implementation of large projects
- Trans-regional management of the environment
- Promoting coordination among organizations engaged in the integrated management
- Elimination of regional prejudices and giving priority to national goals
- Paying attention to the quality (of water) in addition to (its) quantity
- Taking account of the viewpoints of relevant organizations in the allocation of the water
- Observance of the principles of sustainable development in the implementation of the projects
- Assigning the responsibilities regarding the dam and its upstream and downstream to a single

organization

- Considering all the issues related to the integrated management of water resources in credit allocation
- Paying attention to the neighboring basins
- Policy-making based on sustainable development principles and determining the current and future water needs of each province
- Observance of the rights of customary water right holders
- Paying attention to the social regional factor of poverty in the integrated management of water
- Assigning priority to the economic value of water

1.3.2 Social and Economic Issues

- promoting public participation
- Raising public awareness of optimum exploitation of water resources
- Promoting the participation of stakeholder provinces in the basin management
- Paying attention to people and media representatives and other relevant groups in the course of decision-making and planning
- Development of pilot mechanized farms for the purpose of training agricultural water users
- Participation of users and NGOs in water projects
- Providing information to the members of Islamic Rural Councils for the purpose of preventing tensions arising from water exploitation
- Cooperation between Farmer Houses in the process of information provision regarding exploitation of the basin's water resources
- Genuine public participation and needs assessment
- Examining social, economic and political issues faced by the users as well as their own opinions in that regard
- Realistic assessment of people's role in the management and exploitation of the basin's water
- Using optimum water use patterns as the criteria for the distribution of water among users
- Improving (changing) irrigation methods in order to increase efficiency
- Raising public awareness through training and use of media

1.3.3 Environment

- Tackling the issue of human and industrial sewage in the basin
- Implementing projects after the approval of their environmental impact assessment reports
- Raising public awareness of environmental risks
- Planning for sewage (urban, industrial, etc) treatment to prevent the pollution of the basin
- Revision of the methodology of environmental assessments

1.3.4 Natural Resources

- Regulating grazing to prevent erosion of soil
- Determining the land use across the basin

- Harnessing of water and watershed management in upstream
- Government's attention to formulation of comprehensive regulations concerning the protection of water and soil
- Paying attention to agricultural issues in downstream
- Allocation of water from basin to farming for the purpose of stabilizing people's livelihoods
- Examining the quality of water in Ghezelozan basin in order to enhance the quality of water
- Reducing discharge of agriculture drainage in the river
- Improving the basin's ecosystem
- Promoting agriculture to foster rural communities and reduce immigration

1.3.5 Laws and Regulations

- Enforcement of optimum water use law and its observance in optimization of consumption patterns
- Unification of parallel legislation in different organs
- Clear definition of responsibilities and legal frameworks of various organizations related to the management of water resources
- Practicality of laws followed by organs related to water resources management

1.3.6 Information and Data Infrastructure

- Establishment of an optimum network for measurement and data collection regarding water resources
- Establishing a center for the exchange of data and information at basin's level
- Paying attention to the issue of protection in the integrated management of basin's water resources
- Tackling the current shortage of information
- Updating the results of the studies conducted on water resources considering drought and climate change
- Providing information about the current issues of the basin to the members of the Parliament in order to prevent possible tensions
- Providing information to governmental organs in provinces through the Ministry of Energy
- Establishment of an optimum network for measurement and updating data on water resources

1.3.7 Mining and Industries

- Considering privatization of industries in the allocation of water resources
- Taking account of the potential water needs of mines in the province
- Estimation of the quantity of water needed for the development of industries in long term in the province

1.4 ALLOCATION OF WATER

Water allocation should be based on:

- The population and dominant form of employment in each region

- Criteria for land use planning
- The geographical distribution and water share of upstream
- The contribution of surface and underground water resources
- The type and quantity of water needs
- The potential of agricultural lands in different provinces
- The indicators of sustainable development
- The indicator of the ratio of water produced in each province To the total amount of water in the basin
- The need for drinking water in each province
- The issue of the value of water
- Land use management
- The priorities set by national policies
- The priorities set for water use
- The environmental and ecological requirements
- Downstream needs and rights of upstream
- Water need of the provinces lacking access to other water basins
- The added value of water
- The possibility of inter-basin water transfer
- The limitation of surface and underground water resources in the region
- The dominant type of cultivation in each region (water needed for irrigation farming)
- The fertility and size of agricultural lands in each region
- The strategic role and importance of each province
- The factors such as water, soil; climate; human resources; access to technology and water productivity
- Anti-poverty policies

1.5 LEGISLATION

- Legalization of the basin's steering committee
- Revision of the duties of relevant organs and promoting coordination among them
- Redefining the water tariff based on potentials and needs
- Harmonizing the functioning structures with the actual and potential needs in the basin
- Defining the development pattern in the basin taking account of water limitations (potentials and needs)
- Integrating hydrological and environmental management of water resources
- Formulating directions for the exploitation of water resources in the basin
- Formulating regulations for water users aimed at protecting the rights of downstream users
- Formulation of comprehensive laws regarding the integrated management of water resources (governing all related aspects including watershed management, environmental issues, etc)
- Formulation of laws and regulations on patterns for using fertilizers and pesticides for the purpose of protecting the quality of the river water

- Concluding memorandums of understanding between regional water companies for the purpose of promoting coordination among them
- Formulating instructions on water allocation in common basins for the purpose of fair distribution of water
- Unification of all existing laws and regulations pertaining to different sectors in the form of a comprehensive law on Ghezelozan Basin
- Formulation of laws on observance of the qualitative rights of downstream users
- Legalization of customary water use and documentation of the indigenous knowledge
- Formulation of laws on cultivation patterns to be followed by farmers in downstream
- Formulation of laws on water use management for different sectors

CHAPTER 2. ARDEBIL

2.1 VIEWPOINTS OF THE WORKSHOP PARTICIPANTS ABOUT INTEGRATED MANAGEMENT OF THE GHEZELOZAN-SEFIDRUD BASIN

Integrated management of water resources means:

- Responsibility over solving current problems and balanced development of the provinces in the future
- Free an impartial reflection of stakeholders' decisions and applying them
- Taking into account the environmental indicators in management policies
- Taking holistic outlook and justice in all sections considering the industrial and economic conditions of the regions
- Flexibility in decision-making over water allocation
- Technical and fair decision making of stakeholders according to the needs
- Re-engineering in previous water rights
- Identifying water users and estimating water need in three positions including current circumstance, crisis, long-term situation
- Optimum use of water resources and satisfaction of users
- Taking into account the long term strategies in reducing agricultural consumption, water aquifer, industry development, needs for healthy water
- Coordination and thinking about solving problems
- Taking into account social justice and development
- Failure in paying attention to the hierarchy of the projects
- Pointing weak points and strong points, dangers, and opportunities
- Centered management by taking into account real needs of the stakeholders according to the priority of developmental targets in healthy drinking water, agriculture, industry and tourism water, etc.
- Water potential assignment for allocation based on fundamental exploitation
- Water right supply among provinces
- Management of productive resources and water consumption
- Fundamental planning based on studies, scientific and technical researches in order to exploit water by observing principles of sustainable development
- Increasing unanimity and avoiding conflicts
- Assigning water allocation of each basin to appoint water rights
- Establishment of management structure for integrated decision making

2.2 PROBLEMS

2.2.1 Provincial Needs

1) Drinking Water

- Lack of sustainability of resources to supply drinking water in Khalkhal and Kusar

- Lack of drinking water because of over-population
- Failure in water supply because of lack of water resources in wells and springs
- Failure in precise estimation of drinking water

2) Industry

- Industry's underdevelopment
- Failure in using Ghezelozan water to provide industrial needs

3) Environment

- Polluted rivers' effects on downstream
- Failure to prepare environmental evaluation report in eight provinces
- Inappropriate quality of Ghezelozan River in the vicinity of Ostor Dam
- Disobedience of contaminant units of water resources in a case of refinement
- Soil erosion and sedimentation in Ghezelozan River because of heavy rain
- Failure in adjustment of river's environmental process
- Failure in water supply in the protected zone of Khalkhal
- Pollution of backwater in hatcheries in the vicinity of the river
- High level of drought compared to national indicators

4) Agriculture

- Inappropriate conditions of topography
- Absence of integrated lands
- Absence of water resources for irrigation and meeting the needs of rich lands
- Climate changes, reduction of rain, increase of drought, raising provincial demands
- Lack of appropriate potential of soil in Khalkhal and Kusar
- Low level of consumption aquifer
- Absence of sufficient water resources for rich lands
- Water over-use in other provinces

2.2.2 Social and Economic Problems

- Over-population in Khalkhal and Kusar and increase of need for water
- Using old methods of irrigation that leads to wasting water
- Immigration to major cities
- Failure in providing appropriate facilities to apply anti-poverty policy
- Unemployment because of lack of water
- Closure of cement factories in Ardebil because of lack of water
- Social tensions in generating new water rights as a result of organizing rivers

2.2.3 Water Resources

1) Surface Water

- Disproportion between water resources and soil resources
- Failure in dam construction and contribution of water supply projects
- Failure in paying attention to inter-transference of water
- Absence of balance in transferring and distribution network of water
- Failure in exploitation of water
- Disproportion between land application and water resources

2) Groundwater

- Over-using underground water resulting from lack of other resources
- Subsidence of plain as a result of decreasing underground water resources
- Crisis as a result of non-balance in feeding water table and exploitation
- Failure in accessing to other resources in Ardebil plain
- Overdraft aquifer of underground water and drying wells
- Limitations in exploitation of underground water

2.2.4 Management and Policy-Making

1) Laws and Regulations

- Different level of exploitation in stakeholder provinces
- Political attitude of water allocation process
- Failure in transferring water to other provinces
- Absence of clear laws and regulations regarding integrated use of water resources
- Lack of connection between provinces regarding water exploitation
- Absence of certain laws regarding use of water resources of water right holders
- Absence of certain laws regarding use of water rights of water right holders
- Absence of legal requirement to apply management in the river especially in upstream

2) Management and Decision-Making

- Oversight of authorities to Khalkhal and Kusar
- Failure in haggling over allocation of water resources
- Failure in paying attention to sub structural considerations in water studies
- Unilateral decision making
- More opportunity for upstream provinces to use river water
- Failure in planning for previous needs
- Failure in paying attention to the balance of water resources
- Failure in applying justice in water allocation
- Failure in water harnessing projects

- Disproportion of indicators in water resources' development
- Rejection of provincial need for water by decision makers
- Political decision making over integrated management of water resources
- New foundation of the province
- Lack of management in the basin, and exploitation in form of consuming and harvesting

2.3 SUGGESTIONS

2.3.1 Suggestions for Provincial Needs

1) Drinking Water

- Development of water package industry for drinking
- Paying attention to the priority of drinking water supply
- Estimating needs for water in a precise way above 1/116 paper of drinking water estimation
- Providing evaluation reports for the projects regarding provincial needs for drinking water
- Paying attention to public optimum use of water and applying methods of optimum consumption
- Long-term supply of drinking water from Ghezelozan River

2) Industry

- Taking into account industrial development in modeling for water resources planning
- Paying attention to exporting industrial manufactures in frontier areas
- Necessity of provision and allocation of 120 MCM to develop industry in Khalkhal and Kusar
- Water supply in industry as well as providing drinking water
- Transferring and using water from Ghezelozan for industry in Khalkhal, Kusar, and Hashtjin

3) Environment

- Preparing environmental impact assessment studies of all projects in margin areas and along the rivers
- Assigning reception level of rivers for contaminant and controlling them in upstream
- Signifying environment protection programs to raise the quality of water resources
- Provision of water needs for wildlife and plant coverage
- Provision of environmental water right in integrated path of river from upstream to downstream
- Using current backwaters in water allocation
- Quality control of water in form of online physical, chemical, and biological indicators
- Provision of river's biological needs
- Taking into account the ecologic need of protected zone of Aghdagh Khalkhal
- Reduction of sediment transference and pollution in the river

- Prevention from erosion of watercourse to protect the ecology of the river
- Recognition and removal of contaminant resources along the river to protect quality of water
- Study of executive strategies to remove contaminant resources
- Contribution of practical strategies to prevent erosion in the vicinity of the river
- Construction of waste collection system

4) Agriculture

- Investment in agriculture section to change the irrigation pattern and cultivation
- Transference of surplus water to the fertile plains of the province
- Prioritizing strategic products
- Harnessing of water in upstream by irrigation and watershed operations to prevent flood and sediment
- Fundamental revival of plant coverage in natural and agricultural resources
- Priority of using surface water in agriculture
- Optimum exploitation of current water resources by using modern methods of irrigation
- Formation of data bank about soil and water
- Change of cultivation pattern and replacing it with less-water consuming crops in Gilan and East Azerbayjan provinces
- Applying new methods of water consumption in downstream and increase of irrigation level
- Taking into account topographical conditions of Ghezelozan as an obstacle in harnessing water

2.3.2 Social and Economic Suggestions

- Economic value of water
- Solving problems regarding using resources of drinking water by water right holders through approval of new laws
- Water pumping from Ghezelozan to Kusar and Khalkhal
- Advertising about optimum way of using water
- Revision of previous water rights
- Informing all stakeholders of social and economic situation
- Cooperative decision making and appointing viewpoints of all provinces with equal right

2.3.3 Suggestions for Water Resources

1) Surface Water

- Using surface water to provide water in underground water tables
- Replacing Ghezelozan water instead of using underground water of Ardebil prohibited plains
- Transferring water to downstream to solve problems regarding quality and quantity of water

- Constructing reservoir dams in appropriate zones by considering environmental issues
- Integrative use of surface and underground water in meeting given needs (drinking, industry and agricultural waters)

2) Groundwater

- Limitation of well exploitation to provide water
- Prevention from decreasing the level of underground water and subsidence of plain
- Replacement of underground water consumption by transferring and providing surface water
- Using underground water resources by feeding and enhancing water tables
- Balance of water table
- Prioritizing the protection of underground waters in Ardebil plain as national capital for future generations

2.3.4 Management and Policy-Making

1) Laws and Regulations

- Revision of water allocation in underdeveloped provinces
- Change of consumption pattern and using surplus water
- Continuous perseverance to enforce approvals of board of ministers regarding water transferring to Ardebil plain
- Construction of management system in accordance with laws of integrated management
- Flexibility in planning for inter-basin activities during hard times
- Reformation of current laws of water exploitation

2) Management and Decision-Making

- Transferring water from basin to Ardebil prohibited plain by providing needs for water in agriculture, industry and city
- Water distribution considering policies of integrated management
- Optimum and modern use of water resources
- Construction of water installations
- Harnessing of water in headwaters and natural resources
- Identifying provincial needs and consumptions
- Researching about watershed to achieve sustainable system in the ecology of the river
- Accelerating of water allocation process
- Using water produced inside the province to supply water in the future
- Harnessing of water by performing small projects regarding water supply in headwater
- Taking into account public viewpoints regarding water resources exploitation
- Evaluation of executive and under-study projects
- Taking fair outlook and observing justice in water allocation to new-established provinces
- Taking into account the local and regional viewpoints of Ardebil Water Company

- Taking into account the provincial targets and promoting developmental conditions
- Precise study over current situation of using potentials
- Avoiding political interference
- Impartial attitude of JICA in research
- Failure in contribution of lines to JICA by stakeholders
- Proportion of produced water in basin level considering development level
- Priority of using water resources by new-established companies
- Taking into account the share of each province in producing water resources
- Taking into account the rights of downstream and upstream in performing the projects for a long time
- Prioritizing of using water in deprived regions
- Advertising about optimum way of using water in industry and agriculture
- Independent planning regarding quality and quantity of consumption

2.4 INTER-PROVINCIAL WTER ALLOCATION

Water allocation should be based on:

- Elimination of biological need of river
- General indicators of needs(in form of positive indicators)
- Size, population, development(in form of negative indicators)
- Contamination, destruction, dams, erosion
- Fixing mass of water during drought and in other seasons
- Priorities of exploitation
- Farmlands and industry
- Priority of providing drinking water
- Producing cultural and livestock products
- Social justice
- Study over priorities of given needs and problems
- Water resources
- International laws
- Disregarding the timing of the plans
- Criteria of water quality and quantity
- Low quality of downstream water
- International commitment and sustainable development of the region
- Long-term potentials and deprivations of the province
- Economical cultivation with low level of water consumption
- Future needs of development
- Provincial potentials
- Location of the province in the frontier area

- Comprehensive models of water resources
- Balance development
- Environmental needs
- Yearly weather forecast
- Failure in paying attention to water structures during drought
- Economic, environmental, social, and cultural factors
- Partial balance of water table, employment, tourism, anti-poverty policy
- Compensation of previous water allocations

2.5 LEGISLATION

- Cooperation of public communities in formulating laws and regulations
- Formulation of bylaws in accordance with overall potentials of all provinces in the basin
- Legislation of laws and regulations based on realities to allocate water
- Necessity of conducting environmental impact assessment for all projects
- Legislation of laws and regulations in regards to evaluating projects and studies by considering provincial priorities
- Updating current laws
- Formulation of comprehensive laws for water resources in the framework of integrated management
- Legislation of new laws and regulations regarding cooperation of groups and stakeholders in water exploitation
- Revision of water allocation law
- Alteration of related regulation of land features such as gradient
- Taking into account the regulations related to regional cultivation pattern
- Change of regulations in transferring water between basins
- Formulation of new regulations using basin's water in deprived provinces to promote development
- Management of consumption pattern instead of demand management
- Formulation of bylaws possessing performance warranty
- Applying international laws
- Observing unanimous attitude in current laws and regulations
- Revision of water rights in developed provinces
- Legislation of necessary regulations considering location of the province in frontier area

CHAPTER 3. KORDESTAN

3.1 VIEWPOINTS OF THE WORKSHOP PARTICIPANTS ABOUT INTEGRATED MANAGEMENT OF THE TALVAR -SEFIDRUD BASIN

Integrated management of water resources means:

- Appropriate planning for exploitation of the basin's water resources in accordance with ecological conditions and upstream potentials
- Taking account of social and political parameters in exploitation of the water resources
- Balanced, wise, organized and fair allocation of water to the stakeholders in course of sustainable development of each province
- Implementing the quantitative optimum management of water resources considering all related economic, social, political, cultural, ecological and water right parameters
- Implementing qualitative optimum management of water resources in order to curb pollutions in the plains at risk
- Fair distribution of water to the provinces and taking into consideration the upstream requirements
- Seeking a remedy for inappropriate and unauthorized exploitation of water resources
- Developing a proper mathematical model for exploitation of available underground and surface waters
- Adopting a systematic view on water resources planning
- Qualitative and quantitative protection of the river in upstream to the downstream
- Real understanding of the water and soil potentials in order to fulfill the requirements and maintain sustainable development
- Unanimous management of the balanced exploitation of underground waters
- Concurrent availability of the latest information of the basin's water resources to all the stakeholder provinces

3.2 PROBLEMS

3.2.1 Policy-Making and Management

- Failure in allocation of water considering the province potentials and suitable lands
- Failure in considering the watershed management and natural resources funding
- Lack of funds in the water–related sectors of the province in order to conduct studies and development projects
- Lack of regional data related to the basin's water resources
- Lack of a definite plan for the development and suitable use of the river's water on account of underdevelopment of the region
- Failure in having a role in implementing the projects of the province
- Lack of a precise definition of the water usage considering the existing limitations
- Failure in implementing the development projects based on water needs of agricultural lands, compensating the aquifer overdraft, and fulfilling the need for drinking water in urban and rural areas

- Supply of water in head river branches aimed at preventing migration, promoting irrigated cultivation, and ensuring the upstream and main head branches customary water rights
- Revision of the engineering Value for the projects under implementation/study, considering the outcome of the integrated management of the water resources
- Lack of coordination between the Ministry of Energy and the Ministry of Agriculture as the producer and consumer of the water resources
- Stabilization of the population centers by implementing developmental plans and enhancing means of livelihood in order to prevent migration for survival
- Giving priority to dams under construction or ready for operation for issuance of water allocation licenses
- Management of the free plains converting restricted plains to protected plains
- Lack of adequate share of the province from the basin's water resources
- Failure in obtaining water in upstream on account of related limitations
- Failure in allocating water to the province in order to carry out projects and studies
- Lack of coordination of the organizations in inter-provincial management
- Management of the province's water resources (dams) by the other neighboring provinces
- Unbalanced and unorganized development within the basin
- Lack of fair and suitable planning, distribution and usage of water
- Lack of precise statistics on the number of the water right holders specifying the extent of their share
- Lack of realistic attitude towards allocation of water because of imprecision of the statistics and information on the resources and consumption rate
- Failure in considering needs in industry, agriculture and drinking in allocation of the water

3.2.2 Water Supply

1) Surface Water

- Immediate escape of water from the province being a mountainous area containing sharp slopes
- Lack of runoff
- Shortage of rain in Ghezelozan Basin
- Failure in enforcing approvals of the Comprehensive Water Plan
- Illegal exploitation of other provinces from the basin's water
- Failure of the province in appropriate distribution and harnessing of the surface waters
- Extra demands for water in industry, agriculture and drinking
- Seasonal rivers

2) Groundwater

- Overdraft aquifer
- Over-exploitation from the wells holding legal license
- Wastage of water because of inappropriate planning of the organizations
- Flow of the factory's effluents and sands pouring into the aquifer

- Ground waters becoming gassy
- Salinity of the underground waters resulting in low–quality water
- Rushing into use of the underground waters because of failure in harnessing surface waters
- Limitation of the underground resources in Kurdistan

3.2.3 Agriculture and Natural Resources

- Failure in considering vegetation
- Failure in considering the farmers as the main consumers in water management
- Losing the opportunities in rainfalls and torrents
- Lack of a unanimous management in exploitation and cultivation system
- Special attention to the watershed management and natural resources issues
- Inadequacy of water allocation to the province compared to the neighboring province's needs
- Failure in taking into account the difference between the pattern of farming and consumption in Kordestan compared to some other provinces as Gilan
- Lack of considering basin's watershed management
- Change in the usage of lands and pastures
- Spoilt pastures and animal husbandry problems in the basin

3.2.4 Economic and Social Issues

- Lack of consideration to the real cost of water
- A possible water crisis in the future
- Economic and cultural poverty of the basin's residents
- Low participation of the users in implementing the projects
- Failure in giving information to indigenous people and promoting their culture in using water and soil
- Lack of occupation and income
- Large-scale immigration of the farmers to the cities
- Undeveloped industries
- Lack of development projects creating jobs
- Tendency of men towards non-production and false occupations
- Social and cultural problems resulting from failure in development of the region

3.2.5 Environment

- Extra sedimentation of the basin
- Failure in paying attention to the environmental impact assessments in implementing different projects
- Over-exploitation of sand from the rivers
- Lack of attention to the plans aiming at decreasing pollutions specially in Telvar River
- Acceleration in the speed of pollutions in the surface and underground waters
- · Disposal of construction waste in entrance areas of the aquifer

- Lack of planning to resolve problems regarding domestic, cattle-related and industrial sewages, because of shortage of funds

3.2.6 Laws and Regulations

- Lack of the conformity of the Water Fair Distribution Act with the existing conditions
- Failure in considering the rights of the upstream stakeholders
- Lack of regulated exploitation of water
- Lack of definite indicators for distribution of water to the stakeholder provinces
- Establishing laws related to the exploitation of water and stating the law-enforcement guarantee
- Lack of cooperation of the Justice Administration in prosecution of the water-related violations

3.3 SUGGESTIONS

3.3.1 Policy-Making and Management

- Collaborative management of decision-making and planning for the basin's water resources
- Holding (at least) bimonthly meetings of the managers of the eight stakeholder provinces
- Considering water rights and provision of water for the upstream stakeholders
- Water and lands management by a committee comprising representatives of Jihad Agriculture Organization, Department of the Environment and the Ministry of Energy
- Sufficient coordination between the related organizations and clear planning based on the requirements of the upstream and downstream stakeholders and observing their rights
- Allocation of the water supply of each province for development of its water resources without consideration of the national economic efficiency
- Concluding a memorandum of understanding between the stakeholder provinces
- Reconsidering demands of the over-consuming provinces
- Considering the fact that some statistics and information presented by the Province's Regional Water Companies are poor and inaccurate
- Avoiding to repeat the criteria formulated by Mahab Ghodss Consulting Engineers
- Applying the integrated management principles in order to achieve sustainable development
- Conducting more studies and exploring water reservoirs in Semidried basin
- Conducting social studies on the resources and disadvantages of the downstream and upstream
- Performing provincial management of the water resources exploitation in executing projects of Telvar Basin
- Setting priorities for the needs and soil potentials in allocation of water resources
- Installing appropriate measuring instruments and monitoring water input and consumption of the basin
- Planning for optimum usage of Ghezelozan River by the farmers of the province
- Continuation of the plans and provincial projects in order to curb the transfer of sediments
- Fair distribution of water between Kordestan and other provinces

- Making use of the management experiences of the other countries taking account of ecological conditions of the region
- Assigning management of the basin's water allocation to the stakeholder provinces by the Ministry of Energy
- Considering all the effective factors in comprehensive water management of the basin
- Improving the basin's management structure
- Formulating comprehensive water-related plans and undertaking to implement them
- Accelerating the notification of plans for water allocation to the projects under implementation
- Recognizing the upstream users and developing management of the downstream
- Considering a unanimous management in water exploitation network
- Allocating special funds to construct installations for water supply of the agricultural sector
- Increasing the number of studies and projects on inter-basin transfer of water
- Harmonizing the management of demands in all over the basin's provinces

3.3.2 Water Supply

1) Surface Water

- Harnessing the surface waters in the upstream regions considering the high position of the bedrock and water runoff
- Inter-basin transfer of water from the west rivers to the east as a means of artificial water supply
- Developing irrigation and drainage networks
- Constructing pumping installations
- Stabilizing Ghezelozan river based on the basin's natural conditions
- Giving priority in water allocation to the users located near the head branches of the river
- Recycling the waste water of the industries and optimum usage of that
- Using surface waters rather than underground waters of Ghorveh and Dehgolan in industries
- Changing the existing irrigation systems into pressured ones
- Setting priorities for water allocation in drinking (urban and rural), industry, and agriculture respectively
- Considering the flow of water, area of the basin in each province and the extent of the needs in exploitation of water
- Conducting precise studies on the water rights in over-consuming provinces like Gilan
- Special attention to the basin's main head branch
- Fulfilling the upstream needs as the first priority and the downstream needs regarding its potentials

2) Groundwater

- Controlling water exploitation
- Constant monitoring the wells' digging operations and protecting the underground waters
- Implementing artificial feeding plans

- Collecting and diverting the water provided by the springs and qanats to the underground waters in when the lands are not under cultivation
- Formulating watershed management plans
- Allocation of proper funds for artificial feeding of the underground waters in the east of the province

3.3.3 Agriculture and Natural Resources

- Developing agriculture sector in the upstream
- Developing modern irrigation networks and promoting the irrigation efficiency
- Cultivating crops of less use
- Formulating the comprehensive watershed management plan in the basin
- Recycle and use of sewage for agricultural purpose
- Promoting greenhouse cultivation
- Having serious concern about genetic improvement and producing varieties of less use
- Amending the cultivation pattern
- Prohibiting the cultivation of non-strategic crops
- Changing methods of irrigation
- Considering conditions of the animal husbandry and decreasing pressure of livestock grazing in the pastures
- Paying attention to the improvement and restorations of pastures and natural resources
- Organizing geological conditions of the region
- Developing units with short-term benefits like animal husbandry or poultry farms adjacent to wells rather than cultivations with a high water consumption
- Applying real indicators of credit-based distribution in natural resources and watershed management
- Improving the animal husbandry
- Paying special attention to the actual and potential resources as well as protecting the basin's environment
- Considering environmental studies in performing the projects
- Taking account of the entire area of the basin, watershed management issues and plant life

3.3.4 Economic and Social Issues

- Raising public awareness of the ways for protecting water resources
- Correcting the methods of consumption and irrigation in the provinces with high consumption of water
- Ignoring the present water rights , while planning the integrated water management pattern
- Promoting culture of correct consumption
- Promoting culture of protecting natural resources
- Participation of the users and stakeholders in performing projects (including research, implementation and exploitation)
- Training the users especially women in drinking sector

- Water supply for different uses regarding development, population growth, occupation and city-dwellers

3.3.5 Environment

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3.3.6 Laws and Regulations

- Updating laws and regulations
- Comprehensive-oriented approach in formulating the laws
- Exploitation of the water resources based on observing the relevant comprehensive laws
- Giving priority to Kordestan Province in water allocation and issuing the required licenses
- Revision of the statistics and information on water resources and the existing potentials (of the surface and underground waters)
- Taking the real cost of water and observing the water tariff
- Correcting the consumption pattern in the over-consuming provinces
- Taking a unanimous approach in enforcing the laws and regulations in all the basins
- Providing a precise statistics on the water right holders and defining the accurate extent of their rights
- Regulating water exploitation

3.4 ALLOCATION OF WATER

Allocation of water between the provinces shall be according to the following criteria:

- Potentials of the province without consideration of other issues
- Removing the former limitations
- Increasing the water right share of industry
- Basin's area
- Giving priority to the provinces with low consumption rate
- Setting priorities for drinking, industry, agriculture and services
- Combating deprivation and creating jobs
- Basin's actual and potential water resources
- Implemented, under-implementation or research projects

- Practical possibilities for developing water and soil resources
- Integrated management of water resources
- Water needs and aquifer water level
- Location of the province (in the head river branch or not)
- Strategic farming pattern
- Development of each province
- Practical and potential water resources of the provinces
- Area under cultivation
- Developing coordination between the provinces
- Cultivation pattern
- Province's characteristics and conditions
- Involvement of the managers of water companies in decision-making

3.5 LEGISLATION

- Implementing development projects considering the views of the province regional water company and in coordination with other relevant organizations
- Interference in sands exploitation and the relevant laws
- Increasing the provincial authorities in allocation of water
- Avoiding division of lands
- Considering the economic aspects of water and establishing the relevant laws
- Inter-basin transfer of water based on the drinking priorities
- Establishing standards and regulations in accordance with the new form of consumption considering drought
- Amendment of the law of water tariff, regarding over-consumption of the other provinces and increasing income of the upstream provinces by means of this
- Amendment of the Law on Fair Distribution of the Water
- Severe prosecution for disobeying the relevant laws
- Clear and explicit laws on digging unauthorized wells
- Accelerating the approval of the comprehensive water law
- Reconsidering the disputes over water national document
- Formulating local laws related to the basin's water resources
- Promoting transparency of the laws and regulations on the protection of underground waters

CHAPTER 4. ZANJAN

4.1 VIEWPOINTS OF THE WORKSHOP PARTICIPANTS ABOUT INTEGRATED MANAGEMENT OF THE GHEZELOZAN -SEFIDRUD BASIN

Integrated management of water resources means:

- Logical and fundamental exploitation of the basin's water in order to eliminate poverty;
- Promoting justice among water users according to each region's potential;
- Observance of the interests of all groups in water consumption pattern;
- Observance of the rights of arid regions
- Assigning priority to upstream stakeholders over downstream stakeholders;
- Practice of cooperation
- A program from down to top
- Assigning priority to drinking water consumption over other consumptions;
- Sustainable development in accordance with observing environmental considerations
- Determining resources' capacities
- Creating jobs and observance of the rights of stakeholders in arid regions
- Equity, efficiency and environmental sustainability
- Fair distribution of water in the basin considering the potentials of each province
- Formulation of optimum use of water taking into account the priorities , provincial and trans-provincial viewpoints and defining of the function of executive organizations in order to implement this strategy
- Revision of incorrect allocation of water
- Revision of exploitation productivity
- Keeping the water of each region for the lands in that region
- Supply of users' required water from surface and underground resources
- Inter-basin transfer of water
- Optimum consumption management
- Protection of natural resources through optimum exploitation of existing water resources
- Cooperation of Stakeholders in all phases of research, planning, decision-making, implementation and maintenance
- Taking systematic approach and removing current deficiencies in management
- Availability of inputs and resources to the system's components based on justice rather than equality
- Taking account of economic issues in project evaluation based on the formula of cost-benefit
- Planning according to social ,cultural and economic development programs
- Observance of the water rights
- Assigning priority to surface water consumption over ground water during droughts
- Assigning priority to development projects based on each region's potentials
- Poverty reduction

- Value engineering focusing on potentials of each basin
- Taking account of national and provincial interests at the same time
- Striking a balance between the surface run-off and water consumption at basin and province level
- Promoting coordination between relevant bodies and organizations
- Long-term and consistent exploitation of water and soil in the basin
- Maintenance of quality and quantity of water in the whole basin

4.2 PROBLEMS

4.2.1 Surface Water and Groundwater

- Inappropriate geographical distribution of surface and ground waters
- Over-consumption of water resources in Gilan compared to Zanjan
- Low level of provincial access to surface water compared to country's average
- Failure in provision of water for agricultural lands
- High level of EC because of failure in harnessing it in rainy season
- Failure in establishing reservoir dams in head river branches
- Low quality of ground waters for drinking
- Over-use of ground water resources despite of its overdraft aquifer
- Lack of water structures for harnessing surface waters
- Severe reduction of ground waters because of failure in storing surface water
- Excessive pressure on underground water table
- Failure in the implementation of projects on exploitation of surface waters
- Tendency of farmers to use ground water resources
- Flow of fresh water out Zanjan Province to Gilan Province and its conversion to saline water

4.2.2 Drinking Water and Hygiene

- Pollution of urban and rural drinking water due to the changing quality of ground waters
- Failure in adequate supply of water for drinking, industry and agriculture
- Limitation in using surface water for drinking in urban and rural areas
- Over-growth of the province population and the increasing need for hygienic water
- Difficulty in providing drinking water for rural areas compared to downstream areas

4.2.3 Environment

- Destruction of forest ecosystems and reduction in tourism as a result of improper use of water resources in Gilan
- Drop in the quality of water during droughts and as the result of the salinity of water of Ghezelozan
- Failure in considering plans on evaluating the ecological potentials of the province
- Failure in observing land use plans for management and exploitation of water resources

- Failure in zoning of polluting resources in the basin (human-related, agricultural, industrial, service-related)
- Water pollution as a result of using fertilizers and pesticides
- Threats to the biodiversity of rivers
- Failure in resolving the environmental problems related to dam construction
- Lack of precise information about contaminants especially in emergencies
- Failure in formulation and implementation of quality management and environmental monitoring of water resources
- Failure in allocation of financial resources to soil and water protection
- Failure in the provision of the river base flow due to the absence of dams in the upstream
- Implementation of projects without conducting environmental impact assessment

4.2.4 Agriculture

- Disproportion between the agricultural potentials of Zanjan and water allocation potentials in Gilan
- Increase of dry-farming despite of adequate surface water potentials and its outflow from the province
- Failure in implementation of irrigation and drainage network
- Inadequacy of water allocated from Ghezelozan to develop olive cultivation in Tarom
- Failure in development of pressured irrigation systems and modern irrigation networks
- Absence of a comparative comparison between irrigation efficiency of the province and other regions of the basin
- Limited productivity of the farmlands
- Dependence of peoples' income on dry-farming due to failure in the successful exploitation of surface and ground water resources
- Failure in paying attention to semi-dry climate conditions of the province in optimum use of water
- Low income of farmers as a result of inadequate water supply
- Decline in the class of soil due to improper use
- Low quality of agricultural products because of water shortage
- Inflicting damages to farmlands by failure in constructing adequate dams
- Deprivation of the province' farmers because of shortage of water
- Significant difference between irrigation and dry-farming cultivation in the province and the country level standards
- Failure in water supply in a large area of the fertile lands and underdevelopment of agriculture
- Infliction of damages to farmers and investment risks because of lack of water storage to be used during droughts
- Low level of irrigation efficiency in areas with high precipitation rates (Gilan) compared to drier areas (Zanjan)

4.2.5 Industry

- Impossibility of development of the industry and mines in aridity
- Lack of adequate information about water usage in industry
- Failure in providing water in order to meet the industrial needs considering over-population and aimed at the improvement of related indicators
- Failure in implementation of huge industrial projects resulting from lack of water
- Impossibility of water exploitation in restricted plains for industrial development;
- Failure in management of water consumption in industry
- Low quality of water for industry consumption
- High risk investment in the industry sector due to failure in timely water supply
- Obstructive policies regarding water supply for industry section

4.2.6 Social and Economic Issues

- Failure in rural development as a result of underdevelopment of agricultural
- Unemployment and rural immigration especially of young people because of failure in proper water supply
- Relying on Ghezelozan water resources
- Reduction of per capita income because of failure in water supply
- Reduction of water security as a result of increase of supply and decrease of demand for water
- Lack of water for green space construction of the cities
- Housing problems resulting from immigration of rural residents of Ghezelozan to cities
- Failure in cooperative interaction between users and regional water companies
- Failure in timely delivery of water to stakeholders
- Lack of public education in basin area
- Underdevelopment of rural regions due to lack of accessible water
- Severe poverty in rural areas
- Lack of economic security during drought
- Increasing immigration from rural areas
- Economic underdevelopment of the province due to lack of water

4.2.7 Management and Policy-Making

- Failure in proper management and planning for the exploitation of water resources (e.g. construction of water purification facilities)
- Failure in raising public awareness of water consumption
- Lack of reliable statistics and data to be used for the integrated management of water resources
- Failure in informing local residents of issues related to river management and basin protection
- Failure in paying attention to the results of studies conducted by the French consulting

engineers

- Remote management instead of field management by JICA and Mahab staff
- Illogical demands on the part of some of the companies and users in the basin
- Management of Zanjan water resources by other provinces in the past
- Failure in the enforcement of water national policy document
- Lack of an appropriate system for water exploitation
- Lack of coordination between concerned organs and regional water companies
- Failure in adequate investment in the protection and storage of surface running water

4.2.8 Drought and Climate Changes

- Frequent droughts (every 5 years)
- Decreasing water supply as a result of over-exploitation in upstream and rain reduction
- Failure in adequate water allocation from the basin to the province
- Escalation of drought adverse effects on the province comparing to downstream and upstream areas

4.2.9 Natural Resources, Flood and Watershed Management

- Pasture destruction as a result of erosion
- Increase of sedimentation in Semidried and imposing damage on downstream users
- Natural resources destruction as a result of limitation in water farming and living requirements of rural inhabitants
- Deficiency of rules and governmental regulations in protection of pastures, jungles, soil and water
- Failure in organizing rivers and immigration
- Sedimentation in downstream reservoirs from Ghezelozan resulting from lack of upstream reservoirs
- Flowing Flood resulting from lack of sufficient storage reservoirs in the region
- Flowing Flood causes the destruction of upstream provinces leading to downstream provinces' exploitation

4.3 SUGGESTIONS

4.3.1 Surface Water and Groundwater

- Water transfer from neighboring basins
- Using modern methods of using water instead of traditional ones in order to increase the efficiency
- Implementation of productivity improvement projects in the province to reduce water consumption
- Raising consumption efficiency through sale of water based on volume unit
- Surface water supply and replacing it with underground water in the regions with overdraft aquifer
- Improvement of household consumption through public awareness

- Implementation of projects on the protection of river beds and banks
- Conversion of a number of hand-digging wells to a single deep or semi-deep well
- Construction of water pumping stations from river
- Development of low pressure and pressured irrigation network in downstream reservoir dams and water structures
- Increase of dam construction (reservoir, artificial feeding, check dams) in the province in order to supply water for agriculture and other consumptions, harnessing surface water
- Implementation of artificial feeding activities in headwaters to develop underground water table
- Construction of water storage tanks in head river branch
- Expansion of river banks of Ghezelozan to prevent surface run-off
- Assigning priority to supply of water to disadvantaged regions aimed at reducing deprivation
- Implementation of modern methods of irrigation with timely delivery of water
- Preserving the water of main rivers by storing water in different dams across the Province
- Appropriate and prioritized allocation of surface water to drinking and sanitation
- Establishment of comprehensive data bank on provincial needs for water in the province
- Water supply in Gilan province by harnessing surface and underground water in the province rather than transferring water from Ghezelozan

4.3.2 Safe Drinking Water

- Using surface water for resolving qualitative and quantitative problems of drinking water in order to avoid immigration of rural inhabitants
- Separation of drinking water from the water to be used for other purposes in the cities
- Taking account of the future needs for water in rural and urban communities in the next twenty years
- Acceleration of the construction and expansion of sewage networks
- Construction of reliable reservoirs and transferring drinking water to Zanjan and inhabitants of the areas adjacent to the river
- Assigning priority to drinking water supply over the provision of water to industries
- Allocation of safe drinking water from the operational dams and future dams for cities and villages

4.3.3 Environment

- Identifying the current and future polluting sources
- Quality management and environmental impact assessment of water resources
- Identifying ecotourism attractions of the basin
- Basin zoning in terms of level and extent of pollution
- Preserving the quality of river's water in Ghezelozan basin, Zanjan
- Preventing discharge of industrial sewage after the implementation of projects
- Establishing needed reservoirs to eliminate the salinity of water in Ghezelozan
- Enforcing regulations of preventing environmental pollution of water resources

- Adopting necessary strategies to avoid pollution of urban and rural drinking water resources
- Estimating water needs of regions under the supervision of the Department of Environment
- Examining in Saline Water of Mahneshan, Anguran in and 80 km radius
- Implementation of environmental management plans for dams
- Implementation of storage projects for auto-monitoring of rivers
- Observance of all stakeholders' benefits based on environmental considerations and justice
- Identification of aquatic biodiversity species

4.3.4 Agriculture

- Establishment of water structures such as dams, and pumping stations to provide water in agriculture section
- Setting a patterns for the development of agriculture and water consumption for each region
- Conversion of traditional irrigation systems to pressured irrigation systems and promoting of modern irrigation methods
- Paying attention to over-growth of areas under irrigated farming without meeting the needs for water in agriculture
- Assigning priority to the provision of water to agriculture in Zanjan Province given non-economic status of rice cultivation in Gilan province
- Budget allocation and defining water harvesting projects to provide water to areas under dry-farming
- Revision of irrigation methods and cultivation pattern
- Study of the amount of crops in each unit of water based on its real value
- Adjusting current water rights to be used in aridity
- Modification of rice cultivation in Gilan Province to save water
- Paying attention to plans for expanding agriculture and allocation of water resources based on the said plans
- Taking into account the arid lands in the vicinity of Ghezelozan in 400 Km
- Improving cultivation and irrigation methods and cultivation timing aimed at reducing consumed water
- Providing minimum water needed for drinking and agricultural by rural residents to avoid their immigration

4.3.5 Industry

- Treatment and recycle of industrial waste water
- Optimizing industries' irrigation systems
- Development of industries and their water sources
- Examination and final notification of water supply for industrial units and mines
- Requiring the water management consumption for industrial units and mines

4.3.6 Social and Economic Issues

- Conducting social studies in the integrated management of water resources

- Taking into account the low per capita income of farmers compared to the same indicator at country level
- Realization of anti-deprivation and justice-promoting policies through the allocation of water based on potentials of water supply and transfer
- Paying attention to the residents who live in the vicinity of Ghezelozan by providing water for irrigated farming
- Combating the deprivation of the rural population – constituting 48% of the total province population – through the provision for water needs, investment in water storage, and optimum use of water
- Taking into account the ecotourism and agro-tourism in the vicinity of Ghezelozan
- Reservoir dam construction in head river branches in order to provide sufficient water, employment, and meeting the livelihoods of villagers to avoid their immigration
- Organizing continuous training workshops for public to promote the culture of saving water
- Increasing credits for artificial feeding projects of underground water in plains
- Allocating credits for the construction of water purification facilities
- Development of rural towns in the vicinity of the constructed dams for the purpose of economic improvement of the deprived households
- Implementation of projects for raising people's income
- Increase the per capita income in the province to the country average through sufficient water supply
- Applying value engineering in water supply
- Increase of credits for water supply projects
- Formulation of the infrastructural plan for the development of the province to prevent immigration
- Taking into account the diversity of crops and cultivation in Zanjan compared to Gilan
- Priority of water supply for the crops with low water consumption
- Allocating grants for the development of modern irrigation methods

4.3.7 Management and Policy-Making

- Taking into account the indicators for balanced consumption of water at the basin level
- Taking into account the priority of using water by upstream regions
- Avoiding water transfer from arid regions to regions with high precipitation
- Taking into account the local water resources as the first priority of water supply
- Taking into account the potentials of Zanjan development compared to Gilan
- Observing NGOs' rights
- Defining old water rights according to optimum irrigation productivity in all concerned provinces
- Construction of gravity dams in order to replace water pumps in Gilan
- Offering new legal methods to transform backwater to industrial and agricultural water
- Reserving and providing water in upstream to manage and monitor maximum level of flood and river

- Taking into account the national criteria, avoiding rice cultivation in Gilan because of its high level of water consumption
- Prevention of the use of water from Zanjan Province for the purpose of the conversion of forests, wetlands and nurseries to rice paddies
- Promoting cooperation and coordination between regional water companies and the Ministry of Energy, Jihad Agriculture, and the Department of Environment
- Coordination in distribution and implementation of the plans under study
- Organizing training courses on water management in the industrial units and mines
- Familiarizing the stakeholders and water users with regulations concerning the fair distribution of water
- Determining the water share of each province and its storage
- Using modern tools to provide basic information on water resources
- Management of facilities developed base on the tolerance of the basin
- Development of new towns in the vicinity of dams to prevent immigration
- Taking into account the increase of consumption efficiency
- Improving the productivity of the water use
- Taking into account each region's relative advantages in using water
- Presence of JICA consultant in the center of Ghezelozan (Zanjan Province)
- Applying the outcome of studies conducted by French consultants in the integrated management plan
- Using the water from Manjil downstream for agriculture in Gilan
- Preserving water in downstream to protect the environment
- Designing a quality management program for water resources
- Identifying and estimating the water needs of water and land ecosystems in the region
- Compensation of previous failures in investment, agricultural development and water supply
- Establishment a committee comprising Ghezelozan water right holders
- Mid-term and long-term planning to improve the productivity of water consumption
- Integrated management based on economy and value engineering
- Conducting thorough studies on organizing Ghezelozan in Zanjan Province and the implementation of the related projects
- Classification of water resources according to the type of consumption
- Formulation of a water right system in Ghezelozan
- Conducting simultaneous studies on projects regarding watershed management, etc
- Development of centralized water supply centers for safe drinking water for the villages across the province
- Minimizing the water delivered to Gilan considering the existence of adequate surface and ground water resources
- Implementation of water supply projects to avoid outflow of the province water share
- Dam construction to reduce the susceptibility of the province to floods
- Allocation of an appropriate share of the surface water to the industry

- Allocation of at least 60% water transit to Zanjan taking into account the length of the river
- Concurrent management of soil and water
- Anticipation of the province's 100 year water need (for development)
- More coordination with the studies considering land use planning

4.3.8 Drought and Climate Changes

- Management and monitoring of surface run-off to face droughts
- Cloud seeding
- Allocation of adequate budgets for flood control
- Development stations for prediction climatic changes and risk management
- Establishment of an expert group for monitoring droughts
- Water supply in Tarom considering its climate conditions compared to Gilan
- Making necessary arrangements for preventing droughts crises
- Further investment in order to cope with climatic changes during droughts

4.3.9 Natural Resources, Watershed Management, and Flood

- Implementation of projects concerning watershed management, flood control, sedimentation, and protection of river beds and banks
- Activation of smaller aquifers on subsidiary branches
- Reservoir construction to prevent flood and reduce sedimentation along the river path
- Water allocation to develop forests in order to provide fuel in countryside regions
- Prevention of wasting water resources in the dams' downstream
- Using reservoirs to provide water in downstream
- Spread of flood water to feed underground water resources
- Construction of protective walls to prevent destruction of farm lands
- Pasture and forest protection to preserve water penetration in water table and preventing surface run-off
- Raising credits for river engineering projects to stabilize Ghezelozan riverbed
- Exploitation of water resources to increase productivity in area unit and to prevent pasture degradation
- Development of artificial forests to protect and strengthen the water resources
- Harnessing surface water through dam construction
- Establishment of artificial feeding stations aimed at strengthening underground water resources
- Implementation of water and soil protection projects
- Construction of reservoirs dams in head river branches
- Environment protection through developing vegetation in upstream

4.4 INTER-PROVINCIAL WATER ALLOCATION

Water allocation should be based on:

- Length of Ghezelozan river in the province
- Required water
- Total area of fertile lands and the lands under cultivation
- Level of aridity or rainfall
- The Will of the late supreme leader of the Islamic Republic of Iran (allocation of water to upstream)
- Basin's conditions
- Residents' needs and promoting justice
- Water and soil potentials
- Productivity per cubic meter (for producing more crops)
- Optimum cultivation pattern
- Protection of current water resources and restoring underground water resources
- Environmental conditions and sustainable development
- Social, cultural and economic prioritizing
- Promoting irrigated farming
- Value engineering and criteria on production economy
- Underground water crises in plains
- Existing plans
- Assigning priority to drinking water
- Water production of each province
- Population of the basin
- Expansion of gardens instead of rice paddies
- Water rights
- National indicators
- Water integrated management
- Grading positive programs in province
- Estimation of surplus water in each province
- Precipitation
- Local conditions
- Input water and produced water

4.5 LEGISLATION

- Formulating a law on the compensation of damages inflicted on the natural resources and the environment
- Amendment of current regulations and making new laws on optimum use of water
- Amending regulations according to observance of upstream rights
- Amendment of water allocation regulations based on the implementation of pressured irrigation system
- Real price of water

- Formulation of laws on prioritization of surface water use for drinking and sanitation
- Water distribution regulations focusing on sustainable development
- Formulation of new regulations regarding the manner of use of resources
- Encouraging the use of modern technology to increase productivity
- Amendment of water-related laws in order to reduce deprivation and prevent immigration
- Notifying the extent of water allocation prior to new year
- Formulation of water allocation regulations based on viewpoints presented in JICA workshops
- Prohibition of water transfer before meeting the needs of upstream residents
- Prohibition of over exploitation of water in Ghezelozan River by Gilan Province
- Sustainable implementation of water fair distribution Act
- Approval of water distribution protocol in a committee consisting of 8 concerned provinces based on existing and future needs
- Offering legal incentives to encourage consumption productivity
- Formulation of comprehensive law on water and soil to provide, transfer and use of water
- Formulation of a comprehensive program for Ghezelozan ecosystem through making new laws
- Formulation of new regulations to protect customary water rights
- Observance anticipated national development document regarding the use of surface and underground waters
- Prosecution of unauthorized users of sand from the rivers
- Limitation of delivering water in areas with high level of consumption
- Receiving tax from high consuming regions and dedication of this money to the regions with low level of consumption
- Requiring change of the cultivation pattern considering economic indicators, productivity of water, climate conditions and relative advantages
- Limiting the rice cultivation (due to its high water consumption)
- Enforcement of the will of the late leader of the Islamic Republic of Iran regarding the fair distribution of water
- Making fair laws and regulations on the distribution of surface waters between Gilan and Zanjan
- Obliging Gilan to use 40% of its own underground waters
- Guaranteeing the enforcement of laws on dealing with polluting industries
- Making laws on water exploitation based on the ecological capacity of the resources
- Enforcement of preventive laws and prevention from environmental pollution of water resources
- Making laws to oblige water users to install and use volume meters and setting heavy fines for overuse
- Making laws on the extent of the usage of surface run-off based on the level of precipitation in each region
- Review of the Water Act according to land use planning

- Formulation of laws according to integrated management of water
- Flexibility of regulations regarding the supply of water to the industrial units with 50% constructional progress (especially for large-scale projects);

CHAPTER 5. GILAN

5.1 VIEWPOINTS OF THE WORKSHOP PARTICIPANTS ABOUT INTEGRATED MANAGEMENT OF THE SEFIDRUD BASIN

Integrated management of water resources means:

- Fair distribution of water among stakeholders by observing current water rights based on the social and economic conditions
- Paying attention to the production of strategic crops, quality of land, and value added of agriculture
- Paying attention to the needs for drinking water and water for industry, agriculture, and environment based on efficiency and economic viability of water use
- Fair management of transfer and distribution of water considering factors affecting on quality and quantity of the basin by precise supervision and strong executive support
- Integrated management of water resources in the same basin
- Taking into account the national interest, sustainable development, food security, and human health
- Distribution of water resources based on size, population, and cultivation pattern in each province
- Demand and Supply management
- Taking into account the priority of old water right holders to use water resources
- Preventing sector-oriented approach and management of optimum consumption of water

5.2 PROBLEMS

5.2.1 Agriculture, Fishery, Aquaculture

- Farmers' tendency towards changing the type of cultivation
- Putting the rice cultivation at risk due to water shortage
- Lack of enough precipitation
- Reduction of rice production because of lack of water
- Negative effects of lack of water on some crops such as chestnut, walnut, wheat, and olive
- Single-crop production in the province
- Limited land ownership by farmers
- Reduction of efficiency of rice production because of periodic and undulatory irrigation
- Vulnerability of farmers to climate change
- Irrigation of a large part of farmlands by effluents
- Deprivation of water in eastern part of the province
- Threatening the reproduction and fertilization of caviar fish as the result of using water for agriculture (rice padding) and water pollution
- The low per capita income in the agriculture sector
- Reduction of quality of rice cultivation due to increase in water rationing
- Failure in supplying the needed water for the fertilization of caviar fish in the estuary of

Sefidrud

5.2.2 Drinking Water and Sanitation

- Increase in specific diseases due to the lack of water
- Tendency of farmers toward using sewage and polluted water for irrigation because of the reduction of water share of the province from the basin
- Change of quality and quantity of drinking water
- Pollution of drinking water in most of the cities in Gilan
- Failure in proper storage of water in the province
- Spread of cancer because of pollution of surface run-off

5.2.3 Economic and Social Problems

- Probable cause of waste of billions of rials in investment due to changing irrigation methods
- The country's economic loss due to shortage of water for strategic rice cultivation
- Failure in cash circulation in the province's economic sectors due to negative impacts of shortage of water for rice cultivation
- The reduction of the farmers' income due to droughts and the shortage of water in recent years
- The reduction of income in local water companies producing hydroelectricity
- Endangerment of the 2 thousand year old water rights of the Province by constructing upstream dams
- Non-consideration of downstream rights (Gilan) in the water studies conducted in the upstream
- Increase in the employment crisis of farmers due to inadequate irrigational water
- Deficiency of land in creating income – through agriculture - due to shortage of water
- Increase in social tension and conflict because of water shortage
- Deep and long-term impact of social endangerment
- Population increase and unemployment
- Change of the ruling culture of irrigation and agriculture specifically after the construction of Sefidrud Dam
- Spread of poverty and increase of social disorder due to the decrease of Gilan's water share
- Strong dependency of the province's economy to water
- Increase in poverty and addiction
- Reduction of public participation
- Reduction of economic and social security of users due to the reduction of water rights

5.2.4 Industry and Development

- The loss resulting from industrial and humane activities in upstream
- Increasing the need for water because of tourism
- Failure in providing water from internal resources
- Lack of industrial development in the province

- Absence of necessary supervision on using the basin's water
- Construction of reservoir and deviation dams and installation of pumping stations in upstream

5.2.5 Security

- Security issues resulting from lack of water
- Failure in tolerating the effects of lack of water by people
- Increase of tensions and local conflicts and their impact on the province security

5.2.6 Management and Policy-Making

- Failure in applying precise information to formulation of water-related plans
- Gradual decrease of dam base flow
- Failure in the completing the implementation of modern networks and improving the existing networks
- Increase in wasting water because of paragraphs 2 and 3
- Rice cultivation's need for water at sprouting periods
- Ignoring the right condition for rice cultivation
- The problems related to the allocation of water to rice paddies in the province despite of the amounts stipulated by the National Water Document
- Presenting the future needs instead of current needs by other provinces
- Lack of appropriate structures within the limits of Fomanat and Gilan Plain
- Failure in completing the implementation of Sefidrud Network
- Failure in taking account of the current limitations of the projects in the province
- Inadequate credits for the construction of dams on the rivers of the province
- Over-use of water in upstream
- Formulation of programs which are not operational
- Lack of ground water resources in Gilan
- Failure in considering the volume of basin's water in the projects
- Out of order irrigation and drainage networks
- Non-availability of clear plans for the allocation of the basins water to the province
- The lack of possibility of construction of reservoir dams with proper capacity due to the topographical conditions of Gilan
- Absence of committees on water allocation in the stakeholder
- Failure in coordination of using water and provincial water need
- Lack of the possibility of water transfer because of lack of proper installations

5.2.7 Environment and Natural Resources

- Ecological and environmental effects of using water in upstream
- Environmental pollution of water and ecological problems in downstream
- Intimidation of aquaculture by upstream pollution

- Environmental effects of using water from Semidried Dam
- Dangerous diseases resulting from using backwater and polluted water
- Gradual increase of saline water in Ghezelozan River
- Pollution of water inside the province because of over-population and rural dispersion
- Decrease of underground water and advancing sea water
- Erosion and sediments settled in the rear part of Sefidrud Dam
- Ecological imbalance in the habitat for whiting breeding
- Pollution resulting from irrigating rice fields by returned waters
- Failure in performing watershed management in Ghezelozan Basin
- Severe pollution of Goharroud River by chemicals and sewage

5.3 SUGGESTIONS

5.3.1 Agriculture, Fishery and Aquaculture

- Creating some facilities for using the rain water in the second half of the year
- Promoting usage of the second-rate products of the region
- Increasing the irrigation efficiency through using modern irrigation methods
- Conducting studies on the irrigation methods and different plant varieties in order to bring about the best results
- Preparing cultivation table all over the basin
- Completing the plan for equipping and integrating the lands
- Considering to produce rice as a strategic crops
- Increasing rice cultivation in an area of land by using alternative methods
- Supplying safe water for agricultural lands
- Providing proper water rights in accordance to the actual area of the rice fields
- Completing the irrigation and drainage networks in Gilan and Fumanat plain
- Using the water resources inside the province for supplying water in agriculture
- Making use of circulating system in aquaculture for agricultural use
- Second cultivation in order to help the farmer's economy
- Prioritizing to cultivate strategic crops
- Supplying 80% of the province water need through the basin's water
- Making study on the future of the province regarding kinds of cultivation
- Creating facilities and helping the farmers to plant crops like walnut, sugar, olive and etc
- Using pools for storage of rain water adjacent to the agricultural lands
- Mechanizing and facilitating the agriculture
- Determining the consumption rate of water in rice cultivation considering the existing efficiency
- Allocation of water (needed for the irrigation network) for the water year and agricultural seasons

- Establishing production workshops related to agriculture in the villages in order to create jobs
- Supplying water for agricultural lands and fish farms
- Making the farmers involved in exploitation of water resources for better understanding of the problems
- Developing mechanized agriculture
- Supplying water for agricultural use in order to promote rice cultivation
- Increasing the farmers income through creating facilities in agricultural institutions
- Schedule the cultivation time in provinces

5.3.2 Drinking Water and Sanitation

- Preventing domestic and industrial pollutions in Sefidrud Basin
- Considering the quality of water in allocation process
- Accelerating the funds allocation for Bijar Dam project for drinking water supply
- Constant monitoring the hygienic indicators of the drinking water
- Separating the drinking water from the irrigation canals in order to preserve the hygienic and environmental conditions
- Provision of water from the Astor Dam resources
- Separating the distribution of water for drinking and sanitation
- Supply of drinking water through bottles

5.3.3 Economic and Social Problems

- Appropriate investment in exploitation of the existing water resources of the province
- Recycling of water and reusing it in fishery, poultry farming and tourism)
- Decreasing the production costs through offering subsidies in the related units
- Considering tourism issues
- Allocation of the real water rights of the province from Ghezelozan and Shahrood Basins
- Obliging the users of the new constructed dams to observe the water rights of the old users
- Distinguishing the old stakeholders from the new ones in decision-making
- Correcting lands in proper way in order to use the returned waters
- Prevention of the land use change
- Assessing the real needs of the upstream provinces
- Preserving the water right of the province prior to any decision making
- Establishing water police in the basin in order to control the exploitation rate of the upstream stakeholders and preserve the rights of the downstream
- Providing funds to regulate other internal resources
- Promoting ecotourism and giving less importance of the 2nd and 3rd grade agricultural lands
- Considering the economic value of water in producing different kinds of products
- Training people and increasing the participation of them in distribution of water
- Establishing the stakeholders associations for optimum consumption and distribution of

water

- Promoting the economic potential of the farmers considering improper conditions of their livelihood
- Paving the way for increasing public awareness of the existing water problems
- Considering the importance of 300,000 Gilan families dependence on the rice fields
- Changing the consumption standard and proper saving
- Making it absolutely essential to follow the right criterion in water usage
- Developing public culture in order to observe their water rights
- Promoting culture of optimum consumption of water in different sectors

5.3.4 Development and Industry

- Preventing the water intake of the upstream dams for saving Gilan from drought
- Preventing the addition of new Levels in Sefidrud Upstream
- Planning for development of agriculture- related industries
- Considering the economic aspect of water in different provinces
- Constant monitoring of the industries
- Enforcing severe rules against the industry units polluting waters
- Establishing sewage treatment systems for industrial and domestic units
- Preventing over- exploitation of sands
- Preventing the entrance of wastewater of the upstream industrial units into the dam
- Creating jobs for the surplus labor in agriculture sector through tourism and industry

5.3.5 Security

- Providing safety of water resulting in safety of food and country's independence
- Offering incentives to the farmers to cultivate rice by supplying enough water
- Controlling the media to provide correct information

5.3.6 Management and Policy-Making

- Constructing diversion and reservoir dams on the province internal rivers
- Including the subject of supplying water for Sefidrud irrigation network in the basin's studies
- Accelerating construction of Ostor Dam in order to compensate lack of water in Sefidrud
- Preventing construction of more dams on the rivers ending in Sefidrud Dam
- Restoration of the worn-out Sefidrud network by supplying water resources
- Distribution of water based on its volume
- Providing water rights for breeding whiting
- Preventing unauthorized exploitation of water
- Formulating intelligent plans for water distribution considering the changes in the course of action
- Constructing dams in downstream

- Making accurate study on the existing water potentials of the province
- Conducting comparative studies on supplying ground waters
- Supervising the allocation of water by a board composed of the related senior experts in the Ministry of Energy in order to prevent unjust distribution of water to the stakeholders (as law-enforcement guarantee)
- Establishing a high trustworthy board supervising water resources of the basin
- Establishing an organization having authority to supervise the integrated management of water resources and users (especially upstream stakeholders)
- Supplying the control instruments for entrance and exit of water through GIS centralized system
- Strong resistance of the Ministry of Energy to the construction of new dams and existence of new water right holders in all the areas of the basin (8 provinces)
- Management of the water distribution based on the need for drinking water by the Ministry of Energy
- Establishing a management committee for Sefidrud River composed of the governors of the related provinces for wise decision making
- Modernizing the irrigation networks in order to prevent waste of water
- Planning for land use management
- Putting suitable gates in order to control the stream of water
- Management of the supply and demands of water in the basin
- Optimizing the irrigation network in order to prevent waste of water
- Allocation of at least 2 billion cubic meters of water to Gilan for the needs in agriculture, environment and drinking from Sefidrud Basin dam
- Revising the distribution and transfer of water network
- Practicing the integrated management of water resources of the adjacent basins
- Holding constant meetings in the Ministry of Energy on the integrated management of the water resources of the basin, based on the supply and demands of water
- Changing the management view on development and sustainability
- Using modern technology in order to register the quantitative and qualitative data and have quick access to information
- Calculating the existing volume of water in the basin in the first six months of the year and fair distribution of water based on the shares of each province
- Allocating funds for recycling of water
- Thinking nationally and acting regionally
- Preventing the amateur practices in allocation and distribution of water
- Difference in costs of water supply for the right holders lands compared to the expenses for development of new irrigated lands
- Prevention of the unauthorized exploitation of water from upstream dams and reservoir of Sefidrud Basin
- Preventing development of the new cultivation lands in upstream till specification of water resources
- Establishing water supply systems inside the province

- Determining a standard for exploitation of water in accordance with water allocation
- Installing measurement instruments on the main gates
- Land use plan in the watershed management
- Establishing an authoritative decision- making unit in the Ministry of Energy

5.3.7 Environment and Natural Resources

- Considering the quality of water entering Sefidrud Dam form Ghezelozan and Shahrood branches
- Developing environmental knowledge and public training
- Using environmental NGO's for training
- Considering the value and class of the soil of the soil
- Taking into account the watershed management, erosion and sedimentation in Sefidrud Dam
- Creating essential facilities for sewage treatment
- Prevention of producing unsanitary products due to the polluted waters supplied to the farms
- Increasing amount of the pollutants
- Preventing salinity of Sefidrud Basin through waste waters of the upstream
- Preventing usage of wastewater for irrigation of the agricultural lands
- Forestation in the watershed management

5.4 ALLOCATION OF WATER

- National document of water (water need)
- Area under cultivation
- Population growth rate
- Establishing water rights for many years
- Kinds of the strategic product
- Investment impact
- Population
- Irrigation period
- Existing regulations (constitution)as a basis
- Land use criteria
- Investment restoration
- Water needs of the products
- Climate conditions
- Underground waters and its quality
- Economic value of water in producing crops
- National interests
- Funds allocated in the provinces in the past years
- Kinds of products and their need to water
- Preserving and optimizing the present irrigated lands

5.5 LEGISLATION

- Law-enforcement guarantee
- Using laws of the developed countries in the integrated management of water resources
- Formulating and approving the legal regulations(constitution) for the former stakeholders
- Defining the legal priorities from economic and social point of views
- Ratifying a bill of the allocation rate for the stakeholder provinces through the Ministry of Energy
- Revision of the law on fair distribution of water
- Formulating laws on controlling the distribution of water by JICA
- Establishing a legal and judicial unit for observing the consumption of water in provinces
- Formulating and approving the customary existing laws considering the stakeholders
- Formulating laws and regulations for observing the exploitation standard
- Establishing domestic laws considering the specific conditions of Gilan
- Allocation of adequate funds for maintaining the networks
- Allocation of adequate funds for preventing erosion and implementing watershed management
- Formulating laws on comprehensive management of water based on the integrated management of water resources

CHAPTER 6. QAZVIN

6.1 VIEWPOINTS OF THE WORKSHOP PARTICIPANTS ABOUT INTEGRATED MANAGEMENT OF THE SEFIDRUD BASIN

Integrated management of water resources means:

- Environmental protection and sustainable development
- Distribution of water based on regional and national priorities instead of merely customary water rights
- All-embracing watershed management aimed at economic, social and cultural development
- Paying attention to development in upstream and downstream regardless of the locality of water resources and the history of water use
- Management of supply, transfer, and discharge of water
- Systematic and lawful management of water regardless of personal interests and tastes
- Utilization of resources in a fair and optimum manner
- Prioritization of uses and considering value added of water
- Allocating resources needed for the optimum use of water for different purposes (human, environment) in different provinces
- Holistic view of sustainable and unsustainable factors in the basin
- Fair distribution of water aimed at development and based on future needs of each province
- Distribution of water between stakeholder provinces based on the area of each province
- Observing justice in the distribution and exploitation of water for current and future needs
- Organization of water supply system as well as qualitative and quantitative improvement of water based on existing and potential economic, social, cultural, environmental, legal, political and human resources
- Taking account of cultural, social and economic conditions
- Observing all environmental standards before locating the site of large projects such as dams or networks
- Developing a system for integrated use of water based on the needs of each province
- Paying attention to coordination among all stakeholders in different provinces
- Applying the most effective and low-cost methods for achieving the goals
- Taking account of all stakeholders and their needs aimed at sustainable development
- Resolving the existing problems regarding the exploitation of water resources
- Promoting coordination and cooperation among stakeholder provinces
- Planning for the exploitation of water resources based on the customary water rights
- Planning for the exploitation of water resources for the regional ecosystem based on the needs of the future generations
- Changing the traditional patterns of water management
- Striving for realizing more technical and optimum management of water resources
- Balanced distribution of water between users
- Distribution of water based on the needs and potentials of each province

- Inter-sectoral and trans-sectoral coordination aimed at the optimum exploitation of water resources
- Fair, legal and sustainable allocation of water resources to stakeholders based on the principles of environmental protection and sustainable development
- Better approaches to the allocation, consumption and exploitation of water resources located in the basins shared by provinces
- A very useful method for inter-basin transfer of water
- Taking account of the past, present and future exploitation systems
- Using water resources based on the supply potentials in each region

6.2 PROBLEMS

6.2.1 Water Supply

- Shortage of water in summer (especially during drought) in a number of villages located in mountainous areas
- Use of 15m deep collector wells for drinking water by villagers living on foothills
- Low quality of underground waters as the main source of drinking water in cities and villages
- Limited underground water resources
- A timeworn urban water distribution network (although with limited share in water supply)
- Provision of part of the drinking water for Tehran Province from Qazvin Province
- Problems in the provision of water for drinking, agriculture and industry
- Increasing demand for water in the province
- Shortage of water in Shahrood Basin
- Lack of a comprehensive study on the transfer of water from other basins related to Qazvin
- Water supply efficiency in agriculture, sanitation and drinking
- Limitation of water allocation to some areas leading to difficulty in providing water to other areas
- Limited water resources in Qazvin (disproportionate to the industrial development and population growth)
- Inadequate water allocation to the lands under cultivation
- Unlimited agricultural and industrial development and adjacency to the capital
- Surface water exploitation disproportionate to customary water rights
- Serious future water shortage for drinking, industry and agriculture
- Large-scale industrial investment and uncertainty in terms of water provision
- Failure in inter-basin transfer of water
- Reduction of efficiency due to ineffective irrigation networks and inefficient transfer of water
- Problems of lands in downstream
- Limited allocation of water from Shahrood River
- Failure in efficient use of existing water resources

- Uncertainty about the feasibility of the provision of surface water predicted in the irrigation network plan because of the water need of Tehran Province
- Shortage of water in Shour Basin (in south of Qazvin)
- Topographic situation of Qazvin in terms of population density and businesses
- Low precipitation
- Lack of participation of all stakeholders in the allocation and management of the water resources
- Reduction of quality and quantity of underground waters
- Lack of drainage in the southeast of Qazvin
- Focusing on using underground waters in a vast area of the province and lack of desirable management in this regard
- Lack of an outlet for the aquifer
- Risk of salinity of underground waters
- Overdraft aquifer in Shour Basin
- Over-exploitation and overdraft aquifer
- Strong reduction of the level of underground waters in Qazvin Plain because of failure in the transfer of predicted surface water for its 80,000 ha irrigation network

6.2.2 Environment

- Pollution of underground waters because of the industrial development of Qazvin Plain
- Lack of development of organic agriculture
- Lack of appropriate mechanisms for curbing different types of pollution
- Lack of a mechanism for preventing sewage from polluting water and soil and failure to use sewage as a new resource
- Lack of coordination among bodies in charge of issuing license for industrial activities for the purpose of preventing the pollution of inception water resources
- Lack of qualitative standards for surface and underground waters
- Issuance of license for different agricultural activities without considering land use plans and regional ecological potential
- Poor environmental management skills of provincial and state authorities
- Implementation of dam and network projects without requiring environmental impact assessments
- Lack of an integrated environmental approach especially regarding eco-tourism
- Unauthorized exploitation of resources and polluting them
- Environmental pollution because of the activity of fish farms
- Poor environmental approaches regarding recycle of sewage
- Relocation of industries from Tehran to Qazvin resulting in increasing the use and pollution of water resources
- Qualitative limitations of water resources
- Discharge of effluents from factories located in Alborz region to Qazvin Plain

6.2.3 Policy-Making and Management

- High pressure on basic resources because of lack of management of demand for water
- Lack of a managerial mechanism governing all the regional elements of the basin
- Failure in supervising the consumption of water in different sectors (agriculture, drinking, industry, and tourism) to prevent wastage
- Undesirable distribution of water supply and consumption (in terms of time and location)
- Failure in fair distribution of surface water
- Prioritizing other provinces over Qazvin
- Lack of long-term planning
- Instability of management (frequent changes in managerial staff)
- Timeworn irrigation network and waste of water in the network
- Failure in the management of demand
- Lack of appropriate management to realize optimum exploitation of water resources
- Lack of coordination in the implementation of projects
- Lack of equal management of water resources in the basin
- Lack of balance between water resources, potentials and facilities
- Failure in realization of irrigation efficiency

6.2.4 Economic, Social and Cultural Problems

- Over-population and centralization of different activities (agriculture, industry, etc) in the south of the basin and abundance of water resources in the north of the basin
- Using sand and grit of the river regardless of the opinions of the experts of Qazvin regional water organization
- Destruction of 30-year old gardens and alfalfa farms under irrigation network
- Failure in producing fodder needed by industrial animal husbandries due to the shortage of water
- Failure in allocation of adequate funding for the construction of Bourmanak reservoir dam on Ghezelozan River
- Drying of 1000ha of land under the cultivation of maize and alfalfa because of shortage of water
- Failure in observing the cultivation pattern in Qazvin Plain
- Failure in using effective irrigation methods
- Failure in integrating agricultural lands
- Failure in realizing the desirable use of irrigation systems
- Reluctance of the youth in engaging in agriculture and disability of the elderly for such purpose
- Limited productivity of water supply and consumption as the result of unrealistic pricing of water
- Growth of population and industry in Tehran Province and its impact on water resources of other provinces
- Immigration of excess population of Tehran to Qazvin Province

- Poor exploitation of water resources (and its required investment) during the past 30 years
- Disharmony between the country's political divisions and basin divisions
- Large-scale immigration to Qazvin
- Increasing water needs of the province due to climate change and frequent droughts
- Lack of a desirable cultivation pattern
- Lack of a proper definition of the pattern for the water supply and consumption
- Adjacency of Qazvin Province with Tehran Province that has been given priority for water consumption
- Inadequate attention to the living conditions of water users
- Failure in having an appropriate approach to modern technologies and using them
- Failing in integrating lands
- Lack of desirable planning for reuse of water
- Average irrigation efficiency of lower than 35%
- Lack of adequate funding for developing drainage and irrigation system for Bourmanak Dam
- Exit (from the province) of the largest resource of surface water in Shahrood Basin

6.2.5 Laws and Regulations

- Lack of a legal position for users institutions
- Failure in considering all existing elements (soil, plants, tourism) in the integrated management of water resources
- Encroachment on the borders of water resources and its related legal void
- Lack of conformity between the Water Fair Distribution Act (1982) and the Executive Bylaw of its Second Chapter respecting underground waters (1984)

6.3 SUGGESTIONS

6.3.1 Supply of Water

- Transfer of water from the neighboring basins considering potentials and capacities of the region
- Creation of check dams for harvesting of water and maintaining the water path
- Requiring modern irrigation systems and cloud seeding
- Provision of water to industry, services and drinking from Shahrood River (Alamoot River)
- Purification and recycling of any effluent before establishing industries and different agricultural sectors;
- Provision of clean water from surface water resources;
- Rapid implementation of urban sewage systems for preventing pollution of underground waters
- Transfer of water from Shahrood for compensating shortage of water required in the province;
- Quantitative and qualitative protection of Qazvin water resources (the largest plain of Iranian Central Plateau) as a national and regional obligation

- Providing new water resources and compensating for the overdraft aquifer
- Making use of natural aquifers for feeding underground water
- Implementing watershed management projects as well as water and soil projects
- Combining the use of surface and underground water resources;
- Provision of water from rainfall and making use of that for feeding underground waters
- Provision of Tehran drinking water from other water resources and decreasing pressure on Qazvin water resources
- Identifying and eliminating illegal wells
- Fair and sustainable provision of surface water in accordance with the level of development
- Increasing productivity of the irrigation and improving productivity of the new water resources
- Using water from Shahrood River instead of unauthorized wells (and preventing them)
- Investment in research sector and projects of cloud seeding
- Construction of dams on rivers and preventing exit of water from the province
- Creation of irrigation networks in the province
- Making use of the effluents and residuum and wastewater in agriculture and industry
- Promoting productivity and optimum use of existing water resources through modern methods of supply and consumption (in drinking, agriculture and industry)
- Making use of effective ways for reducing use of water in agriculture

6.3.2 Environment

- Making a change in management approach by prioritizing ecological potential and region's sustainable development
- Economize on water usage aiming at decreasing production of sewage
- Sewage treatment and recycling as far as possible
- Considering the water right of the environment in planning and allocating of resources
- Considering the consequences of using effluents in agriculture;
- Taking account of environmental issues arising from the manner of using water resources
- Putting an environmental-oriented insight as the main issue of concern in all water-related studies
- Periodic environmental monitoring of underground water resources in terms of quality (microbes, bacteria)
- Prioritizing use of the treated effluents in agriculture and raising public awareness
- Supplying large cities and villages and industrial units with sewage treatment facilities
- Promoting the culture of people regarding environmental conservation
- Collecting and disposal of effluents and sewage
- Identifying the pollutants and taking action in decreasing or getting rid of them
- Applying technical methods for decreasing the negative impacts of pollution
- Carrying out environmental impact assessment studies for all polluting industries prior to policy making and decision making

- Implementing a comprehensive waste management plan (regular and some special waste)
- Construction of sewage treatment facilities and installation of online systems for industrial and urban purposes
- Using sewage treatment systems in cities and industrial towns
- Collecting and treatment of sewage in cities and industrial towns
- Construction of sewage treatment systems of industrial towns before the construction of these towns
- Establishing sewage treatment systems in industrial districts before implementation
- Compensating he aquifer overdraft
- Decreasing illegal usage of water resources
- Requiring animal husbandry units to use standard sewage systems
- Carrying out studies and implementing projects on immediate use of produced waste water
- Promoting culture of proper use of water resources and preventing their pollution
- Promoting organic farming and decreasing chemical-based cultivation
- Carrying out research on climate change arising from over-exploitation of water resources
- Taking the responsibility for dealing with water pollution-related issues from the Department of Environment and giving it to the regional water organizations (companies)
- Using more surface water resources instead of underground water resources in order to decrease the pressure on underground resources
- Avoiding issuance of licenses for establishing new fish farms in Shahrood area
- Binding existing Shahrood fish farms to establish water treatment plants
- Preventing the discharge of agricultural wastewater comprising chemical fertilizer and poisonous materials into Shahrood river
- Immediate enforcement of environmental laws
- Binding factories to use online systems to treat waste water
- Determining the authorities in charge of the prosecution of violations regarding sewage discharge
- Use of fresh water only for the purpose of preventing the salinity of lands
- Developing treatment facilities for reuse of water (for industry, agriculture and drinking)
- Raising the awareness of public and authorities of the risks involved in the ignorance of environmental issues via mass media, especially TV
- Allocation of special credits for projects on hygienic disposal of urban and rural sewage in order to avoid pollution of surface and underground waters
- Making use of biotechnology in sewage treatment aiming at less damage to ecosystems
- Promoting systems of collecting, recycling and hygienic disposal of solid urban and rural residues
- Assigning priority to environmental impact assessment and determining its real position
- Taking account of industrial, organic and microbial pollutions in surface and underground water
- Enforcement of the Article 105 of the Law of the 3rd Economic, Social, and Cultural Development Plan of the Islamic Republic of Iran authorized in the 4th Development Plan

- Setting a pattern for development in accordance with province ecological capacity
- Carrying out environmental impact assessment before locating the site of water-related projects
- Inclusion of environmental costs in the expenditure of industrial units
- Implementation of cooperation plan, promoting balance between livestock grazing and existing pastures, and restoration of habitats
- Raising indigenous people's awareness of environmental issues
- Imposing fines for the units polluting water according to the volume of sewage they produce
- Checking the availability of sewage treatment systems in the industrial units
- Implementation of limnological studies on Shahrood River
- Determining the water rights of the Department of the Environment

6.3.3 Policy-Making and Management

- Cancelling the rights of other provinces' priority over others in critical situations
- Inter-basin water transfer in the province
- Implementation of the integrated management of the resources
- Identifying ,studying and site location of the aquifers - watershed management
- Conducting studies on the consumption potentials and products in the agriculture sector in stakeholder provinces
- Establishing a steering committee represented by the stakeholder provinces headed the Ministry of Energy
- Enforcing the comprehensive management plan of the province water resources
- Determining the agricultural water tariffs based on real cost of water
- Making a research on constructing underground reservoirs in Qazvin Plain
- Setting soil barriers in order to harness the water of the basin's rivers
- Considering the Shour Basin (especially Qazvin Plain) capacity for accommodating industrial units
- Appropriate use of underground waters
- Treatment and reuse of effluents
- Multilateral interaction between organizations aiming at issuing license for establishing industries
- Taking legal actions against violators polluting water resources
- Binding all the users to treat the waste water before discharging into the river
- Avoiding to issue license for the industries polluting the environment
- Involving the Department of the Environment in the integrated management of resources
- Raising public awareness and a sense of responsibility through mass media
- Providing information on the future risks of polluting water resources to the public, authorities, industries, farmers, etc.
- Management of the waste water and its reuse
- Increasing the area under the management of the Department of the Environment up to 10% of the entire area of the province

- Taking account of the discussions carried out on the optimum exploitation management of the surface and underground water resources through appropriate strategies rather than structural analysis
- Development of check dams for absorption of water and maintaining the water path (water harvesting)
- Offering incentives to the provinces with a high productivity in using water
- stopping the competition for making dams in the head branches of rivers
- Obligatory use of modern irrigation systems
- Seeking a remedy and cloud seeding
- Taking appropriate approach to development and determining development potentials
- Implementing land use planning
- Thinking globally and acting locally
- Considering comprehensive studies on allocation rather than recent studies
- Inter-basin transfer of water
- Forbidding construction of dams and development of agriculture in the upstream
- Stopping the competition for dam construction till the application of the integrated management
- Provision of water for drinking and industry from surface water rather than groundwater
- Promoting productivity through optimum use of the resources

6.3.4 Social, Economic and Cultural Issues

- Carrying out projects on increasing productivity
- Eliminating water subsidies
- Creation of an organization comprising water right holders with regard to surface and groundwater resources
- Increasing interaction between different organizations in management system
- Promoting a culture of proper use of water resources through mass media
- Establishment cold water fish farms on the river
- Prioritizing Qazvin plain considering production and other related issues in development process
- Implementation of irrigation plans and prevention of wasting water
- Defining and notifying the real value of water to the users
- Considering water rate in production costs
- Using treated sewage in agriculture considering all hygienic and environmental issues and arrangements
- Taking account of justice and sustainability for all the users of water resources in (agriculture, industry, environment , drinking and other uses)
- Considering more efficiency and less costs
- Promoting culture for institutionalization patterns and technologies along with the optimum consumption of water
- Establishment of fish farms in Shahrood River

- Obligation of using modern irrigation systems in agriculture
- Decreasing the waste of water in agriculture
- Promoting agriculture rather than developing cities
- Making use of traditional gardens as the largest aquifer of the country in non –consumption seasons in order to feed groundwater of the plain
- Promotion and education of consumption culture
- Prohibiting the import of agricultural products which can be produced inside our country such as apple, pear, almond and citrus
- Promoting culture of users in order to increase productivity
- Using the experiences of the farmers in agricultural exploitation
- Making use of economic patterns regarding the exploitation of surface and underground water resources
- Informing the public through national and provincial mass media
- Implementing education courses in accordance with native culture
- Planning with the participation of indigenous people
- Determining real cost of water
- Considering economic, social and cultural development of the basin's villages
- Preparing attractive programs regarding country's water-related problems
- Education of different classes of the society concerning different uses of water
- Organizing users constitutions in the form of trade and cooperative associations
- Assessment of the economic expenses of damages resulting from unbalanced development
- Implementing projects and making choices after considering economic studies
- Taking rate of water used from surface resources in order to control the extent of usage
- Using bottles of drinking water
- Disinfecting the water used for drinking and other human uses
- Developing the range of responsibilities of the users constitutions for irrigation network management
- Optimizing management methods concerning consumption and demand in the irrigation network of Qazvin Plain
- Education and development of the culture of the farmers in economizing the use of water
- Increasing productivity of water volume units
- Requiring an intermediary between users of the upstream and downstream
- Determining proper water rate in agriculture, domestic and industry
- Promotion of modern agriculture (using greenhouses)
- Legalization and documentation of the farmers water rights
- Considering water as a good not a national resource and public property
- Provision of water for the potential neighboring lands from Shahrood River in order to avoid migration of the residents

6.3.5 Laws and Regulations

- Distribution of credits based on basin's existing priorities and capacities and setting priority of the upstream over others as producing resources of water
- Revision of the laws considering the development process
- Applying the experiences and techniques of the developed countries to the water-related process and taking into consideration the differences in laws, regulations and circular letters
- Formulation of laws and regulations for the purpose of taking the real cost of water from the urban and rural subscribers
- Law-enforcement guarantee of fair distribution of water especially concerning groundwater
- Establishing rules for controlling waste water of the different production and consumption sectors (such as in fish farms, etc)
- Resolving legal problems at the same time as integrating lands
- Approving strong laws against illegal users especially those who use underground water
- Formulating laws and water usage management in industry
- Editing laws and exploitation of the basin's water resources and treatment of the waste
- Revision of the treated waste water standards
- Holding special water-related courts in form of councils comprising experts and specialists in water related issues
- Revision of the standards and changing the present situation from mg/l to the discharge rate (ton) at a given time
- Approving water-related laws all over the country by asking opinions of the experts in distribution and supply of water resources as well as considering views of farmers constitutions
- Allocation of credits in order to carry out dam, irrigation networks and channels projects
- Establishing special laws for developing agricultural lands
- Determining the extent of the legal pollution and location of the waste discharge
- Revision of the laws and establishing severe regulations for increasing irrigation efficiency
- Setting prices based on resources, accessibility and usage instances
- Cooperation of the judiciary with the officials enforcing Article 30 on preventing illegal provision of water from surface water resources
- Prohibition of digging illegal wells by formulating comprehensive laws and regulations
- Granting sufficient legal power to the users unions
- Enforcing the law of fair distribution of water to all classes of the society
- Revision of agricultural water rights from river-based water resources
- Appropriate monitoring of the water resources limitations
- Amendment of the Fair Distribution Act in order to resolve its shortcomings
- Increasing penalties for disobeying water-related rules and digging illegal wells
- Establishing severe laws against pollution of water resources
- Timely enforcement of fair distribution of water
- Presenting a definition for law-enforcement guarantee of the present laws

- Establishing provincial laws based on existing resources and usage instances
- Preparing the final protocol of allocation and inspection of basin's water resources shares related to each province by the highest officials
- Approval of the water allocation related document in the cabinet as well as ratifying its principles in the Islamic Consultative Assembly
- Enforcing the Fair Water Distribution Act and optimum usage of surface water in agriculture sector and issuance of required licenses (water right documentation)
- Removing subsidies of water rate in industrial and domestic field
- Modernizing all environmental standards, laws and regulations
- Formulating laws in agricultural sector concerning optimum consumption of water at high levels
- Revision of laws and regulations and removing parallel laws

6.4 WATER ALLOCATION

Allocation of water should be based on:

- The results of national land use plans
- Potentials of soil and agriculture and the strategic status
- Geographical and political situation of the province
- Possibility of lack of sustainability arising from droughts and inflicting damage to agriculture, industry and drinking water sectors
- Area of the basin in stakeholder provinces
- Excess water
- Role of Qazvin Plain in national economy
- Environmental considerations
- Main agriculture products
- Overdraft aquifer
- Volume of water supply in each province
- Capacity of province for accepting immigrants
- Short history of the existence of Qazvin Province
- Provincial priorities
- Impacts on other provinces
- Taking account of previous studies
- The geographical location of Qazvin (in the vicinity of Tehran Province)
- Population density and employment
- Human resources active in production
- Suitable seasons for cultivation
- Production ranks
- Industrial development
- Water needed by sectors of environment, industry, mining, sanitation, environment and drinking

- Future trend of the development of the province
- Value added for water
- Water resources of each province
- Compensating the shortages of allocations made in the past
- Customary water rights

6.5 LEGISLATION

- Enforcement of existing laws and regulations
- Defining per capita water consumption for each region
- Formulating a water consumption pattern for each region
- Revising the regulations governing the integrated management of water resources every few years based on the social and policy making conditions
- Formulating a protocol on the water resources of each basin by provincial authorities and its approval by the Cabinet and the parliament
- Fair and sustainable allocation of water resources in accordance with the regulations
- Avoiding favoritism in the enforcement of laws and regulations to the benefit of Tehran
- Approval of a law on the distribution of the basin's water to be observed by all provinces (similar to the Act on Borderline Rivers approved by the parliament)
- Revising water tariffs and rights based on the real economic value of water
- Formulating laws and regulations on unauthorized wells
- Formulating laws and regulations on using modern technologies and methods in agriculture, industry and mining
- Giving authority to provinces in using their share of water
- Approval of a law on the integrated watershed management in the country based on land use planning (including supply, transfer and consumption management)
- Guarantying the enforcement of laws and regulations
- Formulating regulations on inter-basin transfer of water in order to protect the rights of customary water right holders
- Amendment of the law on receiving inspection fees from the owners of wells used in agriculture
- Amendment of laws on receiving the (real) cost of water from the public
- Assigning authority to provinces in the allocation of water to the lands with elevation difference of more than 100 meter
- Including the rights of downstream residents in relevant laws
- Formulating laws on the transfer of water from areas rich in water resources to dry areas
- Using the experience of other countries in the formulation of laws and regulations (TVA, NYVA in the United States)

CHAPTER 7. TEHRAN

7.1 VIEWPOINTS OF THE WORKSHOP PARTICIPANTS ABOUT INTEGRATED MANAGEMENT OF THE SEFIDRUD BASIN

Integrated management of water resources means:

- Participatory planning for the exploitation of water resources
- Sustainable provision of stakeholders' needs and ensuring the observance of environmental considerations
- Resolving environmental issues related to the management of water resources
- Qualitative and quantitative protection of underground and surface waters considering all natural and human needs
- Ensuring a minimum water provision to all stakeholders
- Preventing parallel decision-making, confusion and inter-basin conflicts
- Ensuring smooth transfer of water between basins
- Benefitting from expert opinions
- Ensuring sustainable development and balanced exploitation of water resources
- Coordination between sustainable development and allocation of inter-basin water resources at country level
- Fair allocation of water resources among basins based on social development indicators
- Creating balance between provision and consumption of water
- Ensuring the realization of the goals of water resources development plans
- Simultaneous management of water resources and water use and assigning priority to the management of water use with engaging all the stakeholders
- Optimum exploitation of water resources and preventing parallel actions and avoiding narrow sectoral approaches
- Assigning the share (of water resources) of each regional water company in the province
- Meeting prerequisites of urban, industrial and agricultural development plans
- The most logical way for the management of water resources in a given basin
- Optimum and sustainable use of water resources based on the environmental considerations
- Fair distribution of water resources regardless of political pressure or non-expert opinions
- Allocation of water based on water needs and national priorities
- Creating balance between human, plant and animal use of water and available water resources
- Ensuring the allocation of water resources to agriculture as the provider of food security

7.2 PROBLEMS

7.2.1 Policy-Making and Management

- Increasing allocation of agricultural water to drinking and sanitation thus failing in realizing optimum use of water resources
- Failure in conceptualizing optimum use of water in different sectors (3 *mored tekrar*)

- Low price of water
- Failure in management of effluents
- Failure in sustainable use of existing water resources
- Lack of the institutional structures needed for engaging stakeholders in the integrated management of water resources
- Accumulation of industries in the industrial towns located to the west of Tehran
- Lack of adequate investment in the management of water resources
- Large-scale investment in water provision plans
- Inter-basin water transfer regardless of existing side issues
- Failure in recycling water
- Ignoring the sustainable development of the population of Tehran Province

7.2.2 Water Resources Exploitations

- Lack of appropriate infrastructure
- Lack of appropriate designs for optimum transfer and distribution of water
- Failure in using existing challenges and opportunities
- Hidden use of water in areas located between basins
- Reduction in construction of dams
- Low efficiency of transfer and distribution of water
- Existing difficulties in ensuring and maintaining the quality of water
- High cost of inter-basin transfer of water
- Difficulties in the development of Tehran in terms of water provision
- Infrastructural restrictions for inter-basin water transfer
- Difficulties concerning provision of drinking water
- Common use of Shahrood River water by Tehran and Qazvin provinces
- Qualitative and quantitative crisis concerning underground waters of the province

7.2.3 Environment

- Failure in appropriate sewage treatment
- Pollution of water resources in the province
- Lack of protection of Tehran's drinking water
- Sedimentation in Sefidrud Dam
- Pollution of water in upstream and its impacts on downstream
- Failure in reuse of effluents
- Imbalance of quality and quantity of water in the basin
- Pollution of surface and underground waters because of human and industrial substances
- Lack of adequate attention by other governmental organs to the quality of water and its pollution
- Lack of an appropriate per capita standard for water use for agricultural and drinking

purposes

7.2.4 Water Supply

- Impact of tourism on water resources
- Large population of the province
- Inadequate attention to water transfer
- Inadequate funding for water provision and development of new resources
- Lack of land use planning in Tehran
- Urban development and lack of an appropriate consumption pattern
- Population growth in Tehran city (the largest city of the country)
- Growth of suburban towns around Tehran
- Inadequate attention to the existing water resources
- Overgrowth of Tehran's population and the necessity of provision of safe drinking water
- Imbalance between provision and consumption of water
- Increasing rate of immigration to the province thereby threatening water resources and the environment
- Poor qualitative and quantitative condition of underground waters
- Tehran as the focus of social, economic and political attention
- Lack of proper management regarding effluent and residuum repellence resulting in pollution

7.2.5 Laws and Regulations

- Failure in the observance of existing laws and regulations respecting the limits of water resources
- Lack of legal support for integrated management of water resources as a national necessity
- Inability of the Department of Environment in preventing the pollution of water resources
- Incompetency of laws related to water resources or their enforcement
- Poor observance of laws relate to water resources by some organs
- Lack of an optimum pattern for the consumption of water for drinking or agriculture
- Multiplicity of organs in charge of decision-making regarding water resources

7.2.6 Economic and Technical Issues

- Failure in separating water for different uses - drinking, industry, and agriculture
- Poor coordination between provinces in the design and implementing of more cost-effective plans
- High cost of providing safe water and its transfer
- Preference of provincial interests over national interests
- Limitation of Shahrood River water supply
- Termination of useful life of Sefidrud River

7.3 SUGGESTIONS

7.3.1 Policy-Making and Management

- Deciding the optimum consumption rates for different sectors
- Providing necessary facilities for the realization of optimum use for drinking
- Standardization of water use in agriculture
- Using appropriate equipment and facilities
- Protecting existing water resources
- Improving old water-related structures (against earthquakes,...)
- Modernization of drinking water distribution network
- Modernization of irrigation water distribution network
- Separating purified and non-purified water
- Using incentive and punishment regarding water consumption
- Using modern technology and equipment
- Elimination of cultivations which are not cost-effective
- Improving the culture of water use
- Economization of water and its price
- Setting water price based on the existing problems of the basin
- Improving the efficiency of water used for drinking, agriculture and industry
- Recycling water
- Unification of transfer and distribution of water under a single company
- Pricing water based on the implementation cost of projects
- Strategic management of water resources
- Raising public awareness of optimum use of water
- Delivery of water in accordance with optimum use pattern
- Developing tourism in line with protection of environment
- Introducing the consequences of ignoring the value of water
- Using the national-religious culture for the protection of water
- Supplying drinking water in bottles
- Priority of agriculture over industry in terms of water provision
- Reduction of per capita consumption based on standards
- Increasing the efficiency of irrigation
- Delivery of water in the right time and the right place (according to demand)
- Reducing waste of water in the network
- Provision of hardware and software required for consumption management
- Investment in the equipment used for the reduction of the use of water (reduction of per capita water consumption)
- Determining a water consumption pattern for agriculture

- Using other countries' experiences about the optimum use of water
- Determining a consumption pattern while assigning priority to water used for drinking
- Conducting studies on regionalization of agriculture based on local conditions and the need for agricultural products in each region
- Reducing waste of water in transfer and consumption
- Observing global standards on water consumption
- Implementing water use management projects in the industry sector
- Implementing water use management projects in the agriculture sector
- Sticking to water use patterns for drinking and sanitation
- Improving the participation of the private sector in water use, supply and transfer
- Establishing water users associations
- Determining and enforcing consumption pattern in agriculture and industry sectors
- Using modern irrigation methods
- Prohibition of increasing the area of lands under cultivation across the province
- Improving the quality of agricultural products with lower water consumption
- Participation of water users in the operation and maintenance of water-related structures and facilities
- Cultivating agricultural products with lower water needs in accordance with the capacity of local water resources
- Improving irrigation and drainage networks

7.3.2 Water Resources Exploitation

- Taking more advantage of academic institutions in order to use new methods in planning for the usage of water resources
- Identifying new water resources
- Exploitation of Chaloos Basin
- Dividing the urban water supply network into two different networks
- Assigning a larger share of water supply to Taleghan Dam
- Unification of the management of water supply, distribution and consumption monitoring
- Transfer and use of Alamoot River water
- Maximum exploitation of Taleghan Dam and Taleghan River
- Taking account of conditions of Tehran province
- Water governance
- Considering the principles of sustainable development and its indicators
- Construction of new dams
- Preventing water pollution
- Provision of water through consumption management
- Reviewing and revising the goals of existing systems of water provision based on the existing conditions
- Replacing traditional water use methods by modern methods

- Qualitative and quantitative protection of water resources through prohibition of unauthorized exploitation of surface and underground waters
- Inter-basin transfer of water
- Improving irrigation methods
- Management of water resulted from precipitation
- Differentiating between various cases of water consumption based on the quality of water needed
- Conducting feasibility studies for using uncommon water resources
- Creating new capacities for power production that do not need water
- Prioritizing water resources based on the type of consumption
- Estimating the amount of water needed for inter-basin water transfer
- Using effluents in agriculture and industry
- Strengthening aquifers
- Reducing waste of water in the distribution networks
- Annual examination of basins
- Construction of a dam on Alamoot River
- Allocation of more budget to sewage treatment plans in order to use the treated sewage as a source of water
- Identification of new sources of underground waters

7.3.3 Environment

- Preventing water polluting industrial units from operation
- Taking account of the costs incurred by water pollution and incorporating it in the price of water
- Integrating the management of water resources with land use planning
- Development of comprehensive tourism plans considering social, economic, cultural and ecological capacities
- Adopting strategic management mechanisms in the management of water resources in order to develop micro and macro strategies in the water sector
- Raising public awareness of issues related to the quality and quantity of water resources
- Prioritizing problems and offering solutions to them
- Management of industrial sewage in order to prevent water pollution
- Accelerating the completion of water treatment plants
- Development of Tehran's sewage network
- Using incentive and punishment in order to ensure the observance of environmental considerations by water users
- Development of leisure activities and facilities along the river banks
- Institutionalization of the enforcement of environmental regulations in order to make all organs and people abide by them
- Determining the environmental needs of the basin based on the existing conditions and laws
- Implementation of sewage treatment and recycling plans

- Preventing the construction of polluting facilities in the vicinity of water supply facilities
- Development of sewage treatment networks in cities and villages
- Promoting tourism in dams' upstream areas
- Watershed management in order to reduce sedimentation in the lakes
- Completion and operation of the urban sewage treatment facilities
- Integrated management of the basin
- Using the water resulted from sewage treatment for agricultural purposes
- Introduction of a drinking water consumption pattern
- Watershed management in the basin
- Assessment of the impacts of water supply projects implemented in the downstream
- Formulation of laws for preventing the discharge of domestic and industrial sewage into surface or underground waters
- Reducing the exploitation of underground waters to prevent land subsidence
- Maintaining environmental and climatic conditions after the implementation of water supply plans
- Continuous monitoring of the quality of the water in the basin and assessment of the results of such monitoring
- Paying attention to the role of the environment in the integrated management of water resources
- Protecting rivers and preventing their pollution
- Monitoring the process of sedimentation in the dams' reservoirs, especially in Alamoot River
- Recycling the sewage in the south of Tehran and other cities located to the south of Alborz
- Raising public awareness using the mass media in order to prevent the pollution of water resources
- Preventing the pollution of surface and underground waters through the formulation of new laws or revision of the existing laws
- Establishment of institutions for the protection of the environment
- Preventing changes to the region's ecosystem
- Paying more attention to water resources pollution by the Department of Environment
- Curbing sedimentation in the basin through the implementation of the comprehensive watershed management plan
- Relocation of polluting units
- Fighting urban over-growth
- Reduction of water consumption through raising public awareness and increasing water cost
- Paying attention to the environmental consequences of plans for the transfer of water in the design of projects
- Management of surface waters in cities
- Using modern technologies in the purification of water
- Enforcement of environmental regulations
- Ensuring the minimum flow of water needed in the downstream

- Precise implementation of projects for inter-basin water transfer
- Construction of sewage treatment facilities for the purpose of Promoting the sustainable use of water

7.3.4 Water Supply

- Improvement of the urban water transfer network
- Improvement o urban and agricultural water supply systems
- Modernization of the water distribution network
- Separation of drinking water from water for other uses
- Integrating water supply management with land use planning
- Improving the agricultural water use pattern
- Conducting studies on land use planning in Tehran province
- Implementation of industry- and population-related projects in the province based on cities' development potential
- Integrating water supply management with regions' ecologic capacity
- Increasing efficiency
- Preventing waste of water in the network
- Setting a real price for water
- Improving supply and distribution systems in order to prevent waste of water
- Using modern systems for water distribution such as trickle irrigation in agriculture
- Balanced management of water supply and demand
- Government's supervision of water supply
- Prosecution of offenders respecting water use
- Paying attention to the population growth in the province based on sustainable development principles
- Creating jobs and economic incentives in other provinces to reduce immigration to Tehran Province
- Improving factors involved in water transfer
- Creating two separate urban water supply networks: one for providing drinking water (high quality) and another for providing water for sanitary uses (with minimum required quality)
- Development of factories that produce bottled water
- Improving water distribution networks (for drinking and agriculture)
- Preventing the development of new population centers
- Considering effluents as a source water
- Supply of water to the agriculture sector based on optimum cultivation and consumption patterns
- Allocation of water to the agriculture sector with guarantee of delivery at certain (requested) time and place

7.3.5 Laws and Regulations

- Enforcement of laws and regulations by judicial authorities in coordination with related

ministries (energy and Moja)

- Improving existing laws and regulations in order to foster public participation
- Formulation of laws and regulations for crises (droughts, etc)
- Assessment of effectiveness and relevance of existing laws and regulations
- Raising public awareness of legal issues
- Formulation of more strict laws respecting water use
- Guaranteeing the observance of rivers limits and borders through enforcement of strict laws in order to prevent encroachment
- Amending existing laws governing industries
- Promoting transparency of laws and regulations to avoid parallel actions
- Judiciary's support of the enforcement of laws related to water supply
- Formation of specialized courts for water-related cases
- Follow-up and finalization of a comprehensive law on water
- Coordination for the enforcement of laws related to water resources
- Monitoring the observance of laws and regulations
- Examining the effectiveness of the laws and regulations
- Formulating different standards for different water resources based on their specific conditions regarding quality and pollution
- Formulating clear laws with certain entities in charge of their enforcement
- Revising and updating relevant laws
- Revision of laws on investment in water sector aimed at diversification of funding resources
- Formulation of new laws and revision of existing laws
- Formation of supervisory committees in governmental and non-governmental organs
- Inclusive monitoring aimed at adaptation of qualitative parameters with the existing standards
- Formulation of a comprehensive plan for the integrated management of water in Sefidrud Basin and obliging all regional water companies to observe it
- Integrated management of country's natural resources
- Institutionalization of the management of the basin
- Promoting national and international private-sector investment in the water sector
- Formulating laws on prevention of the discharge of domestic and industrial sewage into surface and underground waters
- Monitoring and supervision of the enforcement of laws (through the formation of supervisory groups)
- Formation of a single center for decision-making regarding the supply, distribution and consumption of water

7.3.6 Economic and Technical Issues

- Inclusion of real price of water for drinking, agriculture and industry
- Examining potentials for the production of hydropower energy in line with the development of water supply in the basin

- Conduct of the required economic and environmental studies
- Transfer of water from dams to treatment facilities through pipes in order to minimize water pollution
- Allocation of appropriate funds for the implementation of development plans
- Conduct of studies for economizing the exploitation of water resources
- Examining ways for increasing coordination among provinces
- Land use planning
- Foreign investment
- Private sector investment
- Implementing multi-purpose plans on water supply
- Implementing short-terms water supply projects
- Avoiding copying in designing structures; optimum technical designing based on local conditions
- Study and implementation of plans for transfer of water within the province
- Conduct of studies on the development of a dam for providing water and hydropower in downstream
- Promoting the engagement of the private sector in the construction and maintenance of water structures
- Taking account of the economic value of water in water supply plans
- Development of a water supply market
- Considering economic viability of development of water structures
- Technical and economic prioritization of projects proposed for implementation in Sefidrud Basin
- Provision of bottled water (similar to Arabic states)
- Watershed management aimed at preventing reservoir sedimentation and better use of existing structures
- Estimation of real costs of projects
- Paying attention to optimum exploitation of water resources
- Economizing the projects on water supply
- Allocating more funds to developmental projects

7.4 WATER ALLOCATION

Allocation of water should be based on:

- Comprehensive plans approved by the Water Resources Management Co.
- Land use
- Drinking, agricultural and industrial needs
- Productivity
- Priority of the provision of drinking water
- Time and place of demands for water
- Efficiency

- Strategic role of each province
- Per capita consumption of renewable water
- Industrial infrastructure of each province
- Allocation of a percentage of agricultural water for drinking and industrial purposes
- Provision of water required for the projects to be implemented
- Regional population
- Area of land under cultivation
- Agricultural and industrial potentials of each province in line with the objectives of sustainable development
- Environmental considerations and local natural characteristics
- Value added of water
- Sanitary needs
- Social issues
- Administrative and political importance of each province
- Inter-basin water transfer especially in crises (drought, etc)
- Other water resources
- Considering Tehran as the largest province of the country

7.5 LEGISLATION

- Preparing a bill for the establishment of an integrated council on country's natural resources with representatives from all relevant bodies
- Distribution of credits in accordance with the developmental plans to be implemented
- Re-pricing the water to be used by the agriculture sector
- Formulation of a comprehensive law on water
- Creating legal grounds for land use planning
- Creating legal grounds for integrated management
- Improving the existing laws
- Construction of Alamoot Dam on Shahrood Alamoot River and transfer of part of its water to Tehran
- Allocation of required budgets for the sewage plans
- Making the environmental impact assessment a prerequisite for the approval of all research plans regarding water sector
- Conceptualization of water governance
- Improving laws in order to increase the participation of water users
- Enforcement of the Water Fair Distribution Act; especially, Articles 21 and 26
- Amendment of laws and regulations based on the potentials of each region
- Improving laws in order to assign priority to demand management
- Shift from supply management to demand management
- Amending the structure of water economy.

Annex – 2
Q & A IN LOCAL CONSULTATION

Annex - 2

Q & A IN LOCAL CONSULTATION

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CHAPTER 1. EAST-AZARBAIJAN

Q: Consensus of politicians (Governors, assembly members, etc.) will be required for the establishment of RBO. How can we persuade them?

A: Lobbying to the politicians only by the administrative authorities is not enough. NGOs and universities should be involved in such lobbying. It is a good tip for acquiring politicians' approval that you explain that the establishment of RBO is a benefit not only for the whole river basin but also for the Province to which such politicians belong.

Q: What are the criteria for evaluating water resources development plans of the Provinces?

A: Though they are so many including water resources potential, protection of vested right, efficiency, it is very difficult to decide what is applied. It should be finally decided by the Provinces in RBO.

Q: It takes long time to establish RBO, where the criteria are discussed. What do you apply when you examine the draft Master Plan?

A: It would be appropriate to apply in the following order from the viewpoint of integrated management for the river basin:

1) Water resources potential such as precipitation amount

2) Economic efficiency

3) Agricultural development potential as the overwhelming majority is irrigation use

4) Correction of disparities among regions

5) Priorities set by each Province

Since the model targets the very huge river basin, it produces some error for individual dam plans. Therefore, JICA Study team has no intention to set priority for each individual dam plan but to rank in ABC only to be used as reference

Q: There are some areas where efficiency cannot be improved due to their poverty. How do you apply social consideration to such areas?

A: JICA Study team has not enough information to conduct social consideration in detail. We would like to ask the Provinces to propose it to WRMC and would like to incorporate it into the Master Plan if it is possible.

Q: What are the grounds for estimating demands for industry and drinking?

A: The estimation was based on the report of MG which was provided by WRMC. Demands for drinking water are based on the census data in 1998. Though we tried to acquire the census data in 2006, we finally could not get them. However, the Master Plan considers demand growth in the future and matches the water strategy of MOE even in the situation of limited data.

Q: About the way to improve irrigation efficiency

A: It is assumed that the efficiency improves at once with 100% modernized irrigation in the area where an irrigation construction system is planned. In other areas, it is assumed that the efficiency improves on step-by-step basis with the improvement in farmers' consciousness.

Q: About the employment of 5-year probability drought

A: Generally, 5-year or 10-year probability drought is employed in the world. Considering the precipitation amount in Iran, 5-year probability drought is employed from the viewpoint of efficiency.

Q: About the examination of groundwater

A: Due to the limitation of data and the model, groundwater was not examined so precisely.

Q: How did the citizens participate in planning?

A: As the citizen participation is not required by JICA, this Study did not employ such approach fully. However, as its compensation, representatives of farmers and NGOs were required to express their opinions when they participated in the workshop for the conflict analysis held in 2008.

CHAPTER 2. ARDEBIL

Q: Some Provinces can improve irrigation efficiency and others cannot. Because Ardebil Province has strong winds, causing very high cost of irrigation, it is impossible to persuade farmers to accept modern irrigation system.

A: We understand that in upper reaches, there are some areas with the similar topographic characteristics, where it is very difficult to improve the efficiency.

Q: Is the Study conducted on Province basis?

A: According to the contract with JICA, the Study is conducted on basin basis. By the way, if the water is transferred from the outside of the basin and retransferred to the outside of the basin, it is not covered by the Study.

Q: Do you think the increase of the allocation to the Province?

A: We include schemes of Provinces as much as possible.

Q: Did you grasp the water balance by each Province?

A: We grasped it on sub-zone basis. We do not have enough data for rearranging it on Province basis.

Q: What rate is appropriate for irrigation efficiency?

A: We will set upper and lower limits and make a sensitivity analysis between them.

Q: Don't you set the irrigation efficiency in Gilan Province at a higher level?

A: In Gilan Province, farming land extends over the alluvial fan. Thus, it is understandable that it is difficult to improve the efficiency with such topographic conditions. Rather, Gilan Province should use groundwater since groundwater resources are rich there.

Q: The control point of the simulation should be set at the river mouth to Caspian Sea. Thus, ground water use by Gilan Province can be indicated explicitly.

A: Many rivers pour into Caspian Sea, which make it difficult to distinguish their flows. We set the control point only for the purpose of convenience for the examination, which does not guarantee the water use of Gilan Province.

Q: The strategy of MOE stipulates that irrigation efficiency be improved by 5% in every 5 years.

A: It should be confirmed that the strategy be implemented actually.

Q: C zone includes Ardebil Province, parts of East-Azarbaijan Province and Zanjan Province. The irrigation area in C zone is smaller than only that of Ardebil Province.

A: Irrigation areas at present are based on the data of MG. We will confirm this matter.

Q: Farmers are abandoning cultivation and escaping from villages in the south part of the Province. How do you include such social change of population in the model?

A: The model is built based on hydrology, which does not include detailed population changes.

Q: Is Ardebil plain, which is important for the Province, included in the Study?

A: Since Ardebil plain is outside of the basin, it is not included in the model. If important matters such as environment are presented, they will be described in the report.

Q: Water resources development schemes that are less than 5 MCM are not included in the Master Plan as they share 2% of the total. The actual volume of 2% is big from the view point of Ardebil Province.

A: The Study's target is the whole river basin. Thus, 2% should be considered from the viewpoint of the whole river basin. In addition, if those less than 5 MCM were included in order to increase the precision, the work volume would be gigantic.

Q: Why was the Ardebil water transfer plan not included in the Study?

A: The target plans were decided in the summer 2008 and the plan is proposed in March 2009, which was too late. Such newly proposed plan should be discussed in RBO which is proposed to be established. As we understand the importance of the Ardebil water transfer plan, we promise that the potential will be examined and describe its importance in the report.

Q: Although JICA Study is almost same in contents, using same basic data with MG, why are the results different?

A: The reason is that they use different models.

Q: How do you decide the criteria of water allocation?

A: It is meaningless to decide the criteria of water allocation if you do not have the water to be allocated. We examine first whether the water is enough as the whole river basin.

CHAPTER 3. KORDESTAN

Q: There are improperly designed dams other than Sir Dam. Why is Sir Dam specially mentioned in the diagram?

A: This examination is just preliminary one. It will not directly affect the future management plan.

Q: The simulation results will change if the dam plan or cropping pattern is changed.

A: It is expected that the provinces themselves will do the simulation with changing various conditions as well as with elaborating the model in RBO in the future.

Q: How do you estimate the irrigation efficiency?

A: Its figures for the present conditions are the mean value based on the reports of MG and Pandam. Those for the future are estimated as valid with consulting with agriculture experts.

Q: In traditional irrigation areas, there are two types; those held by users with water right and users without water right. How did you treat them?

A: Those two types were not distinguished.

Q: How do you assume that the irrigation efficiency will be improved?

A: Some areas are assumed to be improved as 100% modernized and other areas to be improved as partially modernized based on acquired data. For example, in the irrigation system of Gilan, only primary and secondary channels, which are managed by MOE, are assumed to be improved. As tertiary and smaller channels are managed by MOJA, estimation of their improvement should be consulted with MOJA.

Q: How will the irrigation efficiency improved? Do you have more detailed plan?

A: The objective of the Study is to formulate a master plan which examines the water balance of the whole river basin and improvement plan for individual areas is outside of the Study scope. If data for examining detailed plan had been acquired, more elaborated plan could be proposed. It is expected the plan for irrigation improvement will be elaborated in RBO in the future.

Q: Concerning the low supply rate in Sir Dam, are there any mistakes in the simulation?

A: If there was a problem, it may be the credibility of the rainfall data. As detailed results of the simulation will be included in Progress Report 3, detailed questions are required to be presented as comments on the report. In addition, since the workshop on the model will be held from May 9th by the model expert in Tehran, such details on the model are required to be discussed in the workshop.

Q: How is the credibility of the simulation model itself?

A: This series of programs for the simulation is already used in many countries and acquires a good reputation. However, the model targets the unprecedentedly huge area and is under development. It is required to elaborate the model with more precise data continuously.

Q: Water demand of Kordestan Province is underestimated in the "National Document." Thus, the true result of the simulation should be different one.

A: JICA Study team has no authority to change the "National Document." If the water demand is not true, requirement should be made by the Province. The water demand of Kordestan Province is deemed not necessarily small, comparing with those of other Provinces.

Q: Is it possible to improve irrigation efficiency in the upper reach Provinces?

A: There is still room for improvement. It is rather Gilan Province that should make much more efforts to improve the efficiency.

CHAPTER 4. ZANJAN

Q: Why is Manjil Dam the check point?

A: The reason is that the analysis becomes easy. This check point is not related to the evaluation of dam plans.

Q: It is wrong that the area in the outside of the river basin is included in the Interim Report.

A: We revised it to exclude the area in the outside of the river basin after the Interim Report is issued.

Q: There is enough ground water in the lower reaches. It should be considered.

A: We considered the ground water. In addition, because of the topographical conditions in Gilan Province, flowing water is infiltrated and stored in the very shallow layer of earth, which is called subsurface water. It also can be used as a water resource.

Q: It should be considered that the water is flowing from the irrigations system in Gilan out to Caspian Sea for nothing.

A: Water channels form a mesh pattern because of the alluvial fan to pour into Caspian Sea. It is difficult to include it into the model with grasping all the channels.

Q: Gilan Province has water resources in the outside of the river basin. It is not fair unless they are not considered.

A: The target of the Study is the river basin and we do not examine on the basis of the Province.

Q: It was reported that the difference of the maximum and the minimum of the environment flow is 1,200 MCM. Which was presented here?

A: We presented the minimum one. It is reserved for egg laying by sturgeons in the lower reaches.

Q: There still remain some traditional areas where efficiency will improve to no more than 50% Kordestan Province and Zanjan Province.

A: We would like to ask you to show any good idea If you have one to solve the issue.

Q: There is a lot of land where salinity accumulates in Zanjan Province. Is it true that we do not have any solution for this matter?

A: We do not have such kind of land in Japan and JICA Study Team has no knowledge. When we asked MOJA, they have no experience to cope with this matter. To say the truth, we do not have any solution.

Q: Environment flow should be set for the upper reaches.

A: It is easy to set the environment flow by JICA Study Team. However, it should be decided by yourself whether you should set the environment flow to give up other water use because you do not have enough water.

Q: Concerning improvement of irrigation efficiency, farmers in the lower reaches have not interest and it is costly in the upper reaches. Farmers in the lower reached should be asked to make efforts to improve.

A: There is a significant difference in the recognition of water use between farmers producing rice and those producing wheat. In addition, we do not know whether such behavior of farmers in the lower reaches is true. We will propose the system where the targets of improvement are set and their achievement is checked every year.

Q: It is reported that inflow to Manjil Dam is 4,500 MCM and outflow to Caspian Sea is 6,500 MCM. Water is discharged for nothing in Gilan.

A: This matter is based on Pandam's report. We revised it after we review it. In addition, we will propose reuse of used water.

Q: You said that the data are not enough. Issuing the Final Report should be postponed until the precise data are acquired.

A: A technological cooperation project after the completion of this development study is under consideration. It is better that such data be elaborated in that stage.

Q: Each Province will propose new water resources development plans from now. How do you cope with them?

A: Such new plans should be discussed and consensus should be made in the RBO proposed to be established.

Replies to Comments Submitted in Writing

[Mr. Nahavandipoor, Deputy of Planning, Zanjan MOJA]

- Environmental flow for local fish is not considered in JICA study team's report. It needs to mention that Zanjan fishery company is conducting such a study.

Reply to the above question: As the JICA study report mentioned, local issue based on local conditions could not answered since more detailed information/data are necessary for it.

- Water resources development in relatively poor area where many dependants on agriculture should be considered.

Reply to the above question: Therefore the report described irrigation sufficiency in the traditional irrigation areas.

- Modern irrigation systems are being developed (3000hectare development in 2008). This can be considered in water use efficiency and also water resources development. Development potential in Zanjan province is more than what JICA study suggests. Modern irrigation system development in Zanjan province is planned as 5000 hectare in each 2009 and 2010.

Reply to the above question: If modern irrigation system could be extended like that, the benefits of surplus water could be received in the same local areas. That is first beneficial areas received. Therefore modernization in the irrigation areas could give its benefits in the same province.

- Due to overuse of groundwater, recharge of groundwater resources through watershed management is suggested.

Reply to the above question: Watershed management has effects of water fostering to increase infiltration of rainfall to groundwater aquifer, but this effect is not so big and watershed management needs long time to achieve its goals.

- Conversion of water resource (groundwater to surface) should also be considered in Sefidrud dam down stream.

Reply to the above question: We considered it in the depressing aquifer of groundwater table so that areas downstream of the Sefidrud dam are neglected.

[Dr. Bazargan, Zanjan University Professor and NGO member]

- It is clear that JICA study team has considered Manjil dam as the check point of basin, whereas a noticeable amount of water consummated in Gilan plain irrigation network, is supplied by Manjil dam, although Gilan plain has a high potential water resources.

Reply to the above question: The model considers the local water resources of surface water, but groundwater in the Gilan Plain is not considered due to lack of data.

- If Manjil dam is considered as check point, then we need to estimate water resources until Manjil dam, and Gilan plain's water requirement should not be considered.
- Even if Manjil dam is accepted as check point, most of surface water resources inside Gilan are ignored and only Sefidrud river part is put into the model.

Reply to the above two questions: One of the evaluation points is Manjil dam, but numerous points were set up in the model evaluation as well as Gilan Plain. In the Gilan Plain, the reasonable water use would be done in the model.

- In JICA study interim report, 111 hectare of paddy fields is mentioned as lands out of basin, whereas water for this area can be supplied by other local resources. Don't you think we need to consider final point of river discharges to the sea as check point?

Reply to the above question: As the team replied above, the model has evaluation points of downstream ends to the Caspian Sea. The reasonable water use is made in the simulation.

- Without considering local water resources, implementing an integrated management in whole basin will be impossible.
- We really expect all resources be considered in Basin management and if any model for basin will be illogical and not functioning well.

Reply to the above two questions : The team agrees upon it, and made efforts in this direction as much as possible. If data and information which the team obtained, however, are limited, the team performance would be also limited.

[Mr. Mahdinejad, Deputy of Planning& Management Improvement, RWC]

- There is a difference between minimum and maximum of environmental flow in preliminary JICA report. This difference is 1000MCM. Problems of Water users in up-stream can be largely solved with this amount of water.
- What are the final figures for environmental flow if environmental study is finished?

Reply to the above two questions: The team already proposed new approach on environmental flow.

- According to the law, annually 1% of water loss in urban water pipeline should be eliminated, but in JICA study report, we notice 1% increase of water loss per year.

Reply to the above question: The team considered the loss of water transfer and described it in Chapter 6.

- Economical value of water is not seen in JICA report.

Reply to the above question: A socio-economist studied in economic effects of water resources development, and these results will be compiled in the supporting report.

- JICA, has suggested some solutions for water shortage problem in one month for Gilan province, but there is no solution for problems in upper-hand of basin.

Reply to the above question: The approach of the study already changed following the suggestions of the stakeholders. Please check in the progress (4) Report to be printed in March 2010.

- Water resource conversion (GW to SW) is suggested in up-stream but in Gilan plain where there are rich groundwater, there is not such a recommendation. In general, water resources conversion up and down the basin should be done vice versa.

Reply to the above question: Water source conversion shall be made in the serious lowering aquifers of their groundwater tables. In the Gilan Plain the team has not enough data of groundwater.

[Mr. Parsamanesh, Zanjan RWC Study Department]

- In JICA study report, plantation is suggested to maintain flow, but previous activities shows that in badlands, watershed management activities do not work. Does JICA team recommend a specific plant for this purpose?

Reply to the above question: The team discussed on it with MOJA, but MOJA also has no remedial solution to improve such land. It is very difficult to reply on this matter for Japanese, since such wide badlands does not exist in Japan.

- Why JICA team believe nothing can be done regarding to salinity problem?

Reply to the above question: The team considers the salinity problem serious, so that the team discussed on this matter with MOJA watershed experts. As the results of the discussion, MOJA could not find suitable remedial measures due to geological origin.

- It was said that Zanjan province has no plan for agriculture development. What is the source of this information?

Reply to the above question: The team did never mention such things.

- Regarding environmental flow, it is necessary in up-stream to check the damages and effects of considering a guaranteed basic environmental discharge in down-stream.

Reply to the above question: Along the mainstream the environmental flow was examined in the study. If environmental requirements in the upper part and tributaries are necessary for checking, the local data and environmental parameters to be conserved are requested to provide to the team.

[Expert from MOJA]

- Irrigation water demand is completely related to water quality. Productivity of crop in some areas of Ghezelozan basin is 0.2 Kg/m³ although the salinity problem exists. Therefore productivity in Zanjan is comparable with down-stream of basin.

Reply to the above question: The team considers the salinity problem serious, so that the team discussed on this matter with MOJA watershed experts. As the results of the discussion, MOJA could not find suitable remedial measures due to geological origin. In addition, the site countermeasure represented by a reaching method can be recommended; however, that is costly alternatives.

- Usually in model running, requirements and consumptions are clear, but in JICA team presentation, we could not recognize a summary of water resources in 7 provinces. If there is no data of water resources in some areas, how we can input their requirements in the model?

Reply to the above question: The team also used the water requirements in the model, and summarized in the report.

- Can we rely on groundwater resources in up-stream with minus balance?

Reply to the above question: The team also needs reliable data/information of groundwater table, aquifer volume and its water balance.

[Mr. Akrami, Consultant of Zanjan RWC]

- JICA study team mention Manjil dam as "check point" but we see that Manjil dam is considered more important than only a check point. We suggest considering final point of river discharges to the Caspian sea as check point in simulation. In addition, it is better to consider one main check point (discharge point to the sea) and few check points in other different points.

Reply to the above question: One of the evaluation points is Manjil dam, but numerous points were set up in the model evaluation as well as Gilan Plain. In the Gilan Plain, the reasonable water use would be done in the model. The model has evaluation points of downstream ends to the Caspian Sea. The reasonable water use is made in the simulation.

- Target year is 2031 and it is better to extend study period for more 6 months but try to collect whole necessary data such as local water resources, consequently giving more accurate result.

Reply to the above question: Unfortunately the study period was already fixed, although data collection in your country needs much more time than the other countries. Thus the team expects continuous second phase as technical cooperation project.

[Expert from Zanjan MOJA]

Two points should be mentioned:

- 1- Increasing of Salinity and EC due to climate change in up-stream

Reply to the above question: Careful examination is necessary to determine such causes.

- 2- Agricultural development is one of the main axes for Zanjan province development, but in JICA report it was said that area of agriculture lands will be decreased.

Reply to the above question: The team follows the data/information collected so that those descriptions depend on them. But the team recognizes the agriculture land is never decreased in Zanjan Province even if some area of traditional agricultural land is change to the dam command area in the target year.

[Mr. Fahimi, General Director of Zanjan RWC]

- Zanjan RWC will confirm the reports if all local rivers inside the basin considered in water balance.

Reply to the above question: Water balance study was made in a unit of same river reach as Mahab Ghodss Company used.

- If Gilan province with its water potential and demands was located somewhere in Japan, would you consider any water shortage for it?

Reply to the above question: In Japan we have much more rainfall and water resources development facilities in each river basin so that serious water shortage in agriculture would not occur in recent years.

- If Ghezelozan basin was in Japan, would you decide to ignore problems in up-stream? And how long you could tolerate such a condition? Would you finally think about a solution or not?

Reply to the above question: The team considers how the water demands could be satisfied not only in the lower basin but also in the upper basin. That is the main theme of IWRM, integrated water resources management.

- Gilan province faced a bad drought before, but could overcome the problem with using groundwater, so that potential of groundwater in Gilan should become clear and that volume should be deducted from surface water.

Reply to the above question: The team did not receive the data/information on the groundwater development potentials in Gilan Alluvial Plains, such as shape and volume of aquifer, and groundwater tables and groundwater quality. Thus the team could not examine the details on the groundwater.

- If we think to establish RBO, then all demands and solutions to meet the needs should be presented beforehand.

Reply to the above question: The RBO shall be established as an organization where such issues shall be discussed and the solution shall be found.

- Almost 20% of basin water production, 33% of basin area, and 60% of river length is in Zanjan province, on the other hand Zanjan living environment is dependant on Ghezelozan River. Zanjan needs to be viewed in an especial way and if there will not be any good solution for Zanjan.

Reply to the above question: In fact water resources potential is insufficient in Zanjan province. Comprehensive approach would be necessary combining the following various efficient water-uses: (1) water resources development to utilize the limited sources, (2) enhancement of irrigation efficiency to save water, and (3) increase of water reuse/recycle system.

- JICA team has studied and thought about efficiency but no trace on cultivation pattern. Does the study team think that Paddy is the most appropriate cultivation for Gilan? We like to have JICA study team view regarding this point.

Reply to the above question: It is very difficult to answer because the rice cultivation in Gilan is somehow national strategic crops as far as we studied.

- According to JAMAB consultant company, 44 rivers exist in Gilan province and the province should supply a part of its water from those rivers.

Reply to the above question: It is necessary to study the local river system in details to judge topographic difficulties to convey water to Gilan Plain.

- Water quality in Ghezelozan goes bad in the dry seasons, and cause big damage in lands located in river bank and the corps. We would like to ask JICA team if they consider Carry Over dams useful or not?

Reply to the above question: If carry-over dam means a dam which stores water in year of surplus availability to be released in subsequence years of shortage, loss of evaporation from reservoir surface would be great amount. Thus instead of dam, the team recommend sub-surface dam shall be constructed in the underground for this purpose to avoid evaporation.

- Three dams Manjil, Taham, and Taleghan are under operation, and should be considered as operating dams. As you know, Taham dam, Kinehvars dam, Talvar and Calabar dams are located in Zanjan province and should fall in operating dam category. Other dams which some execution budget have been considered and finalized for their construction should be considered in under construction dam category.

Reply to the above question: As the team already informed the RWCs, the team could not change the above category since the simulation was already completed. However, the above category is not so important for the RWCs.

CHAPTER 5. GILAN

Q: It is assumed that irrigation efficiency will increase to 0.5 or 0.6. It is too high.

A: We will make sensitive analysis for irrigation efficiency.

Comment by Gilan: 0.39 is true for the present condition in Gila Province. The figure in Pandam's report is also too high. Since the irrigation facility has become old, it would be less than 0.5 even in 2031.

Q: The law designates the following priorities for water allocation: 1) demands in upper reaches, 2) drinking water, 3) demands in lower reaches, and 4) environmental flow. How do you cope with it in the model?

A: Water is allocated first to traditional irrigation area in the upper reaches in the model. However, as they have no reservoirs in the traditional irrigation areas, it is not guaranteed that their demand is fulfilled. In addition, as there are no good dam sites in the upper reaches, some dams cannot reserve enough water in the upper reaches.

Q: What are the criteria for the selection of dams in the mid-term and the long-term?

A: In the mid-term, those under construction were selected. In the long-term, they are planned to be constructed by 2031.

Q: Drought has been getting severe more and more in last 10 years. How did you corporate this matter in the model?

A: The model uses data of last 30 years. It is not clear what the trend in last 10 years would be in the future. It is expected that the model would be elaborated with accumulated data in the future.

Q: Discharge in four months in spring in the average year is not zero.

A: The model was built from the macro viewpoint and examined the balance between water potential and demands. Water comes from other small basin is outside of the study scope. As the water balance is achieved in the Sefidrud river basin, it does not affect the result whether the water from other small basin is included or not.

Q: In the planning cycle, the plan may be distorted by a political will.

A: It is expected that the distortion would be decreased by a political will as the authority of planning would be clarified through the establishment of RBO. Furthermore, if the minutes of decision is disclosed, the decision making process would be more transparent.

Q: The year of 1987, which is presented as an example of a drought year, cannot be deemed a drought year, considering drought situations in last 10 years.

A: 1998 and 2000, examples of the drought years in last 10 years are 20-year probability and 30-year respectively. It is difficult to employ such years for planning. However, examination for such severe drought years will be conducted.

Q (JICA Study Team): Ardebil water transfer project, which is not included in the SW, is included in MG's report.

A (Gilan RWC): Although Mr. Sayyari asked MG to include Ardebil water transfer project in the study in order to satisfy the other Province, Gilan Province cannot accept the project.

Q: According to the data of Gilban observatory, salinity concentration has increased. What is the countermeasure?

A: The reason is that there are water resources which contaminate high salinity in the upper reaches. Although we have two countermeasures, namely 1) watershed management and 2) diluting by water, the former is difficult because MOJA has never conducted it, and the latter is costly because it requires extra water.

Q: As the upper reach areas use water from resources with good quality water first not from resources including high salinity, salinity concentration gets much worse in the lower reach areas.

A: It is one of very severe conflicts between the upper and the lower reaches. It should be consulted in RBO.

Replies to Comments Submitted in Writing

[Irrigation Efficiency]

- Manjil dam and its irrigation network have been used for past 40 years, and network damage is noticeable. Considering such big figures for future irrigation efficiency seems to be very idealistic .it is very difficult to think about achieving such efficiency.
- It is not possible to achieve the irrigation efficiency considered in mid-term and long-term, because of old irrigation network and irrigation method. Gilan RWC would like to suggest following efficiency rate:

Type	Present	Mid-term	Long-term
SIDN	0.39	0.42	0.45
Traditional area	0.33	0.34	0.35

- JICA study team considers irrigation efficiency 33% for present, 40%mid-term and 50% long-term, which seems to be very high (Maximum or more than maximum) but for new reservoirs which most of irrigation lands are covered by sprinkler irrigation system, irrigation efficiency is considered 0.60 although it can be very higher due to its modern system (Minimum).

Reply to the above three questions: The team recognized the difficulties mentioned by the RWCs in the course of Local Consultations, and proposed that improvement of the efficiency should be one scenario for future improvements.

[Cultivation Area]

- Rice paddy area is estimated 167000 (ha) in JICA study, but gross Cultivation area is 189000(ha) and net Cultivation area 172000 (ha).
- In slide No 3, new agriculture development is seen up to 150,000 (ha) in target year (2031), although we face water shortage at present condition. It does not sound logical.

Reply to the above two questions: Our data/information collection activities were very limited, and the study/works relied on your data/information provided.

- In slide No 4, increase of agriculture area is seen in A,B,C zones. Is there any real guarantee

for Water supply in these zones? And how will be the water supply from basin comparing with E zone?

Reply to the above question: The team present the water supply potentials compared with planned water supply demand. As you pointed out, those areas are facing the serious water shortage in future.

- Figures of cultivation area in up-stream are not real. Besides, we see paddy fields even in Khalkhal area, which is not true.
- Almost 40% of lands in up-stream are mountainous, where there is no economical or technical value for agriculture, but for water demand estimation, all these areas are considered.

Reply to the above two questions: As all of the stakeholders know well, our data/information collection activities were very limited, and the study/works relied on your data/information provided. Our study results had to follow your provided data.

[Land Use]

- According to Land use maps, Gilan plain lands are classified as grade 1, the best soil structure for agriculture especially paddy, which is prioritized as strategic crop. Gilan plain also take advantage of a semi-modern Irrigation network. Agro-production has relatively better condition in Gilan province, whereas soil classification in up-stream (Zanjan, Qazvin and Ardebil) is grade 2 or grade 3 with lower productivity, less economical add-value for water use.
- Land use map in whole basin should be provided first, then mountainous area and high-salinity lands where not suitable for agriculture become clear and separated from other parts. Afterward, planning for irrigation water can be done.

Reply to the above two questions: The above process is one segment of agricultural development and the subsequent water resources development. The team's understanding is that IWRM is how equally, equivalently and reasonably share the limited water after consolidation of this process.

[Statistical Period and Change of Drought Period]

- Statistical period used by JICA study team is a 30 year period which ends in 2006. But frequency of drought has a different behavior in recent years. Besides, most of development plans in up-stream are constructed in recent years. Discharge of river's flow to Sefidrud dam is different as well, and water shortage is very tangible. For simulation model, the new trend of river discharges and drought should be considered (from 1998 up to now).

Reply to the above question: The statistical period of recent drought, as mentioned above, is still in significant from statistical reliability. Furthermore the causes of recent droughts are not clear so far. There are still so many unknown factors in this matter. Therefore the team could not reflect your suggestion in this study.

- Please determine normal year and drought year in the recent years (1998 to now) which indicates closer condition to the reality, and accordingly do simulation.

Reply to the above question: The team already changed following your suggestion.

[Water Quality]

- If we are going to design some development plans in up-stream, consequently more water consumption in up-stream, then we need to guarantee minimum environmental flow at Manjil dam site so that river have enough water to do a kind of self-refine function. Water quality in the entry point of up-stream rivers to Manjil dam is also important.

Reply to the above question: The team examined environmental flow. Please refer to the Progress 4 report.

- Why JICA team does not consider water quality in the model? Survey the water quality and

check heavy metals pollution, salinity, detergents and oil pollutions are very important.

Re: The team collected water quality data, examined them and made some evaluation on them. The salinity issue is considered important, but it is also difficult to remedy this issue due to geological origin. Furthermore the team concentrated quantitative matter in the IWRM of Sefidrud basin, since this issue is considered most urgent and important.

[Model and Simulation]

- It seems that JICA study team has not checked the model sensitivity yet.

Reply to the above question: The model sensitivity check had already done in the process of establishment model, regarding several variations of irrigation efficiency, dams construction pattern and tank model parameters. Finally, the simulation model was calibrated by comparison between observed discharge and simulation result at the location where discharge observation carried out for a long period.

- JICA study team presented a hydrological model for hydrological purpose but a model for integrated management of basin should conclude purposes like increasing of income or cost-saving.

Reply to the above question: Unfortunately the simulation model contains hydrological cycle and water resources development facilities. After simulation, our economic expert examined the above-mentioned economic effects.

- Results of Simulation model run for Manjil dam does not cope with real condition. Calculations and results seem to be wrong.
- In slide No 10, biggest volume of water consumption is shown in May, but due to climatic condition of Gilan province, and irrigation water demand, maximum water consumption is June and early July.

Reply to the above two questions: As all of the stakeholders know well, our data/information collection activities were very limited, and the study/works relied on your data/information provided. Our study results had to follow your provided data.

- In Sefidrud basin simulation, order of priorities (which a copy of it has been submitted to study team during local consultation in Rasht), should be considered.
- In simulation result, in slide No 6, under the title of “Limited potential for water resources development”, it was mentioned that 6000MCM can be regulated in mid-term and long-term, but we know that discharge at the entry point to Manjil dam in normal year is about 4500MCM. How could you get such a result?

Reply to the above two questions: The team already changed water resources development scenarios. Please refer to the Progress 4 report.

[Other Issue]

- None of information of water requirements given by provinces is confirmed yet, and we should wait until analyzing of Satellite information finished and the result came out.

Reply to the above question: The team will present the results in the beginning of March 2010.

CHAPTER 6. QAZVIN

Q: There are some rare creatures such as deer in Alamut. How did you examine the environmental issues?

A: Initial environmental examination was held in this Study to grasp such issues. However, the simulation targets those issues related to water.

Q: Countermeasures for the effect by marlstone on water quality can be made with erosion control. What countermeasures did you make?

A: Erosion control is not the objective of the Study. It is included as a recommendation in the report.

Q: The proposal of RBO does not include farmers, which means a governmental organization. Their opinion is important for water resources management. How do you think of it?

A: Representatives of the farmers are not a permanent component of the proposed RBO. JICA Study Team understands the importance of their opinions. It is expected that how their opinions is incorporated will be discussed by the working group of RBO and be proposed.

Q: Conversion from groundwater to surface water is not possible in some parts of the sub-zone where the conversion is allegedly possible.

A: Simulation is managed on sub-zone basis. So, even if it is possible due to the result of the simulation, it is not possible in some part of the sub-zone.

Q: How did you include the Alamut water transfer project in the Master Plan?

A: We used the results of the JICA study conducted in the past.

Q: About the water use in Gilan Province

A: As the precipitation is large and the water resources potential is high in Gilan Province, it is required that the water balance should be achieved within the Province as much as possible. Presently, much water is discharged for nothing from Sangar weir. The Province can supply enough water with the water resources in the Province from the viewpoint of calculation. In terms of groundwater, its quality is concerned and its potential is not clear.

Q: It seems that the drinking water was not examined in detail. Some areas show shortage in reality.

A: We used the MG's data for drinking water. We did not examine it for each village level. It is very difficult to examine each village due to the limitation of the Study period. By the way, MG's data are based on the 1986 census. They should be revised with the 2006 census.

Q: MOJA is responsible for the improvement of irrigation.

A: MOE is responsible for primary and secondary channels and MOJA is responsible for tertiary and smaller channels. JICA Study Team understands the importance of activities of MOJA and WUAs.

Q: Did you use the land use map prepared by Qazvin Province?

A: Concerning the land use, we use data of MOJA in order to keep uniformity in the whole basin.

Q: It is possible that improvement in irrigation efficiency would not be achieved.

A: It is proposed that sensitive analysis be conducted by the simulation model.

Q: What are the definitions of modern irrigation and traditional one?

A: We use the definitions of Iran International Society of Irrigation.

Q: How do you think of reuse of water? As used water contaminates pesticide and fertilizer, reuse of it has problem on quality.

A: 10% of used water is reused in MG's report. JICA Study uses the same figure. Water quality issue is not included in the simulation because we do not have data. Recommendation will be made in the report.

CHAPTER 7. TEHRAN

Q: Is water use of local rivers considered?

A: All the local rivers are considered. Further, farm land in Gilan is located at alluvial fan so irrigation water infiltrates to the ground and springs. We would like to propose that this spring water be used again for irrigation.

Q: Irrigation efficiency may not improve so much as planned.

A: We will propose the system that checks the improvement of each Province every year. In addition, we will make a sensitive analysis.

Q: Water resources development plans proposed by each Province were approved by MOE. It is questionable that proposed RBO is effective.

A: An organization for consultation is necessary for achieving consensus among the Provinces. MOE may not be suitable for such consultation.

Q: In drought time, dams in the upper reaches may affect those in the lower reaches.

A: Because some dams in the upper reaches cannot fulfill the reservoir, they do not affect Manjil Dam as the result of the simulation. It should be noticed that agricultural production can be achieved at 100% even if the water can be supplied at 75%.

Q: There are weirs and pumping stations as well as dams in the upper reaches. They may affect.

A: We have demand data on reach basis. Detailed water allocation in the reach is not included in the model.

Q: As WRMC has an office for integrated management of the river basin, is RBO necessary?

A: Establishment of RBO will be discussed and coordinated with that office.

Q: There are many pumping stations in the upper reaches. They affect largely in drought time. They should be included in the model.

A: We do not have data of pumping stations. However, capacities of pumping stations should be reflected in the demand data. As such demands were checked, it would be no big difference.

Q: Did you consider water demands from the outside of the river basin?

A: We included Alamut water transfer and Taleghan water transfer which had been proposed so far. Future demands were also examined for these plans. However, as the proposal of Ardebil water transfer was delayed, we will only examine its potential.

Q: The role of MOJA is important for improvement of irrigation efficiency. Did you coordinate with MOJA?

A: We made coordination only with WRMC for irrigation channels. Though we understand the importance of MOJA, it is not included in the stakeholders.

Q: Do you have concrete plans for the groundwater conversion?

A: Groundwater data acquired are that from the macro viewpoint. Detailed plan of groundwater conversion should be made in the next stage.

Q: Is it true that dams in the upper reaches have no effects?

A: It's not our purpose to evaluate each dam. However, we will review the data. JICA Study employs the macro viewpoint and it has some disparity with each dam plans.

Q: Kalagi Dam and Taleghan Dam are planned to be used for drinking water. They are not suitable for the integrated operation with Manjil Dam.

A: We do not have such information. We will reexamine it.

Q (JICA Study Team): How will you manage the irrigation water after the water of Kakagi Dam is used for drinking water.

A (RWC): Water will be used for irrigation only in average years. Groundwater will be used in drought years.

Q: Other related organizations such as DOE and MOJA should join the RBO.

A: The RBO should be expanded with including other related organizations such as users association, DOE and MOJA.

Q: Did you examine water quality?

A: As we acquired only EC and salinity concentration for water quality data, we could not enough examination for water quality. By the way, although salinity problem was pointed in Zanjan Province and Gilan Province, its solution is very difficult because its cause is the huge bad land in the upper reaches.

Q: How does domestic wastewater affect water quality?

A: We do not get BOD data. It is probable that it causes significant influence as there exist very few treatment facilities.

Q: Can you present results of the model in other countries as examples?

A: As the program of the model is new, we will check whether we can find the examples.

Q: Are there any wild lives depending on water resources in the river basin?

A: We practiced IEE. We will confirm its contents again.

Q: Wastewater treatment plants will be constructed. Treated water can be used for irrigation.

A: Wastewater treatment plants are not included in the Study. We would like to propose that the treated water should be used for recharging aquifer after its quality is checked. Then, the groundwater should be used for irrigation instead that the treated water is directly used.

Q: Did you use the results of the Study on Manjil Dam formerly conducted by JICA?

A: We referred the water transfer plan but not an alternative plan of Manjil Dam.

Q: IWRM should be conducted efficiently. As the World Bank and the United Nations issued related reports, they should be referred.

A: We referred various guidelines. However, it is very difficult to find a successful case for IWRM.

Q: According to the study result of the local consultant, water injection is not an effective measure for preventing groundwater lowering.

A: We do not know such study result. Anyhow, measures for preventing groundwater lowering should be formulated.

Replies to Comments Submitted in Writing

1- Tehran Drinking water supply and also water supply in western part of Tehran province where there is limitation of water resources are prioritized by the national level. Therefore, any scenario for water conveyance from Taleghan dam to down stream is not applicable, and we ask for omitting such a scenario, and thinking for other alternatives.

Reply to the above question: The above scenario was already rejected in the master plan following your comments.

2- According to former development study conducted by JICA(Sanyu consultants) in 2001, Alamut water transfer to Qazvin plain was suggested. also construction of a dam in Loushan Area was suggested to cover Manjil dam capacity decrease caused by sedimentation, as a solution for water regulation in Gilan plain. Such alternatives should be included in JICA study team's MP draft.

Reply to the above question: Alamut water transfer project is considered in the master plan, while a dam in Loushan is not considered due to lack of information on it.

3- 14 rivers in Manjil dam down stream and their discharges statistics are reflected in Sefidrud water resources planning study but configuration of water demand for these surface water resources is not considered.

Reply to the above question: Water demand is included in the SIDN already.

4- We could not receive any clear answer or explanation about Model sensitivity.

Reply to the above question: The model sensitivity had already been checked in the process of establishment model, regarding several variations of irrigation efficiency, dam construction pattern and tank model parameters. Finally, the model was calibrated by comparison between observed discharge and simulation result at any discharge observation stations.

5- MOE is considering substitution of water purified by water treatment plants as future resources for drinking water. For example, there are 3 plants in Qazvin province (Bidestan, alvand, Qazvin municipal) under study or operation, with total discharge 2.3m³/s usable in

case of passing Environment organization's standards, but there is no track of these plants in the report.

Reply to the above question: It is possible water sources in future to reuse of treated water by the plants, but so far the study team could not count as water resources. Furthermore, it could be utilized for water source of groundwater recharge.

6- Due to our past experiences, increasing irrigation efficiency through cultivation pattern change is not possible. It needs to mention that MOJA as the main player in this field is not present at Stake holders committee.

Re: The team agrees upon this comment, but the stakeholders are limited within RWCs so that RWCs have responsibility to collect the above-mentioned information from MOJA and to convey them to the team.

7- Regarding to establishment of RBO, there is a possibility of mutual interference of suggested RBO and existing Basin management section in WRMC.

Reply to the above question: The team also agrees upon the comments, and those would be future issue.

8- The result of water conveyance from Taleghan Pipeline (No 2) to Tehran, is reflected in Mahab Ghodss report, but JICA study team has not considered it as a new plan in its report. Due to feasibility of water transfer system from Karaj to Tehran and construction of some concerning facilities, we would like to know if Study team has put this plan in its modeling?

Reply to the above question: Taleghan pipeline is mounted on the model as a water user module which extracts the water from Taleghan dam module in accordance with the water demand requested monthly basis.

9- Usually, there is a noticeable period of time, from completion of dam construction and starting of irrigation network operation. Is such a period considered in JICA study team modeling? If yes, how?

Reply to the above question: The team did not receive such information, but the simulation is made at the mid-term and long-term in which the time-lag do not need considering.

10- To consider Sefidrud(Manjil) dam as a control and monitoring is logical at the present condition, but it does not sound logical for mid-term and long-term ,and indicators in both Sefidrud dam and river must been revised.

Reply to the above question: The simulation results are evaluated at not only Sefidrud dam but also numerous river stretches including downstream ends to the Caspian Sea.

11- Study team has kindly pointed some regions which have problem of water-table decrease at aquifers. We would like to ask study team to give information about the areas where water supply is more than water requirements. For the past 5 years, no new permission has been issued for fish culture plans due to continuation of Sefidrud study project. If we know where is feasible to establish fish culture, we can accept new applications regarding this activity.

Re: There are no significant problems of groundwater use in the territory of Tehran province in the Sefidrud basin. Furthermore, consumption of fishculture might be negligible, and most of utilized water could return to the river. Thus if even surface water is available, water usage should be permitted.

12- In Gilan province, final confirmation of new plans for hydraulic structures is done just after DOE approves it. Thus, some of plans of Gilan RWC has legal problem.

Reply to the above question: The team will refer to this comment.

SUPPORTING REPORT

PAPER 7

SOCIOECONOMIC CONDITIONS AND PROJECT EVALUATION

THE STUDY ON INTEGRATED WATER RESOURCES MANAGEMENT FOR SEFIDRUD RIVER BASIN IN THE ISLAMIC REPUBLIC OF IRAN

SUPPORTING REPORT

PAPER 7 SOCIOECONOMIC CONDITIONS AND PROJECT EVALUATION

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Note: The Contents without any reference source were prepared by JICA Study Team.

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CHAPTER 1. SOCIOECONOMY IN IRAN

1.1 CALENDAR

System of the Iranian calendar and the Gregorian calendar is different as follows:

Table 1.1.1 The Iranian calendar and the Gregorian calendar

Iranian Calendar	Farvardin	Ordibehesht	Khordad	Tir	Mordad	Shahrivar	Mehr	Aban	Azar	Dey	Bahman	Esfand
Gregorian Calendar	21-Mar - 20-Apr	21-Apr - 21-May	22-May - 21-Jun	22-Jun - 22-Jul	23-Jul - 22-Aug	23-Aug - 22-Sep	23-Sep - 22-Oct	23-Oct - 21-Nov	22-Nov - 21-Dec	22-Dec - 20-Jan	21-Jan - 19-Feb	20-Feb - 20-Mar

Therefore, the Iranian year begins on March 21 of the year in A.D. and ends on March 20 of the next year. And, to convert the Iranian year into Christian year, it should be added 621 to the former. In other words, the year 1384 in Iranian calendar means the year 2005 of the year in A.D. In this report, the Gregorian calendar system is used and it means the period from March 21 to March 20 of the next year unless otherwise stated.

1.2 POPULATION

According to the Statistics, population of the nation has been increased drastically since the year 1958, the year when first census has been made, till the year 1993. But, after this year, the rate of increase has fallen down to the present as shown in the following table and figure. The population of the nation is 70.5 million as of 2006 referring to Census.

Table 1.2.1 Historical Population Trend of Iran after First Census

Year in A.D.	Year in Iranian Calendar	Status	Population	Average Annual Growth
1956	1335	Census	18,954,704	3.10%
1966	1345	Census	25,788,722	3.61%
1976	1355	Census	33,708,744	3.07%
1986	1365	Census	49,445,010	4.67%
1991	1370	Census	55,837,163	2.59%
1996	1375	Census	60,055,488	1.51%
1997	1376	Projection	60,693,788	1.06%
1998	1377	Projection	61,768,682	1.77%
1999	1378	Projection	62,843,039	1.74%
2000	1379	Projection	63,916,859	1.71%
2001	1380	Projection	64,990,142	1.68%
2002	1381	Projection	66,062,889	1.65%
2003	1382	Projection	67,135,100	1.62%
2004	1383	Projection	68,206,775	1.60%
2005	1384	Projection	69,277,916	1.57%
2006	1385	Census	70,495,782	1.76%

Source: Iran Statistical Year Book 1385, Statistical Center of Iran, Management and Planning Organization, Iran.

Remark: Projection made by JICA Study Team during 1997 over 2005 by logarithmic mean as "y=2,147,102,390,.30Ln(x)-16,255,998,980.29" based on past trend.

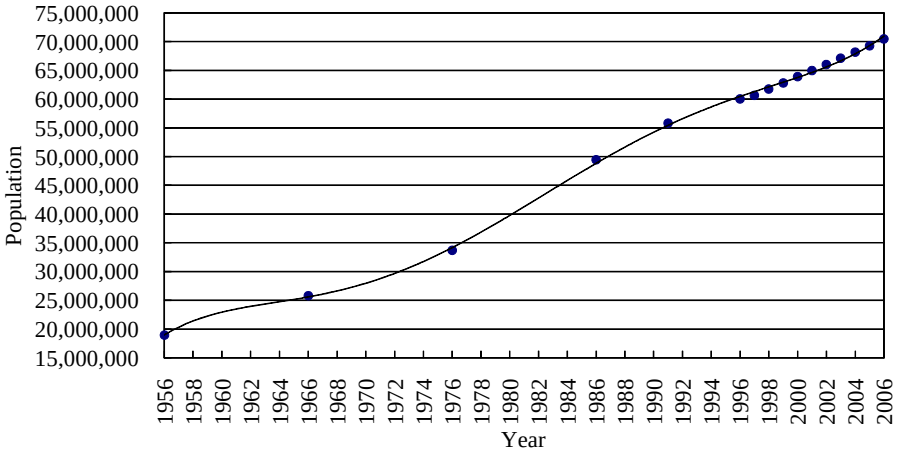

Figure 1.2.1 Illustrated Historical Population Trend in Iran

Annual average increasing ratio of the population during 10 years period since 1996 till 2006 is 1.62 %. So far as indicated in the above table and figure, the population of Iran may be increased with the same rate.

1.3 DISTRIBUTION OF ETHNIC AND RELIGIOUS GROUP

On ethnic, there are 11 well-known ethnic groups as (1) Persian (51 %), (2) Azeri (24 %), (3) Kurd (7 %), (4) Arab (3 %), (5) Lur (2 %), (6) Baloch (or Baluchi) (2 %), (7) Qashqai (?), (8) Turkmen (2 %), (9) Gilaki and (10) Mazandarani (8 %), and (11) Talysh and some others[1].

Figure 1.3.1 Ethnic and Religious Groups and their Geographical Distribution

Shia Islam Twelvers is the state religion (around 90 %), but there are a little devotee groups of Sunni Islam (around 9 %) been mainly living in border areas with Turkmenistan, Iraq and/or Turkey. Almost of Baloches are the devotees of Sunni Islam. In addition to the Islamic religion, there are some

[1] Percentages of ethnic groups are estimated one. There is no any official statistics on ethnic group in Iran according to Wikipedia.

minorities as Bahaism, Zoroastrianism (state religion in the Sasan Dynasty era), Judaism, and some Christianity as shown in Figure 1.3.1.

1.4 ADMINISTRATIVE SETUP

Administrative setup in Iran is as shown in the following figure.

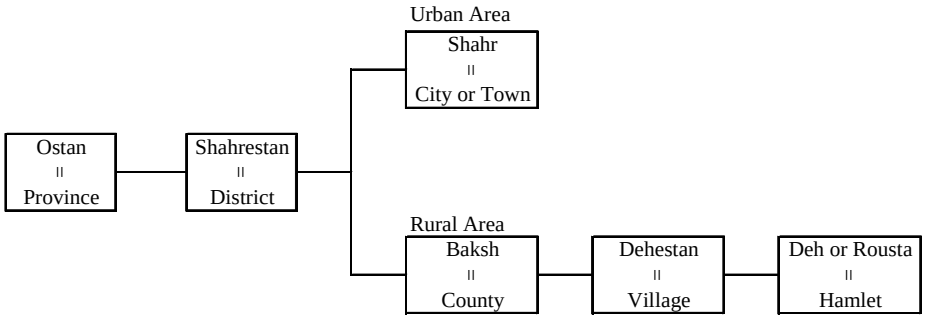

Figure 1.4.1 Administrative Setup in Iran

In the above figure, the term of "Shahrestan" locally called is also translated as "township" by lot of people in Iran. However, according to administrative customs in almost of all the European countries, the township is usually set under the county after province. Accordingly, the term of "the shahrestan" has been translated into English as "District". The term of "shahr" means "town" or "city". Village is locally called as "dehestan." But, above the dehestan, there is "baksh" which has been translated as "county", but this term is used for rural community only. The most subordinate administrative unit is locally called as "deh" or "rousta" that has been translated into English as "hamlet" in this report.

1.5 FINANCIAL STATUS OF GOVERNMENT

As shown in the following table, the present financial status of the Government of the Islamic Republic of Iran is 1,915 trillion Rials as of 2006 in terms of budget scale. This amount includes all the revenue sources including central Government and local administrative, so that it may literally be considered as "the national financial status". Incidentally, this table corresponds to the "balance sheet" in private commercial organizations.

Table 1.5.1 Summary of Governmental Financial Status in Recent Years (Resources)

(billion Rials)

Budget Resources	2002	2003	2004	2005	2006	2007
1. Government Public Budget Resources	273,228	436,023	519,015	569,837	587,597	691,828
1.1 General Resources	240,240	395,554	459,925	537,859	548,571	639,452
1.1.1 Revenues	82,670	204,508	222,666	286,887	244,455	277,508
1.1.2 Cession of Capital Assets	102,558	126,852	150,834	137,371	154,878	175,725
1.1.3 Cession of Financial Assets	55,012	64,194	86,425	113,601	149,238	186,218
1.2 Special Resources	32,988	40,469	59,090	31,978	39,026	52,376
1.2.1 Special Revenues	32,988	40,469	59,090	31,978	39,026	52,376
2. Resources of Government Corporations, Banks and Affiliated for Profit Enterprises	435,915	554,337	688,921	1,055,969	1,372,838	1,677,065
2.1 Government Corporations	391,188	495,257	610,386	956,452	1,226,633	1,497,073
2.2 Banks	37,586	51,350	65,955	83,840	122,513	156,095
2.3 Affiliated for Profit Enterprises	7,141	7,730	12,579	15,678	23,691	23,898
Less: Duplications	15,841	22,099	23,429	35,817	45,329	52,037
Budget Resources in Total	693,302	968,261	1,184,507	1,589,990	1,915,105	2,316,857

Source: Management and Planning Organization, Iran Statistical Year Book 1385.

Table 1.5.2 Summary of Governmental Financial Status in Recent Years (Uses)

(billion Rials)

Budget Uses	2002	2003	2004	2005	2006	2007
1. Government Public Budget Uses	273,228	436,023	519,015	569,837	587,597	691,828
1.1 General Uses	240,240	395,554	459,925	537,859	548,571	639,452
1.1.1 Expenditures	155,635	285,750	315,711	382,829	377,935	399,400
1.1.2 Ownership of Capital Assets	54,987	85,206	99,841	112,979	156,551	184,438
1.1.3 Ownership of Financial Assets	29,618	35,554	44,373	42,051	14,084	55,614
1.2 Special Uses	32,988	40,469	59,090	31,978	39,026	52,376
1.2.1 From Government Special Revenues	32,988	40,469	59,090	31,978	39,026	52,376
2. Uses of Government Corporations, Banks and Affiliated for Profit Enterprises	435,915	554,337	688,921	1,055,969	1,372,838	1,677,065
2.1 Government Corporations	391,188	495,257	610,386	956,452	1,226,633	1,497,073
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Less: Duplications	15,841	22,099	23,429	35,817	45,329	52,037
Budget Uses in Total	693,302	968,262	1,184,507	1,589,990	1,915,105	2,316,857

Source: Management and Planning Organization, Iran Statistical Year Book 1385.

In the “Budget Resources”, the main resource is to be “Revenue”, and the item corresponding to the Revenue is “Expenditure” in “Budget Uses” side. The detail of Revenue and Expenditure is shown in the following table and the item of so called as “the oil money” is not appeared in this Table. And, the Government has continuously registered deficits in these several years. In other words, the financial status of the Government may not be called as “healthy financial status” in case that oil revenue is not included.

Table 1.5.3 Revenue and Expenditure of the Government in Recent Years

(billion Rials)

Item of Revenue and Expenditure	2002	2003	2004	2005	2006	2007
Revenues						
Tax Revenues	62,416	74,781	88,998	130,160	177,617	197,295
Social Contributions	0	0	0	0	0	0
Grants	0	0	0	0	0	0
Revenues from Government Properties	4,562	119,581	114,861	139,111	50,345	57,212
Revenues from Sale of Goods and Services	4,738	5,372	6,892	12,159	9,413	12,504
Revenues from Penalties and Losses	1,671	1,548	2,821	2,493	2,709	3,306
Miscellaneous revenues	9,284	3,227	9,094	2,964	4,372	7,192
Revenue in Total	82,670	204,508	222,666	286,887	244,455	277,508
Expenditures						
Employees Compensation	57,132	63,639	74,362	84,747	116,659	140,266
Utilization of Goods and Services	22,492	25,419	26,367	29,550	32,263	35,872
Expenditures of Properties and Assets	2,616	399	343	432	463	799
Subsidies	38,692	36,309	39,676	44,298	60,600	62,862
Grants	6,965	8,142	8,837	11,545	43,857	13,823
Social Contributions	21,941	32,554	28,944	44,575	69,959	64,492
Other	5,797	119,289	137,182	167,683	54,134	81,286
Expenditure in Total	155,635	285,750	315,711	382,829	377,935	399,400
Operational Balance	-72,965	-81,241	-93,045	-95,942	-133,480	-121,891

Source: Management and Planning Organization, Iran Statistical Year Book 1385.

The oil revenue is counted in “Cession of Capital Assets” in Capital Assets as shown in the following table in detail.

Table 1.5.4 Detail of Capital Assets of the Government in Recent Years

(billion Rials)

Description	2002	2003	2004	2005	2006	2007
Section 1. Oil revenue	100,060	124,232	146,790	134,294	151,801	172,450
Section 3. Sale of public buildings and installations	276	116	312	-*	-*	-*
Section 4. Sale and cession of lands	155	274	393	-*	-*	-*
Section 5. Sale of machinery and equipment	574	430	450	-*	-*	-*
Section 9. Sale and cession of other capital assets	1,493	1,800	2,889	3,077	3,077	3,275
Total	102,558	126,852	150,834	137,371	154,878	175,725

*: According to Statistical Year Book, those data may not be separated by sections 3, 4 and 5.
Source: Management and Planning Organization, Iran Statistical Year Book 1385.

As shown in the above table, "Transfer of Oil Concessions" has mainly shared in the Capital Assets. From this viewpoint, it may be cleared that the Governmental finance is depended on oil revenue.

1.6 INTERNATIONAL BALANCE OF PAYMENT AND BALANCE OF TRADE

As shown in the following table, the International Balance of Payment of Iran has been almost sound since 1996 except that in 1991.

Table 1.6.1 International Balance of Payment in Iran in Recent Years

(million US$)

Description	(Iranian Calendar)	1370	1375	1380	1381	1382	1383	1384
	(Gregorian Calendar)	1991	1996	2001	2002	2003	2004	2005
Current account balance		-9,448	5,232	5,985	3,585	816	1,442	14,037
Trade balance		-6,529	7,402	5,775	6,201	4,430	5,653	19,043
Exports		18,661	22,391	23,904	28,237	33,991	43,852	60,012
Oil and gas		16,012	19,271	19,339	22,966	27,355	36,315	48,823
Non – oil exports		2,649	3,120	4,565	5,271	6,636	7,537	11,189
Import		25,190	14,989	18,129	22,036	29,561	38,199	40,969
Services balance		-4,919	-2,633	-495	-3,503	-4,535	-5,011	-5,894
Receipts		881	1,348	3,488	5,025	6,249	6,905	7,612
Transportation charges and insurance		0	366	731	1,316	1,704	2,051	2,288
Passengers services		61	123	231	250	233	261	337
Travel		57	19	891	1,357	1,033	1,044	992
Investment revenues		213	488	655	653	781	918	1,018
Other public services		218	51	576	632	1,099	1,128	1,263
Other private services		332	301	404	817	1,399	1,503	1,714
Payments		5,800	3,981	3,983	8,528	10,784	11,916	13,506
Transportation charge and insurance		2,737	1,668	1,539	434	756	876	1,213
Passengers services		127	16	6	240	278	309	430
Travel		734	258	708	3,750	3,842	4,093	4,380
Investment revenues		85	898	397	1,082	1,046	1,129	1,307
Other public services		1,567	872	1,135	2,065	3,306	3,706	4,040
Other private services		550	269	198	957	1,556	1,803	2,136
Transfers		2,000	463	705	887	921	800	888
Capital accounts		6,032	-5,508	1,150	2,534	4,476	7,388	-411
Long-term		1,350	-5,246	2,361	3,329	2,045	1,659	410
Short-term		4,682	-262	-1,211	-796	2,431	5,730	-821
Exchange rate changes(1)		0	1,403	-156	-210	-506	1,213	-1,000
Statistical discrepancies		1,319	1,219	-2,219	-1,242	-1,076	-1,312	948
Total balance		-2,097	2,346	4,760	4,667	3,710	8,731	13,574

1. Including decrease or increase in amounts of some foreign debts because of changes in exchange rates of some currencies.

Source: Management and Planning Organization, Iran Statistical Year Book 1385.

However, if the amount of export of oil and gas has been excluded, the amount of import has continuously exceeded the amount of export in international trade excerpted from Table 1.6.1 is shown as the following table. Namely, excess of import over export can be seen every year.

Table 1.6.2 International Balance of Trade in Iran in Recent Years

(million US$)

Description	1991	1996	2001	2002	2003	2004	2005
Exports	18,661	22,391	23,904	28,237	33,991	43,852	60,012
Oil & gas	16,012	19,271	19,339	22,966	27,355	36,315	48,823
Non-oil	2,649	3,120	4,565	5,271	6,636	7,537	11,189
Share Rate of "Oil & Gas" to Export in Talal	85.80%	86.07%	80.90%	81.33%	80.48%	82.81%	81.36%
Imports (F.O.B)	25,190	14,989	18,129	22,036	29,561	38,199	40,969
Balance of Trade	-6,529	7,402	5,775	6,201	4,430	5,653	19,043

Source: Iran Statistical Year Book 1385, Management and Planning Organization, and the Central Bank of Iran.

In this connection as shown in the above table, the amount of oil and gas and their products has shared over 80 % every year. That is reflection of character of this nation of oil as oil-producing country being second rank to Saudi Arabia in the world oil producers.

1.7 VALUE ADDED AND GROSS DOMESTIC PRODUCT (GDP)

Gross Domestic Product means a balance of total producers' products in all the economic activities after deducting intermediate consumptions of them for production. Namely, the GDP is a cumulative amount of value added derived from all economic activities in the country.

Table 1.7.1 shows a summary of the value added in all the economic activities and the GDP in Iran during last several years since the 1991 till the 2005.

Table 1.7.1 Value Added in All the Economic Activities and GDP in Iran

(billion Rials)

Description	1991	1996	2001	2002	2003	2004	2005	Share Rate to the Total GDP in 2005
At Current Prices								
Agriculture, Hunting, and Forestry	7,217	37,381	73,170	80,815	103,873	127,216	152,076	10.04%
Fishing	237	992	1,933	2,070	2,328	2,878	3,021	0.20%
Mining and Quarrying	3,932	38,234	113,838	115,648	169,093	212,781	316,916	20.93%
Manufacturing	10,428	41,824	98,958	117,659	142,962	179,743	234,936	15.52%
Water Supply, Electricity and Natural Gas	684	4,599	13,547	14,366	19,502	30,854	39,445	2.61%
Construction	3,816	16,578	28,258	37,337	47,095	47,464	56,386	3.72%
Wholesale & Retail Trade; Repair of Motor Vehicles and Personal and Household Goods	8,770	39,126	90,155	108,479	125,716	148,251	189,571	12.52%
								0.00%
Hotels and Restaurants	311	2,126	6,070	7,523	9,555	12,513	13,727	0.91%
Transport, Storage and Communications	3,441	13,943	44,561	54,107	67,979	82,387	100,220	6.62%
Financial Intermediation	550	3,026	13,181	16,977	26,736	36,376	48,429	3.20%
Real Estate, Renting and Business Activities	5,987	33,742	73,159	85,891	113,907	138,941	157,277	10.39%
Public Administration and Defense; Compulsory Social Security	3,379	15,822	35,932	42,599	53,244	68,113	87,651	5.79%
Education	1,546	9,007	22,433	28,647	37,084	45,270	46,549	3.07%
Health and Social Work	904	6,753	17,357	22,231	31,643	38,553	52,427	3.46%
Other Community, Social and Personal Service Activities	468	2,358	6,673	8,692	9,888	11,682	15,559	1.03%
Total	51,669	265,510	639,226	743,040	960,603	1,183,022	1,514,190	100.00%
Net Taxes on Imports	805	238	6,629	9,959	15,114	21,643	32,201	
Taxes on Imports	952	3,110	8,488	12,291	17,030	22,686	33,490	
Subsidies on Imports	-147	-2,872	-1,859	-2,332	-1,916	-1,043	-1,289	
Gross Domestic Product (at Market Prices)	52,474	261,767	733,909	952,563	1,185,192	1,547,991	1,931,304	
Gross Domestic Product excl. Oil (at Market Prices) *	46,410	226,862	528,156	633,358	800,338	983,468	0	
Net Income from Abroad	99	-1,649	1,455	-15,932	-21,772	-24,937	0	
Gross National Product = Gross National Income	52,573	260,118	735,364	936,631	1,163,420	1,523,054	0	
Less: Consumption of Fixed Capital	4,990	35,978	88,297	116,572	138,617	183,917	247,499	
National Income	47,583	224,140	647,067	820,059	1,024,803	1,339,137	0	
At 1997 Constant Prices								
Agriculture, Hunting, Forestry	33,900	41,911	44,463	50,646	51,959	49,280	55,206	11.51%
Fishing	1,449	1,297	1,242	1,276	1,488	1,707	1,823	0.38%
Mining and Quarrying	42,113	39,635	35,319	34,154	38,919	38,627	39,379	8.21%
Manufacturing	38,195	44,625	61,153	70,575	80,630	85,339	91,743	19.13%
Water Supply, Electricity and Natural Gas	2,360	5,460	5,340	5,545	5,872	6,360	7,255	1.51%
Construction	12,343	22,453	22,125	23,025	21,413	21,513	22,369	4.67%
Wholesale & Retail Trade; Repair of Motor Vehicles and Personal and Household Goods	42,740	44,777	66,013	69,870	76,069	86,754	91,543	19.09%
								0.00%
Hotels and Restaurants	2,310	2,436	3,024	2,678	2,451	2,717	2,705	0.56%
Transport, Storage and Communications	9,178	17,091	24,153	28,067	33,283	38,202	38,981	8.13%
Financial Intermediation	835	2,618	4,957	4,974	5,873	7,130	8,118	1.69%
Real Estate, Renting and Business Activities	24,952	43,916	46,792	51,951	55,082	59,784	63,013	13.14%
Public Administration and Defense; Compulsory Social Security	13,302	17,462	19,691	21,332	21,319	20,638	20,768	4.33%
Education	9,740	11,484	14,129	14,388	14,228	14,298	14,476	3.02%
Health and Social Work	5,786	8,430	10,458	11,228	11,605	11,802	12,988	2.71%
Other Community, Social and Personal Service Activities	3,309	3,148	6,149	6,238	6,233	7,854	9,083	1.89%
Total	242,511	306,743	365,009	395,947	426,423	452,003	479,452	100.00%
Net Taxes on Imports	4,215	262	1,590	2,056	2,272	3,650	522	
Taxes on Imports	4,984	3,418	7,036	9,136	10,466	13,584	14,288	
Subsidies on Imports	-770	-3,156	-5,445	-7,080	-8,194	-9,934	-13,766	
Gross Domestic Product (GDP at Market Prices)	246,726	307,004	366,599	398,003	428,695	455,653	479,974	
Gross Domestic Product excl. Oil (at Market Prices) *	201,380	272,297	314,911	335,263	365,641	393,350	0	
Terms of Trade Adjustment	-14,738	1,555	33,457	36,912	42,950	82,934	122,682	
Net Income from Abroad	-2,655	-1,675	485	-2,522	-2,780	-2,756	0	
Gross National Product =Gross National Income	229,332	306,885	400,542	432,392	468,865	535,832	0	
Less: Consumption of Fixed Capital	14,916	41,827	49,236	57,883	62,891	65,438	76,839	
National Income	214,416	265,058	351,306	374,510	405,974	470,393	0	

Source: Management and Planning Organization, Iran Statistical Year Book 1385 (and 1384 for Gross Domestic Product excl. Oil (at Market Prices).

And, Table 1.7.2 shows GDPs in terms of "Current Price" and "1997 Constant Price" excerpted from Table 1.7.1 together with calculated annual average increasing ratios.

Table 1.7.2 Fluctuation of GDP in Iran and Its Annual Average Growth Ratio

(billion Rials)

Price Level	1991	1996	2001	2002	2003	2004	2005	Annual Average Growth
At Current Prices	52,474	261,767	733,909	952,563	1,185,192	1,547,991	1,931,304	25.64%
At 1997 Constant Prices	246,726	307,004	366,599	398,003	428,695	455,653	479,974	4.28%

Source: Management and Planning Organization, Iran Statistical Year Book 1385.

As shown in the above Table, in the current price level, GDP growth has changed with quite high rate as 25.6 % of annual average growth rate. However, in the 1997 constant price level, a real growth rate has only changed at 4.3 %. It means that price increased at quite high rate during this period.

From the viewpoint of contribution of the economic activities, “mining and quarrying” shares with highest rate of 21 % to GDP as of 2005. The second and the third highest ones are “manufacturing”, and “transport, storage and communications” with 15 % and 12% respectively. The economic activity of “agriculture” shares only 10 % to GDP as same as “real estate”.

1.8 CONSUMER PRICE INDEX (CPI) AND INFLATION RATE

As far as the statistics shows, the inflation rate has been fluctuated around the lower end of 20 % since 1996 till 2001. The annual average of inflation rate during the period of 5 years from 1991 to 1996 was over the 30%. However, after that period, it was fluctuated around 15%, but it is still high level. In other words, it may say that the inflation rate has been improved comparing with that in previous period. Nevertheless, the annual average inflation rate is still high rate as 14.67% during the period from 2001 to 2005. It means that the inflation rate at present strain to household economy of the people.

Table 1.8.1 Consumer Price Indexes in Urban Area and Inflation Rate

(1997 - 100)

Iranian Calendar	1365	1370	1375	1380	1381	1382	1383	1384	1385
Gregorian Calendar	1986	1991	1996	2001	2002	2003	2004	2005	2006
General index	8.80	22.40	85.20	177.90	206.00	238.20	274.50	307.60	349.5
Annual Average Inflation Rate Since 1986(%)	-	20.55%	25.49%	22.19%	-	-	-	-	-
Annual Average Inflation Against Previous Year (%)	-	-	-	-	15.80%	15.63%	15.24%	12.06%	13.62%
Annual Average Inflation During Previous 5 Year (%)	-	20.55%	30.63%	15.86%	(Average Since 2001)				14.46%

Sources: Iran Statistical Year Book 1385, SCI.

Table 1.8.2 Consumer Price Indexes in Rural Area and Inflation Rate

(2002 - 100)

Iranian Calendar	1382	1383	1384	1385
Gregorian Calendar	2003	2004	2005	2006
General index	114.60	130.20	145.90	163.9
Annual Average Inflation Against Previous Year (%)	12.74%	13.61%	12.06%	12.34%
Annual Average Inflation During Previous 4 Year (%)				13.15%

Sources: Iran Statistical Year Book 1385, SCI.

As shown in Table 1.8.2, the inflation rate is rather low comparing with that in the urban area. But, almost of all the manner of life of people should be depending upon the economy in urban area, so that these economic statuses strain the human life of the people.

1.9 NATIONAL AND REGIONAL DEVELOPMENT PLANS

Iran is now in course of the Fourth Economic, Social and Cultural Development Plan starting from 2005 to 2009.

In this plan, the Government has set several numerical targets in the forms of 4 categories as (1) Economic Sector including GDP growth rate, investment growth rate, population growth rate,

labor force productivity growth rate, unemployment rate, non-oil export growth rate, liquidity rate, and inflation rate, (2) Social Sector including Expenditure Ratio of 10 % Richest to 10 % Poorest Families, Expenditure Ratio of 20 % Upper to 20 % Lower Families, Gini Coefficient (= Engel Coefficient), Social Welfare Indicators, Human Development Indicators, Percentage of Population under the Relative Poverty Line (50 % of the Median Income), Mortality Rate for Children under 5 Years Old (per 1,000 people), Life Expectancy at Birth (Year), (3) Sector on Cultural, Research and Technology including Technology Accessibility Indicator, Educational Development Indicator, Number of Scientists and Engineers Employed in Research and Development Sector (per 1,000,000 people), Number of Registered Scientists Licenses (per 1,000,000 people), Percentage of Export of Hi-Technology Goods to Total Non-Oil Export, Percentage of Literate Persons 6 Years Old and Over, Number of Published Book Titles per 100,000 People, and (4) Sector on Government Systems including Decrease in Number of the Government Employees, Increase in Amount of Budget for the Government Units Administrated, Volume of the Government Social and Cultural Undertaking Divested to Private Sector, Decrease in Production of the Nation's Total Budget to GDP, Decrease in Number of Managerial and Superintending Positions, Percentage of the Government Agencies with Internet Facilities, Percentage of the Clients Satisfied Manner of Service Provision, Average Per-Capita Training of the Government Administrators and Employees per Year, and Share Rate of Budget for the Executive Agencies Divested to the Non-Government Sector for Development as indicated in the following tables.

Table 1.9.1 Overall Numerical Targets of 4th Economic, Social and Cultural Development Plan of Iran (Economic Sector)

A. Economic Sector

Indicators		Average Growth during 1991 - 2001	Average Growth during 2005 - 2009
GDP Growth Rate	(%)	3.9	8.0
Per Capita GDP Growth Rate	(%)	2.4	6.6
Investment Growth Rate	(%)	4.3	12.2
Population Growth Rate	(%)	1.5	1.4
Labor Force Productivity Growth Rate	(%)	1.3	3.5
Unemployment Rate	(%)	4.7	4.2
Non-Oil Export Growth Rate	(%)	5.6	10.7
Liquidity Growth	(%)	27.3	20.0
Inflation Rate	(%)	23.0	9.9

Table 1.9.2 Overall Numerical Targets of 4th Economic, Social and Cultural Development Plan of Iran (Social Welfare Sector)

B. Social Welfare Sector

Indicators	1991	2001	2009
Expenditure Ratio of 10 % Richest to 10 % Poorest Families	33.4	19.4	14
Expenditure Ratio of 20 % Upper to 20 % Lower Families	14.2	10.0	5.5
Gini Coefficient	0.49	0.43	0.38
Social Welfare Indicators	251	423	800
Human Development Indicators	0.736	0.719	0.820
Percentage of Population under the Relative Poverty Line (50 % of the Median Income)	-	15	7
Mortality Rate for Children under 5 Years Old (per 1,000 people)	64.5	34.0	17.0
Life Expectancy at Birth (Year)	64.7	69.8	73.0

Table 1.9.3 Overall Numerical Targets of 4th Economic, Social and Cultural Development Plan of Iran (Sector on Culture, Research and Technology)

C. Sector on Culture, Research and Technology

Indicators		Existing Conditions	2009
Technology Accessibility Indicator		0.26	0.45
Educational Development Indicator	Base = 100	78	84
Number of Scientists and Engineers Employed in Research and Development Sector (per 1,000,000 people)		336	2,000
Number of Registered Scientists License (per 1,000,000 people)		1	4
Percentage of Export of Hi-Technology Goods to Total Non-Oil Export		2	6
Percentage of Literated Persons 6 Years Old and Over		85.5	90.0
Number of Published Book Titles per 100,000 People		33.7	54.9

Table 1.9.4 Overall Numerical Targets of 4th Economic, Social and Cultural Development Plan of Iran (Sector on Government Systems)

D. Sector on Government Systems

Indicators	Numerical Target
Decrease in Number of the Government Employees	5.00%
Increase in Amount of Budget for the Government Units Administrated	50.00%
Volume of the Government Social and Cultural Undertaking Divested to Private Sector	15.00%
Decrease in Production of the Nation's Total Budget to GDP	10.00%
Decrease in Number of Managerial and Superintending Positions	20.00%
Percentage of the Government Agencies with Internet Facilities	100%
Percentage of the Clients Satisfied Manner of Service Provision	95%
Average Per-Capita Training of the Government Administrators and Employees per Year	40 hours
Share Rate of Budget for the Executive Agencies Divested to the Non-Government Sector for Development	15.00%

Source: "Law of the Fourth Economic, Social and Cultural Development Plan of the Islamic Republic of Iran, 2005 – 2009", Management and Planning Organization).

Among them, they have set GDP forecast in more detail as shown in the following table.

Table 1.9.5 GDP Forecast Based on Numerical Target of 4th Development Plan of Iran

(billion Rials - 2002 Constant Price)

Industry of Origin	2004	Projection Based on Numerical Target					Annual Average Growth Rate
		2005	2006	2007	2008	2009	
Agriculture Sector	119,405	126,522	133,950	142,313	152,007	163,594	6.50%
Oil Sector	225,950	231,882	238,161	245,008	252,875	261,938	3.00%
Industrial and Mining Sector	200,872	221,888	245,803	272,925	304,326	342,073	11.23%
Industry	140,610	155,321	172,062	191,047	213,029	239,473	11.24%
Mining	5,424	5,991	6,637	7,369	8,217	9,237	11.24%
Construction	45,799	50,812	56,780	63,319	71,060	80,364	11.90%
Water, Electricity and Gas	9,039	9,763	10,324	11,190	12,021	13,000	7.54%
Service Sector	504,791	545,349	591,025	642,959	703,499	776,653	9.00%
Gross Domestic Products (GDP)	1,051,018	1,125,640	1,208,938	1,303,205	1,412,707	1,544,258	8.00%

Source: "Law of the Fourth Economic, Social and Cultural Development Plan of the Islamic Republic of Iran, 2005 – 2009", Management and Planning Organization).

According to Table 1.9.5 they are expecting the growth rate of agricultural production by 6.5 % in annual average by 2009. On the other hand, there is information from the some officials WRMC that the irrigation water supply volume will not be increased more from the current volume. It means that irrigation system should be modernized as pressurization so that irrigation efficiency is to become better than the current one. This matter is the most important ones for economic benefit in this kind project, so that detail analysis will be made later on.

They have also set "the Government General Budget Framework" as shown in the following table.

Table 1.9.6 Framework of the Government General Budget in the 4th Development Plan

Item	2003	2004	2005	2006	2007	2008	2009	Annual Average Growth
Resources	367,261	459,925	457,492	521,184	593,111	670,808	758,648	10.53%
Revenues	182,723	222,666	270,406	322,747	376,859	437,948	511,170	18.08%
Tax	65,099	88,998	117,830	150,398	182,522	218,559	262,631	24.16%
Transparency of Price of Energy Carriers	103,886	104,000	123,417	136,776	150,937	166,441	185,797	12.31%
Others	13,738	29,668	29,159	35,574	43,400	52,948	62,742	16.16%
Disposable Capital Asset	129,031	150,834	134,765	148,055	166,118	186,117	204,311	6.26%
Oil Royalty	126,654	145,290	128,494	140,735	157,518	175,955	192,242	5.76%
Sales of Oil Products	1,500	1,500	0	0	0	0	0	0
Other Disposable Capital Assts	877	4,044	6,271	7,320	8,601	10,163	12,069	24.44%
Disposable Financial Asset	55,508	86,426	52,321	50,382	50,134	46,743	43,167	-12.96%
Outlays	367,261	459,925	457,492	521,184	593,111	669,808	758,645	10.53%
Expenses for Credit	178,252	200,836	222,234	244,458	268,903	295,794	325,373	10.13%
Energy Carrier Subsidy	103,886	104,000	93,790	96,498	94,508	83,675	62,331	-9.73%
Reimbursement of Credits for Targeting Energy Subsidy	0	0	10,627	20,278	36,429	56,766	75,900	-
Cost of Gasoline Import	0	10,855	0	0	0	0	0	-
Acquisition of Capital Assts for Development	60,987	99,861	102,821	134,746	171,070	214,374	275,841	22.53%
Acquisition of Financial Assets	24,137	44,373	28,020	25,204	22,200	19,200	19,200	-15.43%
Operational Balance	-99,415	-82,171	-75,245	-58,486	-42,982	-24,287	0	-103.60%
Balance of Capital Assets	68,044	50,972	31,944	13,309	-4,952	-28,256	-71,530	-207.00%
Balance of Financial Assets	31,371	42,053	24,301	25,178	27,934	27,543	23,967	-10.64%
Balance of Energy Subsidy	0	-10,855	19,000	20,000	20,000	25,000	47,563	-
Balance of Overall Budget	0	1	0	0	0	1,000	3	-

Source: "Law of the Fourth Economic, Social and Cultural Development Plan of the Islamic Republic of Iran, 2005 – 2009", Management and Planning Organization).

CHAPTER 2. COST ESTIMATION

2.1 TARGET WORKS OF COST ESTIMATION

The project cost is obtained with the unit costs based on the projects in Iran, previous JICA study and comments from Supervision Division on Irrigation and Drainage Research Plans in WRMC. In this estimation, construction supervision cost and administration cost are considered as 7% of the construction cost respectively. Physical contingency is set at 10% of sum of construction cost and above mentioned two indirect costs. The unit cost explained in this section includes the cost for land acquisition.

Target works of cost estimation are as follows;

(i) Irrigation Works

(ii) Dam Construction

(iii) Domestic Water Distribution

Since the amount of industrial water is minimal, the cost for industrial water distribution is considered negligible.

2.2 COST ESTIMATION FOR IRRIGATION WORKS

The cost of irrigation works is estimated with unit cost for improvement and development.

2.2.1 Development of Irrigation Area (with Dam project)

Irrigation area will be newly constructed from not-irrigated area with Dam project.

1) Unit Cost for Main and Secondary Distribution with Intake Facilities

All of the main and secondary distribution is ether with concrete canals or with pipelines. The cost for development with main and secondary distribution with intake facilities is obtained applying following unit prices in accordance with the comment from Supervision Division on Irrigation and Drainage Research Plans in WRMC.

- Development with Main and Secondary Concrete Canal: 25 million Rials/ ha
- Development with Main and Secondary Pipeline: 80 million Rials/ ha

2) Unit Cost for Tertiary Distribution

The cost for construction of tertiary distribution with concrete canal is obtained with unit cost referring the previous JICA study and considering the comment from Supervision Division on Irrigation and Drainage Research Plans in WRMC. The one with pipeline is also obtained in the same manner with concrete canal.

- Development with tertiary distribution with concrete canal: 15 million Rials/ ha
- Development with tertiary distribution with pipe lines: 40 million Rials/ ha

3) Area of Development

Areas of development are shown in dam information submitted by WRMC and RWC in each province.

2.2.2 Improvement of Irrigation Area (with or without Dam)

Water distribution system will be improved by changing the traditional distribution to modern distribution and rehabilitating the distribution method.

1) Unit Cost for Main and Secondary Distribution with Intake Facilities

Since the lack of the information, the unit cost for improving the main and secondary distribution with intake facilities is set at 80% of the one for development.

2) Unit Cost for Tertiary Distribution

Since the lack of the information, the unit cost for improving the main and secondary distribution with intake facilities is set at 80% of the one for development.

3) Area of Improvement

Areas of improvement with dam projects refer to submitted dam information by WRMC and RWC in each province. The ones without dam project in the middle term and the long term are calculated based on the efficiency of irrigation. The efficiency of irrigation is basically set at 0.4 in the middle term and 0.5 in the long term. In the Sefidrud Irrigation Development Network, the efficiency is set at 0.42 at present, 0.48 in the middle term and 0.55 in the long term. The efficiency in the improved area is also set at 0.6. In order to achieve the target efficiencies, the areas for improvement in each Reach are reversely obtained.

The results of cost estimation for irrigation works is shown in Table 2.2.1.

Table 2.2.1 Cost Estimation of Irrigation Improvement

Reach	Area in Present (ha)			Area in Meddium Term (ha)			Area in Long Term									Irrigation Type	Unit Cost (million Rls./ha)	Improvement Cost (million Rls.)	
	Crop	Orchard	Total	Crop	Orchard	Total	Crop	Orchard	Total	Crop	Orchard	Total	Crop	Orchard	Total			Pres to Mid	Mid to Long
1	1,370		1,370	1,023.9	89.0	1,112.9	346.0	30.1	376.1	511.9	44.5	556.4	858.0	74.6	932.6	Pipeline	96	36,106	53,424
2	1,332	1,922	3,254	1,057.5	1,521.9	2,579.4	276.6	398.0	674.6	528.8	761.0	1,289.8	805.3	1,158.9	1,964.2	Pipeline	96	64,762	123,802
3	3,919	667	4,586	2,342.9	413.5	2,756.4	767.3	135.4	902.7	931.2	164.3	1,095.5	1,541.5	272.1	1,813.6	Pipeline	96	86,659	87,446
4	1,738	1,070	2,808	1,296.3	794.5	2,090.8	444.7	272.5	717.2	648.2	397.2	1,045.4	1,092.8	669.8	1,762.6	Pipeline	96	68,851	100,358
5	8,064	1,834	9,898	5,845.5	1,371.1	7,216.6	2,171.9	509.5	2,681.4	2,923.1	685.7	3,608.8	5,094.3	1,194.9	6,289.2	Pipeline	96	257,414	346,349
6	4,257	1,486	5,743	2,564.4	901.0	3,465.4	797.4	280.2	1,077.6	1,282.2	450.5	1,732.7	2,079.6	730.7	2,810.3	Pipeline	96	103,450	166,339
7	133	75	208	102.7	57.8	160.5	30.4	17.1	47.5	51.3	28.9	80.2	81.8	46.0	127.8	Pipeline	96	4,560	7,709
8	1,760	28	1,788	1,254.2	25.6	1,279.8	498.0	10.2	508.2	627.1	12.8	639.9	1,125.1	23.0	1,148.1	Pipeline	96	48,787	61,430
9	2,508	250	2,758	1,810.1	179.0	1,989.1	699.7	69.2	768.9	905.0	89.5	994.5	1,604.8	158.7	1,763.5	Pipeline	96	73,814	95,482
10	3,639	839	4,478	2,644.6	620.3	3,264.9	982.6	230.5	1,213.1	1,322.5	310.2	1,632.7	2,304.7	540.6	2,845.3	Pipeline	96	116,458	156,691
11	6,592	288	6,880	3,843.0	160.1	4,003.1	1,513.8	63.1	1,576.9	1,921.5	80.1	2,001.6	3,435.3	143.1	3,578.4	Pipeline	96	151,382	192,144
12	426	157	583	325.0	120.2	445.2	100.6	37.2	137.8	162.5	60.1	222.6	263.1	97.3	360.4	Pipeline	96	13,229	21,370
13	303	44	347	226.9	33.9	260.8	75.0	11.2	86.2	113.5	16.9	130.4	188.4	28.2	216.6	Pipeline	96	8,275	12,518
14	90	8	98	67.4	5.8	73.2	22.8	2.0	24.8	33.7	2.9	36.6	56.5	4.9	61.4	Pipeline	96	2,381	3,514
15	14	5	19	10.9	3.8	14.7	3.2	1.1	4.3	5.4	1.9	7.3	8.7	3.0	11.7	Pipeline	96	413	710
16	13	6	19	9.9	4.7	14.6	3.0	1.4	4.4	5.0	2.3	7.3	7.9	3.8	11.7	Pipeline	96	422	701
17	13,419	821	14,240	9,622.9	614.2	10,237.1	3,762.7	240.2	4,002.9	3,460.4	220.9	3,681.3	6,165.2	393.5	6,558.7	Pipeline	96	384,278	245,357
18	4,438	508	4,946	3,213.9	357.1	3,571.0	1,237.5	137.5	1,375.0	1,607.0	178.6	1,785.6	2,844.4	316.0	3,160.4	Pipeline	96	132,000	171,398
19	8,039	220	8,259	5,960.3	184.4	6,144.7	2,050.9	63.4	2,114.3	2,980.2	92.2	3,072.4	5,031.0	155.6	5,186.6	Concrete Canal	32	67,658	98,314
20	14,247	4,241	18,488	9,504.3	2,838.9	12,343.2	4,423.5	1,321.3	5,744.8	4,697.5	1,403.2	6,100.7	9,070.1	2,709.2	11,779.3	Pipeline	96	551,501	579,312
21	2,765	5,469	8,234	2,151.8	4,176.9	6,328.7	647.8	1,257.5	1,905.3	918.9	1,783.8	2,702.7	1,472.3	2,858.0	4,330.3	Concrete Canal	32	60,970	77,600
22	4,118	455	4,573	2,971.5	330.2	3,301.7	1,144.2	127.1	1,271.3	1,485.8	165.1	1,650.9	2,629.9	292.2	2,922.1	Pipeline	96	122,045	158,477
23	334	19	353	250.3	13.2	263.5	85.1	4.5	89.6	125.1	6.6	131.7	210.3	11.1	221.4	Concrete Canal	32	2,867	4,218
24	621	234	855	427.7	158.2	585.9	196.5	72.7	269.2	213.9	79.1	293.0	410.3	151.8	562.1	Pipeline	96	25,843	28,118
25	4,278	1,455	5,733	3,044.3	1,014.8	4,059.1	1,255.5	418.5	1,674.0	1,522.1	507.4	2,029.5	2,777.7	925.9	3,703.6	Concrete Canal	32	53,568	64,947
26	6,495	1,176	7,671	4,733.8	835.4	5,569.2	1,786.6	315.3	2,101.9	2,366.9	417.7	2,784.6	4,153.5	733.0	4,886.5	Pipeline	96	201,782	267,322
27	16,828	2,093	18,921	11,351.6	1,403.0	12,754.6	5,488.1	678.3	6,166.4	5,616.2	694.2	6,310.4	11,049.1	1,365.6	12,414.7	Pipeline	96	591,974	599,837
28	209	94	303	143.9	64.6	208.5	65.2	29.3	94.5	71.9	32.3	104.2	137.2	61.6	198.8	Pipeline	96	9,072	10,013
29	562	99	661	380.3	67.1	447.4	181.6	32.1	213.7	190.1	33.6	223.7	371.8	65.6	437.4	Pipeline	96	20,515	21,475
30	4,688	974	5,662	2,399.1	491.4	2,890.5	1,138.4	233.1	1,371.5	946.3	193.8	1,140.1	1,844.2	377.7	2,221.9	Pipeline	96	131,664	81,638
31	730	188	918	499.6	124.9	624.5	234.8	58.7	293.5	249.8	62.4	312.2	484.6	121.2	605.8	Pipeline	96	28,176	29,981
32	78	3	81	55.8	2.3	58.1	22.0	0.9	22.9	27.9	1.1	29.0	49.9	2.1	52.0	Concrete Canal	32	733	931
33	404	207	611	278.3	143.3	421.6	125.0	64.4	189.4	139.2	71.7	210.9	264.1	136.0	400.1	Pipeline	96	18,182	20,227
34	692	92	784	499.2	68.1	567.3	190.7	26.0	216.7	249.6	34.0	283.6	440.3	60.1	500.4	Pipeline	96	20,803	27,235
35	520	94	614	378.9	66.9	445.8	143.0	25.2	168.2	-	-	0.0	-	-	0.0	Pipeline	96	16,147	-
36	878	1,413	2,291	641.5	1,046.7	1,688.2	229.1	373.7	602.8	320.8	523.4	844.2	549.8	897.0	1,446.8	Concrete Canal	32	19,290	27,008
37	2,157	297	2,454	1,916.3	294.5	2,210.8	243.2	0.0	243.2	-	-	0.0	-	-	0.0	Pipeline	96	23,347	-
38	467	93	560	332.2	68.0	400.2	132.6	27.2	159.8	166.1	34.0	200.1	298.7	61.2	359.9	Pipeline	96	15,341	19,210
39	7	3	10	5.1	2.2	7.3	1.9	0.8	2.7	2.6	1.1	3.7	4.4	1.9	6.3	Pipeline	96	259	346
40	1,292	156	1,448	1,141.4	159.3	1,300.7	147.3	0.0	147.3	576.8	71.3	648.1	711.9	88.0	799.9	Pipeline	96	14,141	62,650
41	2,425	164	2,589	1,514.2	110.1	1,624.3	210.7	0.0	210.7	-	-	0.0	-	-	0.0	Pipeline	96	20,227	-
42	1,598	189	1,787	1,408.7	196.6	1,605.3	181.7	0.0	181.7	711.9	88.0	799.9	878.5	108.6	987.1	Pipeline	96	17,443	77,318
43	352	32	384	313.9	30.7	344.6	39.4	0.0	39.4	158.0	13.7	171.7	195.3	17.0	212.3	Pipeline	96	3,782	16,598
44	1,768	345	2,113	1,616.8	338.1	1,954.9	158.1	0.0	158.1	817.2	155.7	972.9	957.7	182.4	1,140.1	Pipeline	96	15,178	94,272
45	238	35	273	214.2	35.5	249.7	23.3	0.0	23.3	108.2	16.2	124.4	129.3	19.3	148.6	Pipeline	96	2,237	12,029
46	131	10	141	115.3	9.9	125.2	15.8	0.0	15.8	58.1	4.4	62.5	73.0	5.5	78.5	Pipeline	96	1,517	6,019
47	15,120	366	15,486	13,099.3	305.9	13,405.2	1,888.8	0.0	1,888.8	6,561.8	133.9	6,695.7	8,426.3	172.0	8,598.3	Pipeline	96	181,325	644,112
48	2,398	540	2,938	2,210.0	528.8	2,738.8	199.2	0.0	199.2	1,117.4	245.3	1,362.7	1,291.8	283.5	1,575.3	Pipeline	96	19,123	132,106
49	300	52	352	214.1	37.8	251.9	85.1	15.0	100.1	107.1	18.9	126.0	192.1	33.9	226.0	Pipeline	96	9,610	12,086
50	2,354	57	2,411	2,065.0	48.2	2,113.2	297.8	0.0	297.8	1,034.4	21.1	1,055.5	1,328.4	27.1	1,355.5	Pipeline	96	28,589	101,539
51	320	16	336	281.2	16.8	298.0	38.0	0.0	38.0	141.2	7.4	148.6	178.0	9.4	187.4	Pipeline	96	3,648	14,342
52	2,890	201	3,091	2,546.6	216.4	2,763.0	328.0	0.0	328.0	1,280.9	96.4	1,377.3	1,593.7	120.0	1,713.7	Pipeline	96	31,488	133,027
53	69,082	0	69,082	46,057.0	0.0	46,057.0	23,025.0	0.0	23,025.0	19,191.0	0.0	19,191.0	49,891.0	0.0	49,891.0	Concrete Canal	32	736,800	859,712
54	48,010	0	48,010	32,008.3	0.0	32,008.3	16,001.7	0.0	16,001.7	13,337.2	0.0	13,337.2	34,672.8	0.0	34,672.8	Concrete Canal	32	512,054	597,475
55	49,962	0	49,962	33,309.7	0.0	33,309.7	16,652.3	0.0	16,652.3	13,879.4	0.0	13,879.4	36,082.6	0.0	36,082.6	Concrete Canal	32	532,874	621,770
56	18,794	0	18,794	13,920.7	0.0	13,920.7	4,873.3	0.0	4,873.3	6,961.3	0.0	6,961.3	11,832.7	0.0	11,832.7	Concrete Canal	32	155,946	222,701
57	14,517	0	14,517	10,752.7	0.0	10,752.7	3,764.3	0.0	3,764.3	5,377.1	0.0	5,377.1	9,139.9	0.0	9,139.9	Concrete Canal	32	120,458	172,019
59	3,540	695	4,235	2,682.6	511.0	3,193.6	874.8	166.6	1,041.4	1,341.5	255.5	1,597.0	2,215.9	422.1	2,638.0	Pipeline	96	99,974	153,274
60	8,913	1,511	10,424	5,447.1	886.8	6,333.9	2,064.1	336.0	2,400.1	2,723.6	443.4	3,167.0	4,787.6	779.4	5,567.0	Pipeline	96	230,410	304,022
61	11,304	6,090	17,394	8,713.6	4,691.9	13,405.5	2,592.5	1,396.0	3,988.5	4,263.4	2,295.7	6,559.1	6,799.0	3,661.0	10,460.0	Pipeline	96	382,896	621,264
62	203	0	203	150.4	0.0	150.4	52.6	0.0	52.6	75.2	0.0	75.2	127.8	0.0	127.8	Concrete Canal	32	1,683	2,406
63	6,459	1,036	7,495	4,357.9	709.4	5,067.3	2,087.8	339.9	2,427.7	2,179.3	354.8	2,534.1	4,266.4	694.5	4,960.9	Pipeline	96	233,059	243,187
64	653	105	758	472.8	76.9	549.7	179.1	29.2	208.3	236.4	38.5	274.9	415.5	67.6	483.1	Pipeline	96	19,997	26,381
65	1,079	73	1,152	950.7	69.1	1,019.8	132.2	0.0	132.2	478.3	30.5	508.8	604.6	38.6	643.2	Pipeline	96	12,691	49,056
66	6,918	1,925	8,843	5,170.4	1,458.3	6,628.7	1,727.1	487.2	2,214.3	2,415.6	681.3	3,096.9	4,029.5	1,136.6	5,166.1	Pipeline	96	212,573	283,373
67	6,670	259	6,929	5,844.6	277.2	6,121.8	807.2	0.0	807.2	2,932.8	122.2	3,055.0	3,719.0	155.0	3,874.0	Pipeline	96	77,491	294,413
合計			443,206			313,150			122,312			142,136			280,214				

2.3 COST ESTIMATION FOR DAM CONSTRUCTION

The cost of dam construction is basically organized and submitted by WRMC and RWC in each province. Considering the instability of budget and the phases of dam projects, the cost of dam construction is reviewed. The relation between the dam height and the project cost of Dams in Phase 3, Phase 4 and Mushampa dam is shown in the following figures. Larger project cost for dam is applied among the one stated by the provinces and estimated value with the linear equation (y = 21153x - 724634) for the dams in Phase 1 and 2 with the minimum cost, 100,000 million Rials.

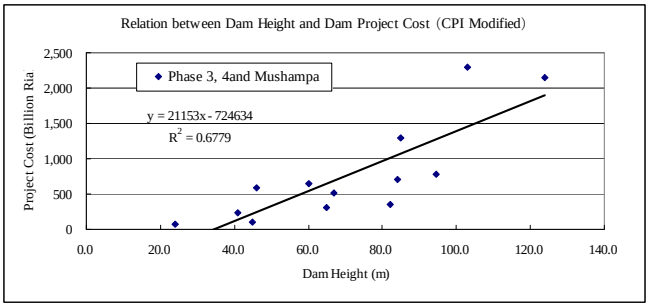

Figure 2.3.1 Relation between Dam Height and Dam Project Cost

Table 2.3.1 Cost Estimation of Development and Improvement Project of Dams

No.	Dams/ Reservoirs	Phase	Province	Beneficial Reach	Purpose	Basin Area (km^2)	Dam Type	Dam Height (m)	Irigation Area (ha)			Project Cost (million Rls.)			Project Cost in 2008 CPI modified (million Rls.)		Pipeline or Concrete	Unit Cost for Irrigation* (million Rls./ha)		Estimated Project Cost** (million Rls.)				Simulation
									Development	Improvement	Total	Dam	Irrigation (Main and Secondary)	Estimated Year	Dam	Irrigation (Main and Secondary)		Development (Main, Secondary and	Improvement (Main, Secondary and	Dam	Irrigation (Development)	Irrigation (Improvement)	Irrigation Total	
1	Manjil	4	Gilan	-	Multi-purpose	56,200	Concrete	86.0	-	-	0	4,500	3,400	1961	-	-	Concrete	40	32	-			-	Present
2	Golblakh	4	Kordestan	44	Irrigation	250	Earth	24.0	800	0	800	17,000	25,000	1998	66,929	84,746	Pipeline	120	96	66,929	96,000	0	96,000	Present
3	Aydughmush	4	East Azarbyjan	11	Irrigation	1,625	Rockfill	67.0	13,700	1,300	15,000	350,000	1,125,000	2005	520,833	1,474,443	Pipeline	120	96	520,833	1,644,000	124,800	1,768,800	Medium Term
4	Sahand	4	East Azarbyjan	60	Irrigation	820	Rockfill	46.0	10,300	600	10,900	400,000	672,000	2005	595,238	880,734	Pipeline	120	96	595,238	1,236,000	57,600	1,293,600	Medium Term
5	Taleghan	4	Tehran	out of basin	Multi-purpose	828	Rockfill	103.0	-	-	0	1,751,000	-	2006	2,294,889	-	Concrete	40	32	2,294,889	-	-	-	Present
6	Taham	4	Zanjan	20	Multi-purpose	161	Earth	118.0	0	400	400	53,393	-	unknown	-	-	Pipeline	120	96	1,771,420	0	38,400	38,400	Medium Term
7	Golabar	3	Zanjan	30	Irrigation	1,131	Rockfill	82.0	7,900	1,400	9,300	302,326	324,000	2007	345,911	370,709	Pipeline	120	96	345,911	948,000	134,400	1,082,400	Medium Term
8	Garmichay	3	East Azarbyjan	6	Irrigation	344	Earth	60.0	2,300	1,200	3,500	570,400	324,000	2007	652,632	370,709	Pipeline	120	96	652,632	276,000	115,200	391,200	Medium Term
9	Kalghan	3	East Azarbyjan	60	Irrigation	203	Earth	65.0	1,500	1,090	2,590	264,500	100,000	2007	302,632	114,416	Pipeline	120	96	302,632	180,000	104,640	284,640	Medium Term
10	Ostor	3	East Azarbyjan	61	Multi-purpose	42,600	Concrete	135.0	6,500	0	6,500	1,434,510	850,000	2007	1,641,316	972,540	Pipeline	120	96	1,641,316	780,000	0	780,000	Medium Term
11	Talvar	3	Zanjan	66	Irrigation	6,441	Rockfill	85.0	29,500	0	29,500	1,136,461	887,000	2007	1,300,299	1,014,874	Pipeline	120	96	1,300,299	3,540,000	0	3,540,000	Medium Term
18	Befrajerd	3	Ardebil	61	Domestic	39	Earth	45.4	0	0	0	100,000	-	2007	-	-	Pipeline	120	96	235,712	0	0	0	Medium Term
12	Siazakh	3	Kordestan	41	Irrigation	1,058	Rockfill	84.0	21,246	754	22,000	615,000	1,390,000	2007	703,661	1,590,389	Pipeline	120	96	703,661	2,549,520	72,384	2,621,904	Medium Term
13	Sange Siah	3	Kordestan	47	Irrigation	255	Earth	41.0	3,400	0	3,400	200,000	200,000	2007	228,833	228,833	Pipeline	120	96	228,833	408,000	0	408,000	Medium Term
14	Sural	3	Kordestan	47	Irrigation	48	Rockfill	45.0	1,008	192	1,200	95,000	68,000	2007	108,696	77,803	Pipeline	120	96	108,696	120,960	18,432	139,392	Medium Term
15	Givi	3	Ardebil	3	Irrigation	600	Earth	79.0	6,300	927	7,227	539,965	528,000	unknown	-	-	Pipeline	120	96	946,453	756,000	88,992	844,992	Medium Term
16	Shafreh Bijar	3	Gilan	-	Domestic	242	Rockfill	94.5	0	0	0	406,783	-	2003	782,274	-	Concrete	40	32	782,274	0	0	0	Medium Term
17	Mushampa	2	Zanjan	17	Multi-purpose	24,860	Earth	124.0	26,000	4,000	30,000	1,639,193	2,600,000	2006	2,148,352	3,407,602	Pipeline	120	96	2,148,352	3,120,000	384,000	3,504,000	Long Term
19	Ramin	2	Zanjan	27	Multi-purpose	67	Rockfill	63.0	0	196	196	160,000	5,000	2007	183,066	5,721	Pipeline	120	96	608,005	0	18,816	18,816	Long Term
20	Babakhan	2	Kordestan	35	Irrigation	924	Rockfill	59.0	5,950	50	6,000	300,000	225,882	2007	343,249	258,446	Pipeline	120	96	523,393	714,000	4,800	718,800	Long Term
21	Sheikh Besharat	2	Kordestan	35	Irrigation	451	Earth	39.0	0	1,500	1,500	213,101	100,000	2007	243,823	114,416	Pipeline	120	96	243,823	0	144,000	144,000	Long Term
22	Alehdare	2	Kordestan	41	Irrigation	96	Rockfill	44.5	0	2,100	2,100	52,000	97,552	2007	59,497	111,616	Pipeline	120	96	216,675	0	201,600	201,600	Long Term
23	Mehtar	2	Zanjan	20	Irrigation	128	Earth	40.0	900	100	1,000	85,000	6,696	2007	97,254	7,661	Pipeline	120	96	121,486	108,000	9,600	117,600	Long Term
24	Ghezel Tapeh	2	Zanjan	20	Irrigation	75	Earth	57.0	450	108	558	52,000	4,000	2007	59,497	4,577	Pipeline	120	96	481,087	54,000	10,368	64,368	Long Term
25	Alan	2	Hamedan	66	Irrigation	67	Earth	33.0	90	310	400	60,000	1,700	2007	68,650	1,945	Pipeline	120	96	100,000	10,800	29,760	40,560	Long Term
26	Sir	1	Kordestan	37	Irrigation	444	Earth	58.0	6,000	0	6,000	122,612	200,000	2007	140,288	228,833	Pipeline	120	96	502,240	720,000	0	720,000	Long Term
27	Zardekamar	1	Kordestan	37	Irrigation	2,075	Earth	40.0	5,000	2,500	7,500	400,000	200,000	2007	457,666	228,833	Pipeline	120	96	457,666	600,000	240,000	840,000	Long Term
28	Hasankhan	1	Kordestan	44	Domestic	2,485	n.a.	n.a.	0	0	0	90,000	-	2007	102,975	-	Pipeline	120	96	#VALUE!	0	0	0	Long Term
29	Mendagh	1	Zanjan	66	Irrigation	33	Earth	40.0	9,000	0	9,000	110,724	263,411	2002	246,053	585,358	Pipeline	120	96	246,053	1,080,000	0	1,080,000	Long Term
30	Songhor	1	Zanjan	30	Irrigation	102	Earth	42.0	900	900	1,800	120,000	90,000	2005	178,571	133,929	Pipeline	120	96	178,571	108,000	86,400	194,400	Long Term
31	Chesb	1	Zanjan	66	Irrigation	135	Earth	45.5	912	270	1,182	100,000	19,290	2005	148,810	28,705	Pipeline	120	96	237,828	109,440	25,920	135,360	Long Term
32	Sangabad	1	Ardebil	3	Irrigation	61	Earth	57.0	1,625	600	2,225	77,153	80,000	2007	88,276	91,533	Pipeline	120	96	481,087	195,000	57,600	252,600	Long Term
33	Niakhoram	1	Ardebil	61	Irrigation	76	Earth	57.0	675	225	900	71,200	22,500	2007	81,465	25,744	Pipeline	120	96	481,087	81,000	21,600	102,600	Long Term
34	Tabrizak	1	Ardebil	3	Irrigation	600	Earth	51.0	450	150	600	26,800	15,000	2007	30,664	17,162	Pipeline	120	96	354,169	54,000	14,400	68,400	Long Term
35	Hashtjin	1	Ardebil	61	Irrigation	49	Earth	38.0	600	150	750	42,000	18,000	2007	48,055	20,595	Pipeline	120	96	100,000	72,000	14,400	86,400	Long Term
36	Burmanak	1	Qazvin	21	Irrigation	282	Earth	n.a.	1,079	1,201	2,280	497,000	80,000	2007	568,650	91,533	Concrete	40	32	#VALUE!	43,160	38,432	81,592	Long Term
37	Almout Weir and Tunnel	1			Irrigation		Concrete	10.0	out of reach	out of reach	out of reach	988,800	332,000	2000	1,131,350	973,607	Pipeline and	-	-	1,131,350	-	-	973,607	Medium Term

Note: * The unit price of piplelines (120 million Rials/ha) is applied for Zanjan, Ardebil, East Azarbayjan and Kordestan (the hill side of the Sefidrud river basin) and the one of concrete canals (40 million Rials/ha) is used in Gilan, Qazvin and Tehran.
* For improvement, the unit price is set at 80% of the one for Development.
** Larger project cost for Dam is applied among the one stated by the provinces and estimated value with the linear equation (y = 21153x - 724634) for the dams in Phase 1 and 2.
** Minimum Project cost is set at 100,000 million Rls.

2.4 COST ESTIMATION FOR DOMESTIC WATER DISTRIBUTION

Structures for domestic water distribution are intake facility, water purification plant, main, secondary and tertiary pipelines, reservoir and pump station.

2.4.1 Development of Domestic Water Distribution

Due to the population and consume amount per capita growth, required water amount for domestic use in the long term is about two times as large as the one at present. Usually, capacity of the domestic water distribution system is designed with development plan estimating the growth of a city where water is carried and the system usually has extra capacity to handle. However, water distribution plans in each province are not clear. Hence following assumption is made for the cost estimation for improvement of domestic water distribution;

- Additional amount of water is produced by the newly installed system.
- The length of the main pipeline is long enough to cover each Reach (assuming the shape of the Reach is a circle, the length of the main pipeline is considered as the diameter of the circle for rural water distribution, and the radius for urban water distribution.)
- The total length of the secondary pipeline is the same with the one of main pipeline.
- Considering the needs of water in the long term, the design capacity of the pump stations and pipelines in the middle term is set at the one in the long term.

1) Unit Cost for Intake and Water Purification Plant

The project cost for intake and water purification plant is estimated as follows;

- Development of Intake and Water Purification Plant: 5,300 million Rials/ MCM

2) Unit Cost for Main Pipeline and Reservoir

The construction cost for main pipeline and reservoirs are estimated as follows;

- Development of Main Pipeline and Reservoir: 55,000 million Rials/ km

3) Unit Cost for Secondary, Tertiary Pipeline and Reservoir

The construction cost for secondary, tertiary pipeline and reservoir is estimated as follows;

- Development of Secondary, Tertiary Pipeline and Reservoir: 20,000 million Rials/ km
  (Based on Secondary pipeline length)

4) Unit Cost for Pump Station

The construction cost for pump station is estimated as follows;

- Development of Pump Station: 2,000 million Rials/ km
  (Based on main and secondary pipeline length)

The result of cost estimation for domestic water distribution is shown in Table 2.4.1 and Table 2.4.2.

Table 2.4.1 Cost Estimation of Domestic Water Distribution in Urban Area

Reach	City	Area (km^2)	New Installation		Ground→Surface		Annual Discharge for Drinking Water ('000 m^3)							Extension from Present to Medium		Extension from Medium to Long		Unit Cost				Medium Term Project Cost (million Rls)					Long Term Project Cost (million Rls)					Medium and Long Project Cost (million Rls)
			Main (km)	Secondary (km)	Medium	Long	Present	Medium	Development Amount (Present to Mid)	Increment Ratio	Long	Development Amount (Mid to	Increment Ratio	Main (km)	Secondary (km)	Main (km)	Secondary (km)	Water Purification Plant and intake (million Rls./MCM)	Pump Station (million Rls./km)	Main (million Rls./km)	Secondary and Tertiary (million	Water Purification Plant and intake	Pump Station	Main	Secondary and Tertiary	Total	Water Purification Plant and intake	Pump Station	Main	Secondary and Tertiary	Total	
3	Givi	670	14.6	14.6			998.2	1279.2	281	1.28	1762.5	483.3	1.77	14.6	14.6	0	0	5,300	2,000	55,000	20,000	1,489	58,400	803,000	292,000	1,154,889	2,561	0	0	0	2,561	1,157,450
11	Mianeh	899	16.92	16.92			13003.3	16606.4	3603.1	1.28	22789.8	6183.4	1.75	16.92	16.92	0	0	5,300	2,000	55,000	20,000	19,096	67,680	930,600	338,400	1,355,776	32,772	0	0	0	32,772	1,388,548
20	Zanjan	2,878	30.27	30.27			55111.4	70170.9	15059.5	1.27	97595	27424.1	1.77	30.27	30.27	0	0	5,300	2,000	55,000	20,000	79,815	121,080	########	605,400	2,471,145	145,348	0	0	0	145,348	2,616,493
53	Rasht	1,086	18.59	18.59			79943.2	100694	20750.6	1.26	133967	33273.6	1.68	18.59	18.59	0	0	5,300	2,000	55,000	20,000	109,978	74,360	########	371,800	1,578,588	176,350	0	0	0	176,350	1,754,938
53	Bandar Anzali	1,086	18.59	18.59			16398.2	20844.3	4446.1	1.27	27945	7100.7	1.7	18.59	18.59	0	0	5,300	2,000	55,000	20,000	23,564	74,360	########	371,800	1,492,174	37,634	0	0	0	37,634	1,529,808
53	Khoman	1,086	18.59	18.59			1250	1587.8	337.8	1.27	2117	529.2	1.69	18.59	18.59	0	0	5,300	2,000	55,000	20,000	1,790	74,360	########	371,800	1,470,400	2,805	0	0	0	2,805	1,473,205
53	Kohoshkebijar	1,086	18.59	18.59	x		786.3	1248.4	462.1	1.59	1664.4	416	2.12	18.59	18.59	0	0	5,300	2,000	55,000	20,000	2,449	74,360	########	371,800	1,471,059	2,205	0	0	0	2,205	1,473,264
53	Lasht Nesha	1,086	18.59	18.59	x		1256.3	1994.7	738.4	1.59	2659.4	664.7	2.12	18.59	18.59	0	0	5,300	2,000	55,000	20,000	3,914	74,360	########	371,800	1,472,524	3,523	0	0	0	3,523	1,476,047
53	Kochesfahan	1,086	18.59	18.59	x		991.8	1574.8	583	1.59	2099.6	524.8	2.12	18.59	18.59	0	0	5,300	2,000	55,000	20,000	3,090	74,360	########	371,800	1,471,700	2,781	0	0	0	2,781	1,474,481
53	Sangar	1,086	18.59	18.59	x		808.7	1284.1	475.4	1.59	1712.1	428	2.12	18.59	18.59	0	0	5,300	2,000	55,000	20,000	2,520	74,360	########	371,800	1,471,130	2,268	0	0	0	2,268	1,473,398
53	Sum of 53		130.13	130.13	x		101435	129228	2596.7		172165	42937		130.13	130.13	0	0	5,300	2,000	55,000	20,000	13,763	520,520	########	2,602,600	########	227,566	0	0	0	227,566	10,521,599
	Considering Shahreh Bijar Dam Development						0	99,418	99418		99,418	0		0	0	0	0	5,300	2,000	55,000	20,000	526,915	520,520	########	2,602,600	########	0	0	0	0	0	10,807,185
55	Lahijan	898	16.91	16.91			8839.9	11236.6	2396.7	1.27	15064.3	3827.7	1.7	16.91	16.91	0	0	5,300	2,000	55,000	20,000	12,703	67,640	930,050	338,200	1,348,593	20,287	0	0	0	20,287	1,368,880
55	Langroud	898	16.91	16.91			9421.8	11976.5	2554.7	1.27	16056.2	4079.7	1.7	16.91	16.91	0	0	5,300	2,000	55,000	20,000	13,540	67,640	930,050	338,200	1,349,430	21,622	0	0	0	21,622	1,371,052
55	Astaneh	898	16.91	16.91			4871.6	6188.3	1316.7	1.27	9488	3299.7	1.95	16.91	16.91	0	0	5,300	2,000	55,000	20,000	6,979	67,640	930,050	338,200	1,342,869	17,488	0	0	0	17,488	1,360,357
55	Kiashahr	898	16.91	16.91			2057.8	2614	556.2	1.27	3485.5	871.5	1.69	16.91	16.91	0	0	5,300	2,000	55,000	20,000	2,948	67,640	930,050	338,200	1,338,838	4,619	0	0	0	4,619	1,343,457
55	Sum of 55																									5,379,730					64,016	5,443,746
57	Siahkol	788	15.84	15.84			1974.6	2508.3	533.7	1.27	3344.2	835.9	1.69	15.84	15.84	0	0	5,300	2,000	55,000	20,000	2,829	63,360	871,200	316,800	1,254,189	4,430	0	0	0	4,430	1,258,619
57	Komleh	788	15.84	15.84	x		666.2	1057.7	391.5	1.59	1410.2	352.5	2.12	15.84	15.84	0	0	5,300	2,000	55,000	20,000	2,075	63,360	871,200	316,800	1,253,435	1,868	0	0	0	1,868	1,255,303
	Sum of 57																									2,507,624					6,298	2,513,922
Taham to Hamedan			112	-	x		0	#N/A	#N/A	-	#N/A	#N/A	-	112	-	0	0	5,300	2,000	55,000	20,000	-	-	-	-	2,740,618	#N/A	0	0	0	#N/A	#N/A
5	Torkamanchai	1,029	1.81	1.81			703.5	897.9	194.4	1.28	1225.4	327.5	1.74	1.81	1.81	0	0	5,300	2,000	55,000	20,000	1,030	7,240	99,550	36,200	144,020	1,736	0	0	0	1,736	145,756
16	Hastjin	12	0.2	0.2			594.3	761.7	167.4	1.28	1049.5	287.8	1.77	0.2	0.2	0	0	5,300	2,000	55,000	20,000	887	800	11,000	4,000	16,687	1,525	0	0	0	1,525	18,212
19	Roudbar	969	1.76	1.76			1386.5	1761.2	374.7	1.27	2552.3	791.1	1.84	1.76	1.76	0	0	5,300	2,000	55,000	20,000	1,986	7,040	96,800	35,200	141,026	4,193	0	0	0	4,193	145,219
21	Manjil	2,476	2.81	2.81			1709.8	2172	462.2	1.27	2895.7	723.7	1.69	2.81	2.81	0	0	5,300	2,000	55,000	20,000	2,450	11,240	154,550	56,200	224,440	3,836	0	0	0	3,836	228,276
21	Lowshan	2,476	2.81	2.81			1609.3	2044.2	434.9	1.27	2725.5	681.3	1.69	2.81	2.81	0	0	5,300	2,000	55,000	20,000	2,305	11,240	154,550	56,200	224,295	3,611	0	0	0	3,611	227,906
21	Roudbar	2,476	2.81	2.81			1386.2	1761.2	375	1.27	2348.1	586.9	1.69	2.81	2.81	0	0	5,300	2,000	55,000	20,000	1,988	11,240	154,550	56,200	223,978	3,111	0	0	0	3,111	227,089
	Sum of 21																									672,713					10,558	683,271
27	Soltanieh	1,290	2.03	2.03			642.5	825.1	182.6	1.28	1150.4	325.3	1.79	2.03	2.03	0	0	5,300	2,000	55,000	20,000	968	8,120	111,650	40,600	161,338	1,724	0	0	0	1,724	163,062
37	Bijar	2,032	2.54	2.54			6335.7	8621.3	2285.6	1.36	13240.9	4619.6	2.09	2.54	2.54	0	0	5,300	2,000	55,000	20,000	12,114	10,160	139,700	50,800	212,774	24,484	0	0	0	24,484	237,258
41	Divandareh	575	1.35	1.35			2392.1	3252.8	860.7	1.36	4968	1715.2	2.08	1.35	1.35	0	0	5,300	2,000	55,000	20,000	4,562	5,400	74,250	27,000	111,212	9,091	0	0	0	9,091	120,303
47	Dehlo'an	2,031	2.54	2.54			1894.3	2576	681.7	1.36	3934.4	1358.4	2.08	2.54	2.54	0	0	5,300	2,000	55,000	20,000	3,613	10,160	139,700	50,800	204,273	7,200	0	0	0	7,200	211,473
48	Ghorveh	942	1.73	1.73			8827.6	12012	3184.4	1.36	18448.3	6436.3	2.09	1.73	1.73	0	0	5,300	2,000	55,000	20,000	16,877	6,920	95,150	34,600	153,547	34,112	0	0	0	34,112	187,659
48	Serish Abad	942	1.73	1.73			895	1217.1	322.1	1.36	1859	641.9	2.08	1.73	1.73	0	0	5,300	2,000	55,000	20,000	1,707	6,920	95,150	34,600	138,377	3,402	0	0	0	3,402	141,779
	Sum of 48																									291,924					37,514	329,438
54	Some Sara	1,208	1.96	1.96			3424.4	4350	925.6	1.27	6669.4	2319.4	1.95	1.96	1.96	0	0	5,300	2,000	55,000	20,000	4,906	7,840	107,800	39,200	159,746	12,293	0	0	0	12,293	172,039
54	Fooman	1,208	1.96	1.96			3650.7	4637.4	986.7	1.27	7110	2472.6	1.95	1.96	1.96	0	0	5,300	2,000	55,000	20,000	5,230	7,840	107,800	39,200	160,070	13,105	0	0	0	13,105	173,175
54	Rezvanshahr	1,208	1.96	1.96		x	1033.8	1313.2	279.4	1.27	2117	803.8	2.05	1.96	1.96	1.96	0	5,300	2,000	55,000	20,000	1,481	7,840	107,800	39,200	156,321	4,260	3,920	107,800	0	115,980	272,301
54	Shaft	1,208	1.96	1.96			586.7	745.2	158.5	1.27	993.7	248.5	1.69	1.96	1.96	0	0	5,300	2,000	55,000	20,000	840	7,840	107,800	39,200	155,680	1,317	0	0	0	1,317	156,997
	Sum of 54																									631,817					142,695	774,512
56	Masal	2,480	2.81	2.81			1829	2323.4	494.4	1.27	3097.6	774.2	1.69	2.81	2.81	0	0	5,300	2,000	55,000	20,000	2,620	11,240	154,550	56,200	224,610	4,103	0	0	0	4,103	228,713
56	Masoleh	2,480	2.81	2.81			77.1	98.1	21	1.27	130.7	32.6	1.7	2.81	2.81	0	0	5,300	2,000	55,000	20,000	111	11,240	154,550	56,200	222,101	173	0	0	0	173	222,274
	Sum of 56																									446,711					4,276	450,987
57	Roudsar	788	1.58	1.58			3984.6	5061.6	1077	1.27	7760.5	2698.9	1.95	1.58	1.58	0	0	5,300	2,000	55,000	20,000	5,708	6,320	86,900	31,600	130,528	14,304	0	0	0	14,304	144,832
57	Amlash	788	1.58	1.58			1661	2110	449	1.27	2813.1	703.1	1.69	1.58	1.58	0	0	5,300	2,000	55,000	20,000	2,380	6,320	86,900	31,600	127,200	3,726	0	0	0	3,726	130,926
	Sum of 57																									257,728					18,030	275,758
59	Khalkhal	643	1.43	1.43		x	4178.9	6124.7	1945.8	1.47	8486.3	2361.6	2.03	1.43	1.43	1.43	0	5,300	2,000	55,000	20,000	10,313	5,720	78,650	28,600	123,283	12,516	2,860	78,650	0	94,026	217,309
60	Hashtroud	2,537	2.84	2.84			2069.4	2641	571.6	1.28	3604.3	963.3	1.74	2.84	2.84	0	0	5,300	2,000	55,000	20,000	3,029	11,360	156,200	56,800	227,389	5,105	0	0	0	5,105	232,494
60	Gharah Aghaj	2,537	2.84	2.84			526.8	672.4	145.6	1.28	917.7	245.3	1.74	2.84	2.84	0	0	5,300	2,000	55,000	20,000	772	11,360	156,200	56,800	225,132	1,300	0	0	0	1,300	226,432
	Sum of 60																									452,521					6,405	458,926
61	Koklar	4,833	3.92	3.92			429.6	550.6	121	1.28	758.8	208.2	1.77	3.92	3.92	0	0	5,300	2,000	55,000	20,000	641	15,680	215,600	78,400	310,321	1,103	0	0	0	1,103	311,424
61	Considering Befrajerd Dam Development						0	0	0		4843	4843		0	0	0	0	5,300	2,000	55,000	20,000	641	15,680	215,600	78,400	310,321	25,668	0	0	0	25,668	335,989
63	Geidar	1,101	1.87	1.87			2192.2	2814.9	622.7	1.28	3924.7	1109.8	1.79	1.87	1.87	0	0	5,300	2,000	55,000	20,000	3,300	7,480	102,850	37,400	151,030	5,882	0	0	0	5,882	156,912

Notes and Assumptions:
1) The cost for tertialy pipelines is included in the one of the secondary pipeline.
2) The main pipeline is newly installed where the water source changes from groundwater to surface water fue to the development.
3) Cost for Transfer project from Talvar dam to Hamedan is based on a article in Tehran Times International 2007/11/25.
4) This table does not include dam construction cost

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Table 2.4.2 Cost Estimation of Domestic Water Distribution in Rural Area

Reach	Area (km^2)	New Installation		Annual Discharge for Drinking Water ('000 m^3)							Extension from Present to Medium		Extension from Medium to Long		Unit Cost				Medium Term					Long Term					Medium and Long
																			Project Cost (million Rls)					Project Cost (million Rls)					
		Main (km)	Secondary (km)	Present	Medium	Development Amount (Present to Mid)	Increment Ratio	Long	Development Amount (Mid to Long)	Increment Ratio	Main (km)	Secondary (km)	Main (km)	Secondary (km)	Water Purification Plant and intake (million Rls./MCM)	Pump Station (million Rls./km)	Main (million Rls./km)	Secondary and Tertiary (million Rls./km)	Water Purification Plant and intake	Pump Station	Main	Secondary and Tertiary	Total	Water Purification Plant and intake	Pump Station	Main	Secondary and Tertiary	Total	Project Cost (million Rls)
1	224	16.9	16.9	233.5	343.2	109.7	1.47	507.8	164.6	2.17	6.76	6.76	10.14	10.14	5,300	2,000	55,000	20,000	581	27,040	371,800	135,200	534,621	872	40,560	557,700	202,800	801,932	1,336,553
2	426	23.3	23.3	706.1	1039.4	333.3	1.47	1539.3	499.9	2.18	9.32	9.32	13.98	13.98	5,300	2,000	55,000	20,000	1,766	37,280	512,600	186,400	738,046	2,649	55,920	768,900	279,600	########	1,845,115
3	670	29.2	29.2	698.4	1026.6	328.2	1.47	1519	492.4	2.17	11.68	11.68	17.52	17.52	5,300	2,000	55,000	20,000	1,739	46,720	642,400	233,600	924,459	2,610	70,080	963,600	350,400	########	2,311,149
4	1,011	35.9	35.9	1677.8	2469.8	792	1.47	3657.6	1187.8	2.18	14.36	14.36	21.54	21.54	5,300	2,000	55,000	20,000	4,198	57,440	789,800	287,200	########	6,295	86,160	########	430,800	########	2,846,593
5	1,029	36.2	36.2	1706.9	2512.6	805.7	1.47	3720.9	1208.3	2.18	14.48	14.48	21.72	21.72	5,300	2,000	55,000	20,000	4,270	57,920	796,400	289,600	########	6,404	86,880	########	434,400	########	2,870,474
6	437	23.6	23.6	725.1	1067.3	342.2	1.47	1580.6	513.3	2.18	9.44	9.44	14.16	14.16	5,300	2,000	55,000	20,000	1,814	37,760	519,200	188,800	747,574	2,720	56,640	778,800	283,200	########	1,868,934
7	51	8.1	8.1	53.1	78.1	25	1.47	115.5	37.4	2.18	3.25	3.25	4.85	4.85	5,300	2,000	55,000	20,000	133	13,000	178,750	65,000	256,883	198	19,400	266,750	97,000	383,348	640,231
8	209	16.3	16.3	346.6	510.1	163.5	1.47	755.5	245.4	2.18	6.52	6.52	9.78	9.78	5,300	2,000	55,000	20,000	867	26,080	358,600	130,400	515,947	1,301	39,120	537,900	195,600	773,921	1,289,868
9	106	11.6	11.6	175.1	257.8	82.7	1.47	381.8	124	2.18	4.64	4.64	6.96	6.96	5,300	2,000	55,000	20,000	438	18,560	255,200	92,800	366,998	657	27,840	382,800	139,200	550,497	917,495
10	794	31.8	31.8	1317.2	1938.9	621.7	1.47	2871.4	932.5	2.18	12.72	12.72	19.08	19.08	5,300	2,000	55,000	20,000	3,295	50,880	699,600	254,400	########	4,942	76,320	########	381,600	########	2,520,437
11	899	33.8	33.8	1490.4	2193.9	703.5	1.47	3249.1	1055.2	2.18	13.52	13.52	20.28	20.28	5,300	2,000	55,000	20,000	3,729	54,080	743,600	270,400	########	5,593	81,120	########	405,600	########	2,679,522
12	77	9.9	9.9	80.5	118.4	37.9	1.47	175.1	56.7	2.18	3.97	3.97	5.93	5.93	5,300	2,000	55,000	20,000	201	15,880	218,350	79,400	313,831	301	23,720	326,150	118,600	468,771	782,602
13	170	14.7	14.7	177.5	260.9	83.4	1.47	386	125.1	2.17	5.88	5.88	8.82	8.82	5,300	2,000	55,000	20,000	442	23,520	323,400	117,600	464,962	663	35,280	485,100	176,400	697,443	1,162,405
14	14	4.2	4.2	15	22	7	1.47	32.5	10.5	2.17	1.68	1.68	2.52	2.52	5,300	2,000	55,000	20,000	37	6,720	92,400	33,600	132,757	56	10,080	138,600	50,400	199,136	331,893
15	6	2.8	2.8	6	8.7	2.7	1.45	12.9	4.2	2.15	1.1	1.1	1.7	1.7	5,300	2,000	55,000	20,000	14	4,400	60,500	22,000	86,914	22	6,800	93,500	34,000	134,322	221,236
16	12	3.9	3.9	12.8	18.7	5.9	1.46	27.7	9	2.16	1.54	1.54	2.36	2.36	5,300	2,000	55,000	20,000	31	6,160	84,700	30,800	121,691	48	9,440	129,800	47,200	186,488	308,179
17	3,442	66.2	66.2	5709.3	8404.3	2695	1.47	12446.1	4041.8	2.18	26.48	26.48	39.72	39.72	5,300	2,000	55,000	20,000	14,284	105,920	########	529,600	########	21,422	158,880	########	794,400	########	5,265,506
18	1,629	45.5	45.5	2701.5	3976.7	1275.2	1.47	5889.3	1912.6	2.18	18.2	18.2	27.3	27.3	5,300	2,000	55,000	20,000	6,759	72,800	########	364,000	########	10,137	109,200	########	546,000	########	3,611,396
19	969	35.1	35.1	13532.5	17996.9	4464.4	1.33	24693.5	6696.6	1.82	14.04	14.04	21.06	21.06	5,300	2,000	55,000	20,000	23,661	56,160	772,200	280,800	########	35,492	84,240	########	421,200	########	2,832,053
20	2,878	60.5	60.5	6023.3	8903.6	2880.3	1.48	13223.6	4320	2.2	24.2	24.2	36.3	36.3	5,300	2,000	55,000	20,000	15,266	96,800	########	484,000	########	22,896	145,200	########	726,000	########	4,817,662
21	2,476	56.1	56.1	2066.4	2855.2	788.8	1.38	4038.2	1183	1.95	22.44	22.44	33.66	33.66	5,300	2,000	55,000	20,000	4,181	89,760	########	448,800	########	6,270	134,640	########	673,200	########	4,442,351
22	602	27.7	27.7	1260.7	1863.6	602.9	1.48	2767.8	904.2	2.2	11.08	11.08	16.62	16.62	5,300	2,000	55,000	20,000	3,195	44,320	609,400	221,600	878,515	4,792	66,480	914,100	332,400	########	2,196,287
23	437	23.6	23.6	6102	8115.1	2013.1	1.33	11134.7	3019.6	1.82	9.44	9.44	14.16	14.16	5,300	2,000	55,000	20,000	10,669	37,760	519,200	188,800	756,429	16,004	56,640	778,800	283,200	########	1,891,073
24	161	14.3	14.3	337.9	499.4	161.5	1.48	741.8	242.4	2.2	5.72	5.72	8.58	8.58	5,300	2,000	55,000	20,000	856	22,880	314,600	114,400	452,736	1,285	34,320	471,900	171,600	679,105	1,131,841
25	3,909	70.5	70.5	3262.5	4507.9	1245.4	1.38	6375.7	1867.8	1.95	28.2	28.2	42.3	42.3	5,300	2,000	55,000	20,000	6,601	112,800	########	564,000	########	9,899	169,200	########	846,000	########	5,586,000
26	2,483	56.2	56.2	5197.6	7683	2485.4	1.48	11410.9	3727.9	2.2	22.48	22.48	33.72	33.72	5,300	2,000	55,000	20,000	13,173	89,920	########	449,600	########	19,758	134,880	########	674,400	########	4,472,731
27	1,290	40.5	40.5	2700.7	3992.1	1291.4	1.48	5929.1	1937	2.2	16.2	16.2	24.3	24.3	5,300	2,000	55,000	20,000	6,844	64,800	891,000	324,000	########	10,266	97,200	########	486,000	########	3,216,610
28	73	9.6	9.6	151.7	224.2	72.5	1.48	333	108.8	2.2	3.84	3.84	5.76	5.76	5,300	2,000	55,000	20,000	384	15,360	211,200	76,800	303,744	577	23,040	316,800	115,200	455,617	759,361
29	96	11.1	11.1	201.2	297.4	96.2	1.48	441.7	144.3	2.2	4.44	4.44	6.66	6.66	5,300	2,000	55,000	20,000	510	17,760	244,200	88,800	351,270	765	26,640	366,300	133,200	526,905	878,175
30	1,199	39.1	39.1	2509.2	3709	1199.8	1.48	5508.6	1799.6	2.2	15.64	15.64	23.46	23.46	5,300	2,000	55,000	20,000	6,359	62,560	860,200	312,800	########	9,538	93,840	########	469,200	########	3,104,797
31	127	12.7	12.7	266.6	394.1	127.5	1.48	585.4	191.3	2.2	5.08	5.08	7.62	7.62	5,300	2,000	55,000	20,000	676	20,320	279,400	101,600	401,996	1,014	30,480	419,100	152,400	602,994	1,004,990
32	287	19.1	19.1	239.7	331.2	91.5	1.38	468.5	137.3	1.95	7.64	7.64	11.46	11.46	5,300	2,000	55,000	20,000	485	30,560	420,200	152,800	604,045	728	45,840	630,300	229,200	906,068	1,510,113
33	62	8.9	8.9	128.8	190.4	61.6	1.48	282.8	92.4	2.2	3.56	3.56	5.34	5.34	5,300	2,000	55,000	20,000	326	14,240	195,800	71,200	281,566	490	21,360	293,700	106,800	422,350	703,916
34	451	24	24	730.2	1142.8	412.6	1.57	1761.7	618.9	2.41	9.6	9.6	14.4	14.4	5,300	2,000	55,000	20,000	2,187	38,400	528,000	192,000	760,587	3,280	57,600	792,000	288,000	########	1,901,467
35	442	23.7	23.7	715.3	1119.4	404.1	1.56	1725.5	606.1	2.41	9.48	9.48	14.22	14.22	5,300	2,000	55,000	20,000	2,142	37,920	521,400	189,600	751,062	3,212	56,880	782,100	284,400	########	1,877,654
36	943	34.7	34.7	786.8	1087.2	300.4	1.38	1537.6	450.4	1.95	13.88	13.88	20.82	20.82	5,300	2,000	55,000	20,000	1,592	55,520	763,400	277,600	########	2,387	83,280	########	416,400	########	2,745,279
37	2,032	50.9	50.9	3290	5148.6	1858.6	1.56	7936.9	2788.3	2.41	20.36	20.36	30.54	30.54	5,300	2,000	55,000	20,000	9,851	81,440	########	407,200	########	14,778	122,160	########	610,800	########	4,045,729
38	143	13.5	13.5	298.6	441.5	142.9	1.48	655.7	214.2	2.2	5.4	5.4	8.1	8.1	5,300	2,000	55,000	20,000	757	21,600	297,000	108,000	427,357	1,135	32,400	445,500	162,000	641,035	1,068,392
39	31	6.3	6.3	64.4	95.2	30.8	1.48	141.4	46.2	2.2	2.52	2.52	3.78	3.78	5,300	2,000	55,000	20,000	163	10,080	138,600	50,400	199,243	245	15,120	207,900	75,600	298,865	498,108
40	1,056	36.7	36.7	1709.9	2675.9	966	1.56	4125	1449.1	2.41	14.68	14.68	22.02	22.02	5,300	2,000	55,000	20,000	5,120	58,720	807,400	293,600	########	7,680	88,080	########	440,400	########	2,912,100
41	575	27.1	27.1	931.8	1458.3	526.5	1.57	2248	789.7	2.41	10.84	10.84	16.26	16.26	5,300	2,000	55,000	20,000	2,790	43,360	596,200	216,800	859,150	4,185	65,040	894,300	325,200	########	2,147,875
42	865	33.2	33.2	1401.2	2192.8	791.6	1.56	3380.3	1187.5	2.41	13.28	13.28	19.92	19.92	5,300	2,000	55,000	20,000	4,195	53,120	730,400	265,600	########	6,294	79,680	########	398,400	########	2,633,289
43	252	17.9	17.9	407.7	638	230.3	1.56	983.5	345.5	2.41	7.16	7.16	10.74	10.74	5,300	2,000	55,000	20,000	1,221	28,640	393,800	143,200	566,861	1,831	42,960	590,700	214,800	850,291	1,417,152
44	1,749	47.2	47.2	2833.1	4433.7	1600.6	1.56	6834.7	2401	2.41	18.88	18.88	28.32	28.32	5,300	2,000	55,000	20,000	8,483	75,520	########	377,600	########	12,725	113,280	########	566,400	########	3,750,008
44	Considering Hasankhan Dam Development							33,259	28,825						5,300				8,483	75,520	########	377,600	########	152,774	113,280	########	566,400	########	4,640,059
45	274	18.7	18.7	573.6	847.9	274.3	1.48	1259.3	411.4	2.2	7.48	7.48	11.22	11.22	5,300	2,000	55,000	20,000	1,454	29,920	411,400	149,600	592,374	2,180	44,880	617,100	224,400	888,560	1,480,934
46	99	11.2	11.2	160.5	251.2	90.7	1.57	387.3	136.1	2.41	4.48	4.48	6.72	6.72	5,300	2,000	55,000	20,000	481	17,920	246,400	89,600	354,401	721	26,880	369,600	134,400	531,601	886,002
47	2,031	50.9	50.9	3289.1	5147.2	1858.1	1.56	7934.7	2787.5	2.41	20.36	20.36	30.54	30.54	5,300	2,000	55,000	20,000	9,848	81,440	########	407,200	########	14,774	122,160	########	610,800	########	4,045,722
48	942	34.6	34.6	1525.2	2386.9	861.7	1.56	3679.5	1292.6	2.41	13.84	13.84	20.76	20.76	5,300	2,000	55,000	20,000	4,567	55,360	761,200	276,800	########	6,851	83,040	########	415,200	########	2,744,818
49	79	10	10	4026.2	6340	2313.8	1.57	9809.2	3469.2	2.44	4	4	6	6	5,300	2,000	55,000	20,000	12,263	16,000	220,000	80,000	328,263	18,387	24,000	330,000	120,000	492,387	820,650
50	172	14.8	14.8	278.2	435.4	157.2	1.57	671.2	235.8	2.41	5.92	5.92	8.88	8.88	5,300	2,000	55,000	20,000	833	23,680	325,600	118,400	468,513	1,250	35,520	488,400	177,600	702,770	1,171,283
51	49	7.9	7.9	79	123.6	44.6	1.56	190.6	67	2.41	3.16	3.16	4.74	4.74	5,300	2,000	55,000	20,000	236	12,640	173,800	63,200	249,876	355	18,960	260,700	94,800	374,815	624,691
52	248	17.8	17.8	400.8	627.2	226.4	1.56	966.9	339.7	2.41	7.12	7.12	10.68	10.68	5,300	2,000	55,000	20,000	1,200	28,480	391,600	142,400	563,680	1,800	42,720	587,400	213,600	845,520	1,409,200
53	1,086	37.2	37.2	15172.4	20177.8	5005.4	1.33	27685.9	7508.1	1.82	14.88	14.88	22.32	22.32	5,300	2,000	55,000	20,000	26,529	59,520	818,400	297,600	########	39,793	89,280	########	446,400	########	3,005,122
54	1,208	39.2	39.2	16878.5	22446.8	5568.3	1.33	30799.1	8352.3	1.82	15.68	15.68	23.52	23.52	5,300	2,000	55,000	20,000	29,512	62,720	862,400	313,600	########	44,267	94,080	########	470,400	########	3,170,579
55	898	33.8	33.8	12543.6	16681.7	4138.1	1.33	22888.9	6207.2	1.82	13.52	13.52	20.28	20.28	5,300	2,000	55,000	20,000	21,932	54,080	743,600	270,400	########	32,898	81,120	########	405,600	########	2,725,030
56	2,480	56.2	56.2	34639.8	46067.5	11427.7	1.33	63209	17141.5	1.82	22.48	22.48	33.72	33.72	5,300	2,000	55,000	20,000	60,567	89,920	########	449,600	########	90,850	134,880	########	674,400	########	4,591,217
57	788	31.7	31.7	11009.3	14641.3	3632	1.33	20089.2	5447.9	1.82	12.68	12.68	19.02	19.02	5,300	2,000	55,000	20,000	19,250	50,720	697,400	253,600	########	28,874	76,080	########	380,400	########	2,552,424
59	643	28.6	28.6	670.6	985.8	315.2	1.47	1458.5	472.7	2.17	11.44	11.44	17.16	17.16	5,300	2,000	55,000	20,000	1,671	45,760	629,200	228,800	905,431	2,505	68,640	943,800	343,200	########	2,263,576
60	2,537	56.8	56.8	4208.6	6195.3	1986.7	1.47	9174.7	2979.4	2.18	22.72	22.72	34.08	34.08	5,300	2,000	55,000	20,000	10,530	90,880	########	454,400	########	15,791	136,320	########	681,600	########	4,513,521
61	4,833	78.4	78.4	5038.8	7406.7	2367.9	1.47	10958.6	3551.9	2.17	31.36	31.36	47.04	47.04	5,300	2,000	55,000	20,000	12,550	125,440	########	627,200	########	18,825	188,160	########	940,800	########	6,224,975
62	227	17	17	3166.6	4211.3	1044.7	1.33	5778.3	1567	1.82	6.8	6.8	10.2	10.2	5,300	2,000	55,000	20,000	5,537	27,200	374,000	136,000	542,737	8,305	40,800	561,000	204,000	814,105	1,356,842
63	1,101	37.4	37.4	2303.8	3405.4	1101.6	1.48	5057.8	1652.4	2.2	14.96	14.96	22.44	22.44	5,300	2,000	55,000	20,000	5,838	59,840	822,800	299,200	########	8,758	89,760	########	448,800	########	2,969,196
64	925	34.3	34.3	1498.1	2344.4	846.3	1.56	3614	1269.6	2.41	13.72	13.72	20.58	20.58	5,300	2,000	55,000	20,000	4,485	54,880	754,600	274,400	########	6,729	82,320	########	411,600	########	2,720,914
65	446	23.8	23.8	722.1	1130.1	408	1.57	1742.1	612	2.41	9.52	9.52	14.28	14.28	5,300	2,000	55,000	20,000	2,162	38,080	523,600	190,400	754,242	3,244	57,120	785,400	285,600	########	1,885,606
66	5,752	85.6	85.6	12040.3	17797.8	5757.5	1.48	26433.4	8635.6	2.2	34.24	34.24	51.36	51.36	5,300	2,000	55,000	20,000	30,515	136,960	########	684,800	########	45,769	205,440	########	1,027,200	########	6,838,684
67	730	30.5	30.5	1181.6	1849.1	667.5	1.56	2850.5	1001.4	2.41	12.2	12.2	18.3	18.3	5,300	2,000	55,000	20,000	3,538	48,800	671,000	244,000	967,338	5,307	73,200	########	366,000	########	2,418,345

2.4.2 Operation and Maintenance Cost

Annual operation and maintenance cost is assumed at 1% of project cost. In addition, Pumps are replaced in every 15 years at 70% of initial installation cost.

CHAPTER 3. PROJECT EVALUATION

3.1 METHODOLOGY OF ECONOMIC EVALUATION

Economic evaluation is to be made by the following steps in this kind of project.

(i) To identify the economic benefit.

(ii) To estimate basic unit value per unit for each benefit item.

(iii) To estimate annual average economic benefit under the "With-" and "Without-Project" concept.

(iv) To identify the economic benefit as differences in "With-" and "Without-Project" conditions.

(v) To identify economic cost converted from the financial cost for the project.

(vi) To compare the economic benefit with the economic cost of project, and evaluate the project feasibility or viability by means of some indices as the economic internal rate of return (EIRR), the net present value (B – C), and B/C Ratio.

Main purpose of this study is not to propose a certain structures, but evaluates the appropriateness's of water distribution coming from dam projects being under study or under plan by Iran side. Hence, the economic indices in each target zone and in each target province should be cleared as a result of suitable water distribution from dams and surface water. Study Team evaluates the suitability of water distribution planned by Iran side.

Accordingly, it means that the resulted indices are the higher, the better results comes from water distribution planned by the Government of Iran to the target zones or Provinces.

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

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

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

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

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

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

It means that the resulted EIRR (%) are the higher, the better results come from water distribution plan to the target zones or Provinces.

Generally, the economic cost of a project is identified as opportunity cost of capital. In this case, if goods and services would be invested in the project under study, they could no longer be utilized for other projects. This implies that the benefits of the other projects could have been created would be sacrificed. These sacrificed benefits of the other projects are called opportunity cost of the project. The applied discount rate is generally considered as the same rate of the said opportunity cost of capital. Therefore, in a case that resulted EIRR is to be higher than the applied discount rate, it means that the economic reliability of the project is higher than a rate of opportunity cost of capital as the sacrificed benefit of the other project.

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

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

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

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

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

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

Projected lives are assumed at 50 years after completion of the dams. It is assumed that farm land development works including improvement from traditional irrigation area to the modern irrigation area will be started at the same time of completion of dams and end at the time of total area of farm lands under the surface water and/or groundwater, and under the dams. Accordingly, the economic benefit will be increasing by target area of farm lands. After that to the end of project life, the same amount of economic benefit will be continued. Cash flow of the economic benefit and economic cost is started at the first year of construction works of dams and by the end of each project life.

Furthermore, annual operation and maintenance cost (O&M Cost) including replacement cost , if any, should also be taken into account for both the dams and farm lands.

3.2 ECONOMIC EVALUATION BY ZONE

3.2.1 Identification of Economic Benefit

1) Identification of Agricultural Benefit

a) Identification of Farm Gate Prices of Crops

As mentioned in Chapter 6 in the main report, irrigation efficiency is estimated at 33 % in average in the target provinces at present. It is recommended that this irrigation efficiency is to be improved by 40 % by the Mid-Term Target year of 2016, and by 50 % by the Long Term Target Year of 2031

The improvement consists of (1) improving the traditional irrigation systems to modern irrigation systems and (2) developing the agricultural fallow area to farm land with modern irrigation systems. In this case, improvement of rain-fed to modern irrigation systems is included in developing the agricultural fallow area to farm land with modern irrigation systems.

By means of the said improvement, productivity of the farm land may be improved, and this is an important item of economic benefit in the Project.

The economic benefit is to be estimated by means of difference of productivity in case of "With-Project" and "Without-Project". Accordingly, the productivity in case of modern irrigation farm land and rain-fed irrigation farm land under the current situation is to be clarified at first. These productivities are the existing productivities, namely the economic benefit without the Project.

In actual farm lands, various crops are cultivated. Here in this study, "wheat", "barley", "paddy", "Pulses", "Alfalfa", "Others (representing Potatoes)", "Orchard (representing as Apples)" are assumed as represented crops as in sub-clause of 3.10 "Agriculture, Soil and Irrigation" in Chapter 3. And the economic benefit is estimated

based on the productivity in case of modern irrigation farm land and rain-fed irrigation farm land for these crops. According to the Agricultural Statistics, these productivities in 2005 are as shown in the following table.

Table 3.2.1 Cultivated Area, Production and Unit Yield of Main Agricultural Crops by Type of Farm Land by Target Province

Province	Current Cultivated (Hectares)			Production(Ton)			Unit Yield (kg/ha)		
	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Average in Both Area
East Azarbaijan	101,071	341,825	442,896	361,877	379,908	741,785	3,580	1,111	1,675
Ardebil	82,975	281,016	363,991	340,414	272,672	613,086	4,103	970	1,684
Tehran	65,255	1,276	66,531	317,960	927	318,887	4,873	726	4,793
Zanjan	26,259	277,351	303,610	94,005	272,913	366,918	3,580	984	1,209
Qazvin	72,085	94,070	166,155	299,611	54,007	353,618	4,156	574	2,128
Kordestan	37,915	486,486	524,401	153,931	476,643	630,574	4,060	980	1,202
Gilan	80	13,851	13,931	199	14,275	14,474	2,488	1,031	1,039
Hamadan	101,975	338,632	440,607	354,858	301,496	656,354	3,480	890	1,490
Total/Average	487,615	1,834,507	2,322,122	1,922,855	1,772,841	3,695,696	3,943	966	1,592
East Azerbaijan	21,287	58,598	79,885	61,708	54,648	116,356	2,899	933	1,457
Ardebil	22,766	72,550	95,316	65,736	66,533	132,269	2,887	917	1,388
Tehran	40,905	0	40,905	150,781	0	150,781	3,686	0	3,686
Zanjan	12,118	37,660	49,778	33,631	27,220	60,851	2,775	723	1,222
Qazvin	15,224	10,769	25,993	53,210	6,098	59,308	3,495	566	2,282
Kordestan	5,585	28,289	33,874	16,826	28,827	45,653	3,013	1,019	1,348
Gilan	34	6,432	6,466	92	7,093	7,185	2,706	1,103	1,111
Hamadan	36,796	29,719	66,515	119,984	30,106	150,090	3,261	1,013	2,256
Total/Average	154,715	244,017	398,732	501,968	220,525	722,493	3,244	904	1,812
East Azerbaijan	2,082	0	2,082	8,343	0	8,343	4,007	0	4,007
Ardebil	2,067	0	2,067	3,813	0	3,813	1,845	0	1,845
Tehran	0	0	0	0	0	0	0	0	0
Zanjan	3,625	0	3,625	11,485	0	11,485	3,168	0	3,168
Qazvin	3,495	0	3,495	12,394	0	12,394	3,546	0	3,546
Kordestan	30	0	30	87	0	87	2,900	0	2,900
Gilan	199,057	0	199,057	762,914	0	762,914	3,833	0	3,833
Hamadan	0	0	0	0	0	0	0	0	0
Total/Average	210,356	0	210,356	799,036	0	799,036	3,798	0	3,798
East Azerbaijan	4,651	30,196	34,847	8,065	15,579	23,644	1,734	516	679
Ardebil	3,047	65,487	68,534	2,473	33,345	35,818	812	509	523
Tehran	507	240	747	623	62	685	1,229	258	917
Zanjan	8,291	13,516	21,807	17,993	4,998	22,991	2,170	370	1,054
Qazvin	1,109	20,549	21,658	1,453	6,542	7,995	1,310	318	369
Kordestan	827	2,122	2,949	764	720	1,484	924	339	503
Gilan	1,469	6,868	8,337	1,682	6,922	8,604	1,145	1,008	1,032
Hamadan	586	5,786	6,372	1,369	2,368	3,737	2,336	409	586
Total/Average	20,487	144,764	165,251	34,422	70,536	104,958	1,680	487	635
East Azerbaijan	70,665	20,476	91,141	585,415	44,150	629,565	8,284	2,156	6,908
Ardebil	34,530	14,972	49,502	192,978	32,366	225,344	5,589	2,162	4,552
Tehran	12,080	0	12,080	153,664	0	153,664	12,721	0	12,721
Zanjan	37,194	5,966	43,160	172,104	12,301	184,405	4,627	2,062	4,273
Qazvin	20,723	0	20,723	165,583	0	165,583	7,990	0	7,990
Kordestan	27,832	28	27,860	193,898	71	193,969	6,967	2,536	6,962
Gilan	59	16	75	256	110	366	4,339	6,875	4,880
Hamadan	41,708	389	42,097	477,020	610	477,630	11,437	1,568	11,346
Total/Average	244,791	41,847	286,638	1,940,918	89,608	2,030,526	7,929	2,141	7,084
East Azerbaijan	10,003	0	10,003	300,700	0	300,700	30,061	0	30,061
Ardebil	25,503	0	25,503	732,076	0	732,076	28,705	0	28,705
Tehran	2,593	0	2,593	47,568	0	47,568	18,345	0	18,345
Zanjan	6,917	0	6,917	152,216	0	152,216	22,006	0	22,006
Qazvin	3,877	0	3,877	88,304	0	88,304	22,776	0	22,776
Kordestan	10,351	0	10,351	271,947	0	271,947	26,273	0	26,273
Gilan	164	405	569	1,519	1,776	3,295	9,262	4,385	5,791
Hamadan	26,517	0	26,517	966,017	0	966,017	36,430	0	36,430
Total/Average	85,925	405	86,330	2,560,347	1,776	2,562,123	29,797	4,385	29,678
Average in Whole Iran	161,908	954	162,862	2,651,986	9,915	2,661,901	16,380	10,393	16,345

The economic evaluation is to be made based on difference of productivity in case of "With-Project" and "Without-Project" in monetary terms as mentioned above. For this purpose, the unit yield of the crops as indicated in the above table should be converted into monetary terms. Incidentally, invested amounts of costs for crop production are different between "Irrigated Farm Land" and "Rain-fed Farm Land" even for the same crops. Accordingly, investment cost (= production cost) and farm gate price both per unit area of farm land should be clarified for making clear the amount of the net production (= the economic benefit) that is resulted from gross amount of unit farm gate price deducting the investment cost.

Unfortunately, there are no data of investment cost and farm gate price both per unit area by the target provinces in the said agricultural statistics, but there are data in average of them of whole Iran. Assuming that there is no any significant difference between whole of Iran and the target provinces, they are applied for the e3conomic evaluation.

Table 3.2.2 Unit Production Cost and Farm Gate Price by Crops in Average of Whole Iran

Crops	Unit Production Cost in Total in Whole Iran (Rials/ha)			Average Unit Yield in Target Province (kg/ha)		Unit Production Cost (Rials/kg)		Farm Gate Price (Rials/kg)		Farm Gate Price (Rials/ha)	
	Irrigated Area	Rain-fed Area	Total	Irrigated Area	Rain-fed Area	Irrigated Area	Rain-fed Area	Irrigated Area	Rain-fed Area	Irrigated Area	Rain-fed Area
Wheat	3,990,920	1,133,860	5,124,780	3,943	966	1,012	1,173	1,112	1,075	4,385,047	1,038,864
Barley	3,324,820	1,148,560	4,473,380	3,244	904	1,025	1,271	1,052	1,271	3,413,181	1,148,638
Paddy	11,643,870	0	11,643,870	4,111	0	2,832	0	2,919	–	12,000,390	0
Pulses	3,690,510	1,383,790	5,074,300	1,680	487	2,196	2,840	3,700	2,329	6,216,694	1,134,557
Alfalfa	1,500,000	1,000,000	2,500,000	7,929	2,141	189	467	2,000	–	15,857,756	4,282,649
Others	16,992,830	5,664,277	22,657,107	29,797	4,385	570	1,292	890	–	26,514,776	3,902,084
Orchard	14,758,500	9,839,000	24,597,500	16,380	10,393	901	946	2,108	–	34,522,025	21,904,719

By the way, producers' price indexes have been fluctuated as shown in the following table.

Table 3.2.3 Producers Price Index in Average of Whole Iran

(1997 = 100)

Major Group	2002	2003	2004	2005	2006
Agriculture, animal husbandry and forestry	219	253	299	311	353
Fishing	261	273	334	385	404
Mineral products	151	158	171	199	268
Manufacturing products	196	216	248	271	303
Electricity, gas and water supply	226	267	315	318	318
Repair of motor vehicles	201	236	280	324	377
Hotels and restaurants	247	290	336	378	426
Transport, storage and communications	223	267	305	342	376
Financial intermediation	370	598	801	849	846
Real estate, renting and business activities	234	279	332	381	441
Education	276	334	410	494	605
Health and social work	251	296	351	422	498
Other community, social and personal activities	242	303	358	405	454

Statistic Yearbook of Iran, SCI.

Among the indexes indicated in the above table, the indexes for "Agriculture, animal husbandry and forestry" are to be applied for agricultural crops. The Table hereunder shows the average producers' prices (investment cost of farmers) and unit farm gate prices by crops estimated for 2008 in whole Iran from the figures shown in Table 3.2.2 by means of extrapolation based on the indexes shown in Table 3.2.3.

Table 3.2.4 Average Producers' Prices by Crops Estimated for 2008 in Whole Iran

Crops	Unit Production Cost in Total in Whole Iran (Rials/ha)			Unit Farm Gate Price (Rials/ha)		Net Unit Farm Gate Price (Rials/ha)	
	Irrigated Area	Rainfed Area	Total	Irrigated Area	Rainfed Area	Irrigated Area	Rainfed Area
Wheat	6,332,738	1,799,194	8,131,931	6,958,133	1,648,456	625,396	-150,738
Barley	5,275,779	1,822,519	7,098,299	5,415,990	1,822,644	140,210	124
Paddy	18,476,335	0	18,476,335	19,042,057	0	565,721	0
Pulses	5,856,051	2,195,779	8,051,831	9,864,565	1,800,300	4,008,514	-395,479
Alfalfa	2,380,180	2,517,891	4,898,071	25,162,873	6,795,649	22,782,693	4,277,758
Others	26,963,993	14,262,033	41,226,025	42,073,287	6,191,774	15,109,295	-8,070,259
Orchard	n.a	n.a	n.a	54,779,081	34,758,111	26,121,421	-8,259,093

Among the figures indicated in the before mentioned Table, all the farm gate prices in "Net Unit Farm Gate Price" are positive in "Irrigated Farm Land", but some figures of the crops in "Rain-fed Farm Land" are "negative" as shown in the before mentioned Table. This means that some of crops are to be sold to market from the farm gate for less than the production cost because of high production cost, nevertheless the all the farm gate prices in "Unit Farm Gate Price" in "Rain-fed Farm Land" are lower than those in "Irrigated Farm Land". It means that all the crops may be profitable in case of improving the rain-fed farm land to irrigated farm land. This means that an economic benefit in the case of improving the rain-fed farm land to irrigated farm land.

And, all the figures in "Net Unit Farm Gate Price" in "Irrigated Farm Land" are to be linking with the agricultural income for farmers in case of developing lands which have produced no any crops until now as the new irrigated farm lands, so that this means the other economic benefit in case of newly developed irrigated farm lands.

About "Net Unit Farm Gate Price" of Orchard, there is no any data on "Unit Production Cost in Total in Whole Iran". So that, the average share rate of unit production cost against farm gate price for other crops except paddy is applied.

b) Effect of Irrigation System Improvement

In the case of this Project, there are 2 components as irrigation improvement effects. The first one is to evaluate the effect of improvement of an agricultural productivity derived from the irrigation improvement for farm lands under control of surface water and groundwater. The other is to evaluate the effect of agricultural production to be newly developed by using water from dams, the effect of improvement of an agricultural productivity derived from the irrigation improvement for current farm lands using water from the same dams. The latter ones are to be as one component because that those are the effects of agricultural production derived from the same dams.

The former one is expected from improvement of farm lands from traditional irrigation systems to modern irrigation systems, and the latter one is expected to generate new agricultural production from rain-fed area or fallow area (because of lack of water) due to be developed as new modern irrigation farm lands.

i) Effects of Irrigation System Improvement of Farm Lands under Surface Water and Groundwater

Current agricultural areas by irrigated and rain-fed farm land are as shown in the following table in each Zone by crops.

Table 3.2.5 Current Agricultural Area by Crops, Irrigated and Rain-fed Farm Lands and Zones

(ha)

Zone	Sub-Zone	Wheat			Barley			Paddy			Pulses		
		Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total
A	A-1	13,994	145,768	159,762	1,540	16,041	17,581	0	0	0	242	2,521	2,763
	A-2	1,298	13,521	14,819	335	3,490	3,825	0	0	0	53	552	605
	A-3	2,190	9,222	11,412	1,276	5,373	6,649	0	0	0	54	227	281
Total of A		17,482	168,511	185,993	3,151	24,904	28,055	0	0	0	349	3,300	3,649
B	B-1	179	1,865	2,044	131	1,365	1,496	0	0	0	2	21	23
	B-2	1,313	5,529	6,842	1,397	5,883	7,280	0	0	0	533	2,244	2,777
	B-3	9,741	41,018	50,759	4,099	17,260	21,359	116	488	604	4,275	18,001	22,276
	B-4	3,008	12,666	15,674	1,625	6,843	8,468	1,955	8,232	10,187	134	564	698
	B-5	1,989	16,511	18,500	127	1,054	1,181	11	91	102	6	50	56
	B-6	2,613	21,691	24,304	529	4,391	4,920	4	33	37	170	1,411	1,581
	B-7	4,232	35,130	39,362	599	4,972	5,571	7	58	65	583	4,840	5,423
Total of B		23,075	134,410	157,485	8,507	41,768	50,275	2,093	8,902	10,995	5,703	27,131	32,834
C	C-1	4,375	36,317	40,692	506	4,200	4,706	1,471	12,211	13,682	69	573	642
	C-2	2,239	8,361	10,600	711	2,655	3,366	0	0	0	36	134	170
	C-3	4,482	18,873	23,355	1,865	7,853	9,718	551	2,320	2,871	206	867	1,073
	C-4	901	1,120	2,021	534	664	1,198	123	153	276	205	255	460
Total of C		11,997	64,671	76,668	3,616	15,372	18,988	2,145	14,684	16,829	516	1,829	2,345
D	D-1	28	35	63	28	35	63	0	0	0	29	36	65
	D-2	985	1,225	2,210	741	921	1,662	1,212	1,507	2,719	457	568	1,025
Total of D		1,013	1,260	2,273	769	956	1,725	1,212	1,507	2,719	486	604	1,090
E	E-1	0	0	0	0	0	0	167,054	0	167,054	0	0	0
	E-2	25	9	34	7	3	10	8,417	3,138	11,555	0	0	0
	E-3	0	0	0	0	0	0	18,794	0	18,794	0	0	0
	E-4	0	0	0	0	0	0	14,517	0	14,517	0	0	0
Total of E		25	9	34	7	3	10	208,782	3,138	211,920	0	0	0
Grand Total		53,592	368,861	422,453	16,050	83,003	99,053	214,232	28,231	242,463	7,054	32,864	39,918

(ha)

Zone	Sub-Zone	Alfalfa			Others			Orchard			Whole Agricultural Area		
		Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total
A	A-1	10,343	107,737	118,080	6,389	66,551	72,940	1,453	15,135	16,588	33,961	353,753	387,714
	A-2	6,809	70,926	77,735	281	2,927	3,208	795	8,281	9,076	9,571	99,697	109,268
	A-3	3,650	15,370	19,020	951	4,005	4,956	1,707	7,188	8,895	9,828	41,385	51,213
Total of A		20,802	194,033	214,835	7,621	73,483	81,104	3,955	30,604	34,559	53,360	494,835	548,195
B	B-1	1,541	16,052	17,593	25	260	285	278	2,896	3,174	2,156	22,459	24,615
	B-2	7,307	30,769	38,076	1,289	5,428	6,717	1,979	8,333	10,312	13,818	58,186	72,004
	B-3	10,556	44,450	55,006	4,819	20,292	25,111	6,490	27,329	33,819	40,096	168,838	208,934
	B-4	7,609	32,041	39,650	3,258	13,719	16,977	1,960	8,253	10,213	19,549	82,318	101,867
	B-5	2,148	17,831	19,979	183	1,519	1,702	482	4,001	4,483	4,946	41,057	46,003
	B-6	9,882	82,031	91,913	1,220	10,127	11,347	2,272	18,860	21,132	16,690	138,544	155,234
	B-7	3,238	26,879	30,117	3,774	31,328	35,102	3,031	25,161	28,192	15,464	128,368	143,832
Total of B		42,281	250,053	292,334	14,568	82,673	97,241	16,492	94,833	111,325	112,719	639,770	752,489
C	C-1	3,359	27,883	31,242	2,569	21,325	23,894	3,528	29,286	32,814	15,877	131,795	147,672
	C-2	5,758	21,501	27,259	1,024	3,824	4,848	1,431	5,343	6,774	11,199	41,818	53,017
	C-3	4,534	19,092	23,626	9,568	40,290	49,858	1,889	7,954	9,843	23,095	97,249	120,344
	C-4	315	392	707	5,409	6,726	12,135	828	1,030	1,858	8,315	10,340	18,655
Total of C		13,966	68,868	82,834	18,570	72,165	90,735	7,676	43,613	51,289	58,486	281,202	339,688
D	D-1	770	957	1,727	527	655	1,182	909	1,130	2,039	2,291	2,848	5,139
	D-2	607	755	1,362	1,180	1,467	2,647	393	489	882	5,575	6,932	12,507
Total of D		1,377	1,712	3,089	1,707	2,122	3,829	1,302	1,619	2,921	7,866	9,780	17,646
E	E-1	0	0	0	0	31,144	31,144	0	31,144	31,144	167,054	62,287	229,341
	E-2	29	11	40	337	126	463	0	0	0	8,815	3,287	12,102
	E-3	0	0	0	0	3,504	3,504	0	3,504	3,504	18,794	7,008	25,802
	E-4	0	0	0	0	2,707	2,707	0	2,707	2,707	14,517	5,413	19,930
Total of E		29	11	40	337	37,480	37,817	0	37,354	37,354	209,180	77,995	287,175
Grand Total		78,455	514,677	593,132	42,803	267,923	310,726	29,425	208,023	237,448	441,611	1,503,582	1,945,193

Source: Estimated by GIS Data Base based on the Agricultural Statistics of Iran, SCI.

Net agricultural production by each Zone can be estimated the agricultural area indicated in the above table multiplied by the net unit farm gate price as shown in Table 3.2.4. Namely, these are the economic benefit in case of "Without-Project" in agricultural sector. Estimated results are shown in the following table in case of Zone.

Table 3.2.6 Estimated Current Amount of Agricultural Production by Crops, Irrigated and Rain-fed Farm Lands and Zones

(million Rials)

Zone	Sub-Zone	Wheat			Barley			Paddy			Pulses		
		Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total
A	A-1	8,752	-21,973	-13,221	216	2	218	0	0	0	970	-997	-27
	A-2	812	-2,038	-1,226	47	0	47	0	0	0	212	-218	-6
	A-3	1,370	-1,390	-20	179	1	180	0	0	0	216	-90	127
Total of A		10,933	-25,401	-14,468	442	3	445	0	0	0	1,399	-1,305	94
B	B-1	112	-281	-169	18	0	19	0	0	0	8	-8	0
	B-2	821	-833	-12	196	1	197	0	0	0	2,137	-887	1,249
	B-3	6,092	-6,183	-91	575	2	577	66	0	66	17,136	-7,119	10,017
	B-4	1,881	-1,909	-28	228	1	229	1,106	0	1,106	537	-223	314
	B-5	1,244	-2,489	-1,245	18	0	18	6	0	6	24	-20	4
	B-6	1,634	-3,270	-1,635	74	1	75	2	0	2	681	-558	123
	B-7	2,647	-5,295	-2,649	84	1	85	4	0	4	2,337	-1,914	423
Total of B		14,431	-20,261	-5,830	1,193	5	1,198	1,184	0	1,184	22,861	-10,730	12,131
C	C-1	2,736	-5,474	-2,738	71	1	71	832	0	832	277	-227	50
	C-2	1,400	-1,260	140	100	0	100	0	0	0	144	-53	91
	C-3	2,803	-2,845	-42	261	1	262	312	0	312	826	-343	483
	C-4	563	-169	395	75	0	75	70	0	70	822	-101	721
Total of C		7,503	-9,748	-2,245	507	2	509	1,213	0	1,213	2,068	-723	1,345
D	D-1	18	-5	12	4	0	4	0	0	0	116	-14	102
	D-2	616	-185	431	104	0	104	686	0	686	1,832	-225	1,607
Total of D		634	-190	444	108	0	108	686	0	686	1,948	-239	1,709
E	E-1	0	0	0	0	0	0	94,506	0	94,506	0	0	0
	E-2	16	-1	14	1	0	1	4,762	0	4,762	0	0	0
	E-3	0	0	0	0	0	0	10,632	0	10,632	0	0	0
	E-4	0	0	0	0	0	0	8,213	0	8,213	0	0	0
Total of E		16	-1	14	1	0	1	118,112	0	118,112	0	0	0
Grand Total		33,516	-55,601	-22,085	2,250	10	2,261	121,196	0	121,196	28,276	-12,997	15,279

(million Rials)

Zone	Sub-Zone	Alfalfa			Others			Orchard			Whole Agricultural Area		
		Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total
A	A-1	235,641	460,873	696,514	96,533	-537,084	-440,551	37,954	-125,001	-87,047	380,067	-224,180	155,887
	A-2	155,127	303,404	458,532	4,246	-23,622	-19,376	20,767	-68,394	-47,627	181,211	209,133	390,344
	A-3	83,157	65,749	148,906	14,369	-32,321	-17,952	44,589	-59,366	-14,777	143,880	-27,418	116,462
Total of A		473,926	830,026	1,303,952	115,148	-593,027	-477,879	103,310	-252,761	-149,451	705,158	-42,465	662,693
B	B-1	35,108	68,667	103,775	378	-2,098	-1,721	7,262	-23,918	-16,657	42,886	42,361	85,247
	B-2	166,473	131,622	298,095	19,476	-43,805	-24,329	51,694	-68,823	-17,129	240,797	17,274	258,071
	B-3	240,494	190,146	430,640	72,812	-163,762	-90,950	169,528	-225,713	-56,185	506,703	-212,628	294,075
	B-4	173,354	137,064	310,417	49,226	-110,716	-61,490	51,198	-68,162	-16,964	277,530	-43,946	233,584
	B-5	48,937	76,277	125,214	2,765	-12,259	-9,494	12,591	-33,045	-20,454	65,585	28,465	94,050
	B-6	225,139	350,909	576,047	18,433	-81,728	-63,294	59,348	-155,766	-96,419	305,312	109,588	414,899
	B-7	73,770	114,982	188,752	57,022	-252,825	-195,803	79,174	-207,807	-128,633	215,038	-352,859	-137,821
Total of B		963,275	1,069,666	2,032,941	220,112	-667,193	-447,080	430,794	-783,235	-352,440	1,653,850	-411,746	1,242,104
C	C-1	76,527	119,277	195,804	38,816	-172,098	-133,282	92,156	-241,876	-149,719	211,415	-300,398	-88,983
	C-2	131,183	91,976	223,159	15,472	-30,861	-15,389	37,380	-44,128	-6,749	185,679	15,674	201,353
	C-3	103,297	81,671	184,968	144,566	-325,151	-180,585	49,343	-65,693	-16,349	301,408	-312,359	-10,952
	C-4	7,177	1,677	8,853	81,726	-54,281	27,446	21,629	-8,507	13,122	112,061	-61,380	50,681
Total of C		318,183	294,601	612,784	280,580	-582,390	-301,811	200,508	-360,204	-159,696	810,562	-658,463	152,099
D	D-1	17,543	4,094	21,636	7,963	-5,286	2,677	23,744	-9,333	14,412	49,387	-10,544	38,843
	D-2	13,829	3,230	17,059	17,829	-11,839	5,990	10,266	-4,039	6,227	45,161	-13,057	32,104
Total of D		31,372	7,324	38,695	25,792	-17,125	8,666	34,010	-13,371	20,639	94,549	-23,602	70,947
E	E-1	0	0	0	0	-251,336	-251,336	0	-257,217	-257,217	94,506	-508,553	-414,047
	E-2	661	47	708	5,092	-1,017	4,075	0	0	0	10,531	-971	9,560
	E-3	0	0	0	0	-28,278	-28,278	0	-28,940	-28,940	10,632	-57,218	-46,586
	E-4	0	0	0	0	-21,842	-21,842	0	-22,353	-22,353	8,213	-44,195	-35,983
Total of E		661	47	708	5,092	-302,473	-297,381	0	-308,510	-308,510	123,882	-610,938	-487,056
Grand Total		1,787,416	2,201,663	3,989,080	646,723	-2,162,208	-1,515,485	768,623	-1,718,081	-949,458	3,388,000	-1,747,214	1,640,787

Source: Table 3.2.5 multiplied by Table 3.2.4, estimated by JICA Study Team..

Here, agricultural productivity per unit agricultural area should be made to clear. Because that, if the irrigated farm land will be increased in the future at the time of mid-term target (2016) and of long term target (2031), kinds of crops to be planted are unknown.

The productivity can be identified by total production shown in Table 3.2.6 divided by the agricultural area shown in Table 3.2.5. As already discussed in the other Chapter, the irrigation efficiencies in mid-term target year of 2016 and long term target year of 2031 are set as 40 % and 50 % respectively. Accordingly, agricultural productivity per ha should be increased too. The increasing is to be made by proportion

of improved irrigation efficiency against current irrigation efficiency. Following table shows their estimation results in the existing case, in the case of mid-term target year, and in the case of long term target year.

Table 3.2.7 Unit Agricultural Productivity by Zone

Zone	Sub-Zone	Irrigated Farm Land (ha)	Current Irrigation Efficiency (%)	Productivity (Rials/ha)		
				Existing Productivity	Productivity in 2016	Productivity in 2031
A	A-1	33,769	37.41	11,191,274	11,965,485	14,956,856
	A-2	8,817	37.44	18,933,318	20,227,051	25,283,814
	A-3	9,765	33.11	14,639,807	17,687,939	22,109,924
Average of A		52,351	36.61	13,215,099	14,424,311	18,030,388
B	B-1	2,156	32.36	19,891,441	24,586,453	30,733,066
	B-2	12,418	30.48	17,426,318	22,871,991	28,589,989
	B-3	39,696	30.57	12,637,234	16,537,367	20,671,709
	B-4	26,484	32.31	14,196,621	17,575,965	21,969,956
	B-5	4,946	32.32	13,260,158	16,411,598	20,514,497
	B-6	15,000	32.51	18,293,099	22,505,409	28,131,762
	B-7	15,464	32.69	13,905,746	17,016,243	21,270,303
Average of B		116,164	31.60	14,672,328	18,429,756	23,037,196
C	C-1	13,377	33.29	13,315,805	15,998,346	19,997,933
	C-2	10,272	33.48	16,579,933	19,810,703	24,763,379
	C-3	17,779	34.05	13,050,782	15,331,726	19,164,657
	C-4	8,315	34.14	13,476,962	15,792,072	19,740,089
Average of C		49,743	33.74	13,859,085	16,512,868	20,641,085
D	D-1	2,291	32.88	21,557,105	26,228,774	32,785,967
	D-2	5,733	31.88	8,100,670	10,162,975	12,703,719
Average of D		8,024	32.17	12,019,904	14,750,000	18,437,500
E	E-1	167,054	42.00	565,721	646,539	740,826
	E-2	8,815	33.03	1,194,648	1,446,788	1,808,485
	E-3	18,794	33.00	565,721	685,723	857,154
	E-4	14,517	33.00	565,721	685,723	857,154
Average of E		209,180	40.19	592,225	686,502	804,343
Total/Overall Average		435,463	36.58	7,591,809	8,301,025	10,376,281

In the above Table, because that the irrigation efficiency is keeping 42 % at present, so that it this case it is set at 48 % for the mid-term target year, and 55 % for the long term target year.

Gross agricultural production can be estimated by production amount per unit area (ha), in other words “agricultural productivity per unit agricultural area” shown in the above table multiplying the current and improved farm land area in irrigation systems under the surface water and groundwater. In other words, it is an economic gross agricultural benefit. Estimation results shown in the table hereunder.

Table 3.2.8 Economic Agricultural Benefit in Total under Surface Water and Groundwater by Zone

Zone	Sub-Zone	Traditional Irrigation Farm Land (ha)	Improved Irrigated Farm Land in 2016 (ha)	Improved Irrigated Farm Land in 2031 (ha)	Total Agricultural Production (million Rials)		
					Current Production	Production in 2016	Production in 2031
A	A-1	33,769	3,780	18,805	377,918	380,845	448,731
	A-2	8,817	931	2,509	166,935	168,139	182,867
	A-3	9,765	2,477	5,758	142,958	150,508	185,973
Total of A		52,351	7,188	27,072	687,811	699,492	817,570
B	B-1	2,156	593	984	42,886	45,671	53,549
	B-2	12,418	4,013	7,620	216,402	238,255	301,471
	B-3	39,696	12,758	25,961	501,649	551,406	710,230
	B-4	26,484	7,376	14,367	375,985	400,911	487,667
	B-5	4,946	1,375	3,160	65,585	69,918	88,511
	B-6	15,000	4,121	9,560	274,396	291,757	368,458
	B-7	15,464	4,168	9,815	215,038	228,001	287,324
Total of B		116,164	34,404	71,468	1,691,941	1,825,919	2,297,210
C	C-1	13,377	3,329	8,353	178,126	187,056	233,941
	C-2	10,272	2,530	5,934	170,311	178,486	218,870
	C-3	17,779	4,083	10,700	232,030	241,344	297,448
	C-4	8,315	1,928	4,382	112,061	116,525	139,508
Total of C		49,743	11,871	29,369	692,527	723,410	889,766
D	D-1	2,291	603	1,447	49,387	52,203	65,633
	D-2	5,733	1,674	3,704	46,442	49,894	63,490
Total of D		8,024	2,277	5,150	95,829	102,098	129,123
E	E-1	167,054	55,679	120,646	94,506	99,006	115,632
	E-2	8,815	2,257	5,536	10,531	11,100	13,929
	E-3	18,794	4,873	11,833	10,632	11,217	14,081
	E-4	14,517	3,764	9,140	8,213	8,664	10,876
Total of E		209,180	66,573	147,155	123,882	129,987	154,518
Grand Total		435,463	122,312	280,214	3,291,990	3,480,906	4,288,187

In Table 3.2.8, the area of farm lands are changed from those of traditional irrigation farm lands to those in mid-term target year and long term target because that a part of farm lands would be shifted to those under dams control.

The current production in "Total Agricultural Production" expresses an economic agricultural benefit in terms of "Without Project". Accordingly, the net economic agricultural benefits at the time of mid-term target year and at the time of long term target year are the amount by subtracting the amount of "Current Production" from the amount of the "Production" in 2016 and that in 2031 respectively. Following table shows its estimation results.

Table 3.2.9 Incremental Increased Agricultural Production of Farm Lands under Surface Water and Groundwater in Target Yeas by Zone

Zone	Incremental Increased Agricultural Production in Target Years (million Rials)	
	Production in 2016	Production in 2031
A	11,681	129,759
B	133,978	605,269
C	30,883	197,239
D	6,268	33,294
E	6,105	30,636
Total	188,916	996,197

ii) Economic Agricultural Benefit of Newly Developed Farm Lands and Improved Farm Lands on Irrigation Systems under Dam Control

An across-the-board of Irrigation efficiency of 60 % is set for the newly developed farm lands and improved farm lands on irrigation systems under dam control. Accordingly, the irrigation efficiency of farm lands under the surface water and groundwater shown in Table 3.2.7 should be revised upwards. Following table shows the productivities of the newly developed farm lands and improved farm lands on irrigation system after completion of dams.

Table 3.2.10 Unit Agricultural Productivity of Farm Lands under Dam Control by Zone

Zone	Sub-Zone	Current Irrigation Efficiency (%)	Productivity (Rials/ha)	
			Existing Productivity	Productivity after Completion of Dams
A	A-1	37.41	11,191,274	17,948,227
	A-2	37.44	18,933,318	30,340,577
	A-3	33.11	14,639,807	26,531,909
Average of A		36.62	13,215,099	21,649,734
B	B-1	32.36	19,891,441	36,879,679
	B-2	30.48	17,426,318	34,307,987
	B-3	30.57	12,637,234	24,806,051
	B-4	32.31	14,196,621	26,363,948
	B-5	32.32	13,260,158	24,617,396
	B-6	32.51	18,293,099	33,758,114
	B-7	32.69	13,905,746	25,524,364
Average of B		31.55	14,672,328	27,904,570
C	C-1	33.29	13,315,805	23,997,519
	C-2	33.48	16,579,933	29,716,055
	C-3	34.05	13,050,782	22,997,588
	C-4	34.14	13,476,962	23,688,107
Average of C		33.75	13,859,085	24,640,868
D	D-1	32.88	21,557,105	39,343,161
	D-2	31.88	8,100,670	15,244,463
Average of D		32.17	12,019,904	22,416,748
E	E-1	42.00	565,721	808,173
	E-2	33.03	1,194,648	2,170,182
	E-3	33.00	565,721	1,028,584
	E-4	33.00	565,721	1,028,584
Average of E		40.19	592,225	884,165
Overage Average		36.56	7,671,911	12,591,828

And, the following table shows areas of newly developed farm lands and improved farm lands of traditional irrigation systems to the modern irrigation systems after completion of dams.

Table 3.2.11 Zonal Areas of Newly Developed Farm Land and Improved Farm Lands on Irrigation Systems under Dam Control after Completion of Dams

(ha)

Sub-Zone	Beneficial Reach	Dam	Farm Lands under Dam Control		
			Newly Developed Farm Lands	Improved Farm Lands on Irrigation Systems	Total Farm Lands under Dam Control
A-1	44	Hasankhan/Golblakh	800	0	800
	47	Sange Siah	3,400	0	3,400
	47	Sural	1,008	192	1,200
Subtotal			5,208	192	5,400
A-2	37	Sir	6,000	0	6,000
	37	Zardekamar	5,000	2,500	7,500
	41	Siazakh	21,246	754	22,000
	41	Alehdare	0	2,100	2,100
Subtotal			32,246	5,354	37,600
A-3	66	Talvar	29,500	0	29,500
	66	Alan	90	310	400
	66	Mendagh	9,000	0	9,000
	66	Chesb	912	270	1,182
Subtotal			39,502	580	40,082
Total of A			76,956	6,126	83,082
B-1	35	Babakhan	5,950	50	6,000
	35	Sheikh Besharat	0	1,500	1,500
Subtotal			5,950	1,550	7,500
B-2	30	Golabar	7,900	1,400	9,300
	30	Songhor	900	900	1,800
Subtotal			8,800	2,300	11,100
B-3	20	Taham	0	400	400
	20	Mehtar	900	100	1,000
	20	Ghezel Tapeh	450	108	558
	27	Ramin	0	196	196
Subtotal			1,350	804	2,154
B-4	17	Mushampa	26,000	4,000	30,000
Subtotal			26,000	4,000	30,000
B-6	60	Sahand	10,300	600	10,900
	60	Kalghan	1,500	1,090	2,590
Subtotal			11,800	1,690	13,490
Total of B			53,900	10,344	64,244
C-1	6	Garmichay	2,300	1,200	3,500
	11	Aydughmush	13,700	1,300	15,000
Subtotal			16,000	2,500	18,500
C-2	3	Givi	6,300	927	7,227
	3	Sangabad	1,625	600	2,225
	3	Tabrizak	450	150	600
Subtotal			8,375	1,677	10,052
C-3	61	Ostor	6,500	0	6,500
	61	Befrajerd	0	0	0
	61	Niakhoram	675	225	900
	61	Hashtjin	600	150	750
Subtotal			7,775	375	8,150
C-4	21	Burmanak	1,079	1,201	2,280
Subtotal			1,079	1,201	2,280
Total of C			33,229	5,753	38,982
Grand Total			164,085	22,223	186,308

Agricultural production, namely economic agricultural benefit of newly developed farm lands and improved farm lands on irrigation systems under dam control can be estimated by using unit agricultural productivity of farm lands under dam control shown in Table 3.2.10 multiplying the above areas of farm lands under dam control. However, the said economic agricultural benefit should be based on "With-" and "Without-Project", so that the net benefit should be estimated taking current agricultural production into consideration for the improved farm lands on irrigation systems.

Times of completion of dams are different with each other, and the economic agricultural benefit will be derived after completion of dams. Namely, the economic agricultural benefit will be generated in different time with each other. Accordingly, the name of dams is needed for making a cash flow of cost and benefit. Therefore, names of dams are included in the above table.

Table 3.2.12 Zonal Economic Agricultural Benefit of Newly Developed Farm Land and Improved Farm Lands on Irrigation Systems under Dam Control after Completion of Dams

(million Rials)

Sub-Zone	Beneficial Reach	Dam	Farm Lands under Dam Control				
			Newly Developed Farm Lands	Improved Farm Lands on Irrigation Systems			Total Incremental Agricultural Production
				Current Production	Improved Production	Incremental Agricultural Production	
A-1	44	Hasankhan/Golblakh	8,953	0	0	0	8,953
	47	Sange Siah	38,050	0	0	0	38,050
	47	Sural	11,281	2,149	3,446	1,297	12,578
Subtotal			58,284	2,149	3,446	1,297	59,581
A-2	37	Sir	182,043	0	0	0	182,043
	37	Zardekamar	151,703	47,333	75,851	28,518	180,221
	41	Siazakh	644,616	14,276	22,877	8,601	653,217
	41	Alehdare	0	39,760	63,715	23,955	23,955
Subtotal			978,362	101,369	162,443	61,074	1,039,437
A-3	66	Talvar	782,691	0	0	0	782,691
	66	Alan	2,388	6,166	11,433	5,266	7,654
	66	Mendagh	238,787	0	0	0	238,787
	66	Chesb	24,197	5,371	9,958	4,587	28,784
Subtotal			1,048,063	11,537	21,390	9,853	1,057,917
Total of A			2,084,710	115,055	187,280	72,225	2,156,935
B-1	35	Babakhan	219,434	995	1,844	849	220,284
	35	Sheikh Besharat	0	29,837	55,320	25,482	25,482
Subtotal			219,434	30,832	57,164	26,332	245,766
B-2	30	Golabar	271,033	24,397	48,031	23,634	294,667
	30	Songhor	30,877	15,684	30,877	15,194	46,071
Subtotal			301,910	40,081	78,908	38,828	340,738
B-3	20	Taham	0	5,055	9,922	4,868	4,868
	20	Mehtar	22,325	1,264	2,481	1,217	23,542
	20	Ghezel Tapeh	11,163	1,365	2,679	1,314	12,477
	27	Ramin	0	2,477	4,862	2,385	2,385
Subtotal			33,488	10,160	19,944	9,784	43,272
B-4	17	Mushampa	685,463	56,786	105,456	48,669	734,132
Subtotal			685,463	56,786	105,456	48,669	734,132
B-6	60	Sahand	347,709	10,976	20,255	9,279	356,988
	60	Kalghan	50,637	19,939	36,796	16,857	67,494
Subtotal			398,346	30,915	57,051	26,136	424,482
Total of B			1,638,641	168,774	318,523	149,749	1,788,389
C-1	6	Garmichay	55,194	15,979	28,797	12,818	68,012
	11	Aydughmush	328,766	17,311	31,197	13,886	342,652
Subtotal			383,960	33,290	59,994	26,704	410,665
C-2	3	Givi	187,211	15,370	27,547	12,177	199,388
	3	Sangabad	48,289	9,948	17,830	7,882	56,170
	3	Tabrizak	13,372	2,487	4,457	1,970	15,343
Subtotal			248,872	27,805	49,834	22,029	270,901
C-3	61	Ostor	149,484	0	0	0	149,484
	61	Befrajerd	0	0	0	0	0
	61	Niakhoram	15,523	2,936	5,174	2,238	17,761
	61	Hashtjin	13,799	1,958	3,450	1,492	15,291
Subtotal			178,806	4,894	8,624	3,730	182,536
C-4	21	Burmanak	25,559	16,186	28,449	12,264	37,823
Subtotal			25,559	16,186	28,449	12,264	37,823
Total of C			837,198	82,174	146,901	64,727	901,925
Grand Total			4,560,549	366,003	652,704	286,701	4,847,249

2) Identification of Economic Benefit on Potable Water Supply

a) Potable Water Supply Volume

There is another economic benefit on potable water supply other than the said economic agricultural benefit in this Project. It is because that, by construction of various dams and by improvement of surface water and groundwater distribution, potable water supply will be further promoted.

The potable water demand shown in the following table is arranged one on data coming from WRMC. They have a plan to supply of potable water based on these demands.

Table 3.2.13 Designed Supply Water Volume at Each Situation in Urban and Rural Areas by Zone

(1,000 m^3)

Zone	Potable Water Demand in Urban Area			Potable Water Demand in Rural Area		
	Current Demand	Demand in 2016	Demand in 2031	Current Demand	Demand in 2016	Demand in 2031
A	20,345	27,679	42,451	35,213	54,020	82,230
B	61,246	78,022	108,417	41,868	62,034	92,281
C	23,910	31,300	42,816	12,214	17,756	26,070
D	0	0	0	4,049	5,595	7,913
E	146,900	187,209	254,258	113,045	150,338	206,278
Total	252,400	324,211	447,942	206,389	289,745	414,772

Source: WRMC

In the above table, on the potable water demand, namely designed supply volume, shifted water volume from groundwater to surface water as water resources in the urban area. In this connection, share rates of water supply volume originated from surface water and groundwater is as shown in the following table.

Table 3.2.14 Share Rates of Supplied Water Volume Originated from Surface Water and Groundwater in Urban Areas

(%)

Water Resource	Current Situation	Situation in 2016	Situation in 2031
Surface Water	76.81%	77.99%	78.98%
Groundwater	23.19%	22.01%	21.02%

From the dams located in the Sefidrud River basin, the Taleghan Dam is supplying the potable water to the urban areas of Tehran Province. And, the Talvar Dam under planning has planned to supply potable water to the urban areas of Hamedan Province. However, both the potable water supplied areas or candidate areas of potable water supply are outside the basin, so that they are excluded from the above table.

In this case also, incremental increased water volume to be supplied should be made clear based on the concept of "With-" and "Without the Project" in the mid-term target year and long term target year. Estimation results are shown in the following table.

Table 3.2.15 Zonal Incremental Increased Potable Water Volume to Be Supplied in Target Years in Urban and Rural Areas

(1,000 m^3)

Zone	Potable Water Volume to Be Supplied in Urban Area		Potable Water Volume to Be Supplied in Rural Area	
	Demand in 2016	Demand in 2031	Demand in 2016	Demand in 2031
A	7,334	22,106	18,807	47,017
B	16,776	47,172	20,166	50,413
C	7,391	18,907	5,543	13,856
D	0	0	1,546	3,864
E	40,309	107,358	37,294	93,234
Total	71,811	195,542	83,355	208,383

b) Identification of Basic Unit of Economic Benefit on Potable Water Supply

For human life, potable water is one of lifelines. In the area where the potable water supply system is not developed yet, by making clear the way of people to have access to potable water, and the amount people have to pay for such potable water, the amount of willingness of people there to pay can be gotten. This is a "Willingness to Pay (= WTP)".

The amount of WTP is not the amount for actual payment, but the amount of valuation for new living environment developed with easy access to get the potable water against the former living environment without any access to get the potable water in facilities. This means the WTP defined in the Contingent Valuation Method (the CVM). And this will

become a basic unit for estimation of economic benefit in case of development of potable water supply systems.

In this Project, systematically organized interview survey has not been made, but several facts have been gotten from some interview survey in the field investigations. Accordingly, the identification of basic unit for estimation of economic benefit of developing the potable water supply is to be made based on results of these surveys.

As a result of field survey, almost of all the people living in the areas where there is no any way of access to potable water have used qanats, wells and springs. And all the people and some of people who are using wells do not pay any charge for taking potable water. Some of wells can supply water to the people with a certain time limit, for example from 17:00 to 18:30. But, in case of qanats, there a lot of plots that the water can not be utilized for drinking and cooking, so that they usually use such water with boiling by LPG gas. In this case, the cost of such gases is considered as a water charge. Furthermore, in many cases of utilizing the wells, the groundwater pumped up with electricity and stored in water tank settled in high tower, and then the water is supplied to each house or to several public taps in towns or villages, so that electric gauge is needed to pay. In this case, the electric charge is also considered as water charge even that the water charge is free.

By organizing the information gotten from the said field survey, it has been cleared that the average amount of expenditure for taking potable water is resulted as a sum of 27,367 Rials/month.HH. If the average consumed water is assumed at 50 ldc and average family size is assumed 5 persons, the amount of expenditure for water can be converted at a sum of 3,649Rials/m^3. Namely, this is a basic unit for5 estimation of economic benefit derived from development of potable water supply systems.

c) Estimation of Economic Benefit on Potable Water Supply

Then, the economic benefit under the completion of potable water supply facilities including the purification plant together with intake facilities and water distribution networks the incremental potable water volume to be supplied as discussed above can be estimated by using incremental potable water volume multiplying the said basic unit for estimation of economic benefit in each target year.

The result of estimation is as shown in the following table.

Table 3.2.16 Zonal Incremental Economic Benefit on Completion of Potable Water Supply Facilities in Urban and Rural Areas

(million Rials)

Zone	Potable Water Demand in Urban Area		Potable Water Demand in Rural Area	
	Demand in 2016	Demand in 2031	Demand in 2016	Demand in 2031
A	26,762	80,662	68,625	171,559
B	61,215	172,124	73,584	183,951
C	26,967	68,989	20,224	50,558
D	0	0	5,640	14,099
E	147,085	391,737	136,081	340,200
Total	262,030	713,511	304,155	760,367

3.2.2 Identification of Economic Cost

Development cost for farm lands, namely, newly developed farm lands with modern irrigation systems, and improvement cost of farm lands from traditional irrigation systems to the modern irrigation systems are estimated based on actual data in the site of the targeted areas as much as possible. There are a lot of dams under various situations as existing dams which are under operating, dams under construction, planned dams just after completion detail design and just facing to starting construction works, planned dams just under making feasibility study, and planned dams faced to make feasibility study applied by the RWCs in the targeted provinces. All the practical dam plans are classified by completion time as mid-term target year and long term target year by means of

possibility of the plan's realization. And, information and data on cost of them have been collected as much as possible, they are put in order, and analyzed. Refer to a relevant Chapter in this report.

And, development cost for potable water supply systems and related facilities is estimated based on the information on similar projects in developing countries taking specific conditions in Iran into account.

The economic evaluation is to be made by comparison between economic benefit and economic cost as previously discussed. Accordingly, the financial cost resulted from cost estimation of the project should be converted into the economic cost.

In this case, the standard conversion factor for estimating a economic price of trading goods under the free competitive market, transfer items as taxes, shadow wage rate for unskilled labors, shadow land price rate for estimating economic price of lands to be acquired under free trading market and so on have to be considered.

For this Project, the above mentioned factors are assumed as shown in the followings based on similar projects in Iran.

Administration Cost:	5%	Of the Construction Cost.
Engineering Cost:	10%	Of the Construction Cost.
Physical Contingency:	20%	Of the whole cost from construction cost to engineering cost.
Share Rate of Labor to Construction Cost:	80%	To the Construction Cost.
Standard Conversion Factor (SCF):	0.9071	based on the statistics of international trade of Iran.
Income Tax for Labor:	10%	According to Personal Income Law of Iran.
Foreign Portion of Equipment:	0%	Assumed.
Import Tax of equipment:	15%	Based on the similar project in developing countries (assumed).
Value Added Tax (VAT):	10%	For domestically procured equipment (assumed).
Corporation Income Tax:	10%	According to Corporation Income Law of Iran.
Profit Rate of Contractors:	10%	Assumed.
Shadow Price of Land (Agricultural Area):	0.1806	Based on similar project in Iran.
Shadow Wage Rate for Labor:	0.6526	Based on similar project in Iran.

On the basis of the above factors, a conversion rate of the economic cost against the financial cost can be estimated at 61.79%. Expediently, it is assumed as 60 % in this Project.

Annual disbursement by each zone is shown hereunder.

Table 3.2.17 Annual Disbursement of Cost for Development of Farm Lands under Surface Water and Groundwater, and Dam Construction Costs and Cost for Farm Lands under Dam Control in Case of Mid-Term Target Year by Zone

Zone A

(million Rials)

Cost	-8th Year	-7th Year	-6th Year	-5th Year	-4th Year	-3rd Year	-2nd Year	-1st Year	Base Year	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	Total Cost
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Financial Cost																	
Under Surface Water and Groundwater																	
Improvement of Irrigation Systems under Surface Water and Groundwater										98,573	98,573	98,573	98,573	98,573	98,573	98,573	690,010
Under Dam Construction																	
Dam Construction	377,337	377,337	377,337	377,337	377,337	117,277	0	45,767	45,767	81,999	81,999	81,999	0	0	0	0	2,341,489
Development and Improvement under Dam Control	0	0	0	0	0	321,818	584,009	584,009	584,009	584,009	584,009	584,009	755,705	755,705	686,009	686,009	6,709,296
Economic Cost																	
Improvement of Irrigation Systems under Surface Water and Groundwater	0	0	0	0	0	0	0	0	0	59,144	59,144	59,144	59,144	59,144	59,144	59,144	414,006
Dam Construction	226,402	226,402	226,402	226,402	226,402	70,366	0	27,460	27,460	49,199	49,199	49,199	0	0	0	0	1,404,893
Development and Improvement under Dam Control	0	0	0	0	0	193,091	350,405	350,405	350,405	350,405	350,405	350,405	453,423	453,423	411,605	411,605	4,025,578
Economic Cost in Total	226,402	226,402	226,402	226,402	226,402	263,457	350,405	377,865	377,865	458,748	458,748	458,748	512,566	512,566	470,749	470,749	5,844,477

Zone B

(million Rials)

Cost	-13th Year	-12th Year	-11th Year	-10th Year	-9th Year	-8th Year	-7th Year	-6th Year	-5th Year	-4th Year	-3rd Year	-2nd Year	-1st Year	Base Year	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	Total Cost
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Financial Cost																						
Under Surface Water and Groundwater																						
Improvement of Irrigation Systems under Surface Water and Groundwater															57,154	57,154	57,154	57,154	57,154	57,154	57,154	400,079
Under Dam Construction																						
Dam Construction	49,603	49,603	49,603	92,842	92,842	210,937	210,937	210,937	210,937	210,937	248,766	205,527	155,924	155,924	155,924	155,924	155,924	155,924	118,095	118,095	0	3,015,201
Development and Improvement under Dam Control						0	0	0	0	0	0	108,240	251,973	251,973	251,973	251,973	251,973	251,973	346,853	346,853	385,253	2,699,040
Economic Cost																						
Improvement of Irrigation Systems under Surface Water and Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,292	34,292	34,292	34,292	34,292	34,292	34,292	240,047
Dam Construction	29,762	29,762	29,762	55,705	55,705	126,562	126,562	126,562	126,562	126,562	149,259	123,316	93,554	93,554	93,554	93,554	93,554	93,554	70,857	70,857	0	1,719,835
Development and Improvement under Dam Control	0	0	0	0	0	0	0	0	0	0	0	64,944	151,184	151,184	151,184	151,184	151,184	151,184	208,112	208,112	231,152	1,619,424
Economic Cost in Total	29,762	29,762	29,762	55,705	55,705	126,562	126,562	126,562	126,562	126,562	149,259	188,260	244,738	244,738	279,031	279,031	279,031	279,031	313,261	313,261	265,444	3,579,306

Zone C

(million Rials)

Cost	-13th Year 1996	-12th Year 1997	-11th Year 1998	-10th Year 1999	-9th Year 2000	-8th Year 2001	-7th Year 2002	-6th Year 2003	-5th Year 2004	-4th Year 2005	-3rd Year 2006	-2nd Year 2007	-1st Year 2008	Base Year 2009	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost																						
Under Surface Water and Groundwater																						
Improvement of Irrigation Systems under Surface Water and Groundwater															145,173	145,173	145,173	145,173	145,173	145,173	145,173	1,016,212
Under Dam Construction																						
Dam Construction	65,104	65,104	65,104	65,104	65,104	214,315	268,701	268,701	321,903	321,903	321,903	321,903	321,903	321,903	321,903	321,903	54,386	54,386	0	0	0	3,761,234
Development and Improvement under Dam Control						0	0	0	0	0	321,818	584,009	584,009	584,009	584,009	584,009	584,009	755,705	755,705	686,009	686,009	6,709,296
Economic Cost																						
Improvement of Irrigation Systems under Surface Water and Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	87,104	87,104	87,104	87,104	87,104	87,104	87,104	609,727
Dam Construction	39,062	39,062	39,062	39,062	39,062	128,589	161,220	161,220	193,142	193,142	193,142	193,142	193,142	193,142	193,142	193,142	32,632	32,632	0	0	0	2,139,553
Development and Improvement under Dam Control	0	0	0	0	0	0	0	0	0	0	81,637	81,637	81,637	81,637	81,637	81,637	276,636	276,636	354,876	354,876	354,876	2,270,995
Economic Cost in Total	39,062	39,062	39,062	39,062	39,062	128,589	161,220	161,220	193,142	193,142	274,779	274,779	274,779	274,779	361,883	361,883	396,371	396,371	441,980	441,980	441,980	5,020,275

Zone D

(million Rials)

Cost	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost								
Under Surface Water and Groundwater								
Improvement of Irrigation Systems under Surface Water and Groundwater	7,653	7,653	7,653	7,653	7,653	7,653	7,653	53,568
Economic Cost								
Improvement of Irrigation Systems under Surface Water and Groundwater	4,592	4,592	4,592	4,592	4,592	4,592	4,592	32,141
Economic Cost in Total	4,592	4,592	4,592	4,592	4,592	4,592	4,592	32,141

Zone E

(million Rials)

Cost	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost								
Under Surface Water and Groundwater								
Improvement of Irrigation Systems under Surface Water and Groundwater	304,334	304,334	304,334	304,334	304,334	304,334	304,334	2,130,340
Economic Cost								
Improvement of Irrigation Systems under Surface Water and Groundwater	182,601	182,601	182,601	182,601	182,601	182,601	182,601	1,278,204
Economic Cost in Total	182,601	182,601	182,601	182,601	182,601	182,601	182,601	1,278,204

Table 3.2.18 Annual Disbursement of Cost for Development of Farm Lands under Surface Water and Groundwater, and Dam Construction Costs and Cost for Farm Lands under Dam Control in Case of Long Term Target Year by Zone

Zone A

(million Rials)

Cost	5th year 2014	6th year 2015	7th year 2016	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																			
Under Surface Water and Groundwater																			
Improvement of Irrigation Systems under Surface Water and Groundwater				130,166	130,166	130,166	130,166	130,166	130,166	130,166	130,166	130,166	130,166	130,166	130,166	130,166	130,166	130,166	1,952,496
Under Dam Construction																			
Dam Construction	45,767	45,767	95,991	269,435	269,435	269,435	236,102	236,102	95,991	95,991	50,224	50,224	0	0	0	0	0	0	1,760,462
Development and Improvement under Dam Control	0	0	0	0	0	0	40,560	0	254,880	254,880	292,200	225,000	345,000	345,000	345,000	345,000	345,000	225,000	3,017,520
Economic Cost																			
Improvement of Irrigation Systems under Surface Water and Groundwater	0	0	0	78,100	78,100	78,100	78,100	78,100	78,100	78,100	78,100	78,100	78,100	78,100	78,100	78,100	78,100	78,100	1,171,498
Dam Construction	27,460	27,460	57,594	182,256	182,256	182,256	141,661	141,661	57,594	57,594	30,134	30,134	0	0	0	0	0	0	1,118,062
Development and Improvement under Dam Control	0	0	0	0	0	0	24,336	0	152,928	152,928	175,320	135,000	207,000	207,000	207,000	207,000	207,000	135,000	1,810,512
Economic Cost in Total	27,460	27,460	57,594	260,356	260,356	260,356	244,097	219,761	288,622	288,622	283,554	243,234	285,100	285,100	285,100	285,100	285,100	213,100	4,100,072

Zone B

(million Rials)

Cost	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																							
Under Surface Water and Groundwater																							
Improvement of Irrigation Systems under Surface Water and Groundwater								238,286	238,286	238,286	238,286	238,286	238,286	238,286	238,286	238,286	238,286	238,286	238,286	238,286	238,286	238,286	3,574,290
Under Dam Construction																							
Dam Construction	306,907	306,907	306,907	306,907	306,907	306,907	399,780	265,956	265,956	265,956	225,460	225,460	140,982	140,982	140,982	140,982	88,642	40,534	40,534	40,534	40,534	0	4,304,717
Development and Improvement under Dam Control								233,600	233,600	233,600	351,200	233,600	402,800	402,800	233,600	233,600	353,400	417,768	353,400	353,400	353,400	372,216	4,761,984
Economic Cost																							
Improvement of Irrigation Systems under Surface Water and Groundwater	0	0	0	0	0	0	0	142,972	142,972	142,972	142,972	142,972	142,972	142,972	142,972	142,972	142,972	142,972	142,972	142,972	142,972	142,972	2,144,574
Dam Construction	184,144	184,144	184,144	184,144	184,144	184,144	239,868	159,573	159,573	159,573	135,276	135,276	84,589	84,589	84,589	84,589	24,320	24,320	24,320	24,320	24,320	0	2,553,965
Development and Improvement under Dam Control	0	0	0	0	0	0	0	140,160	140,160	140,160	210,720	140,160	241,680	241,680	140,160	140,160	250,661	212,040	212,040	212,040	212,040	223,330	2,857,190
Economic Cost in Total	184,144	184,144	184,144	184,144	184,144	184,144	239,868	442,705	442,705	442,705	488,968	418,408	469,241	469,241	367,721	367,721	417,953	379,332	379,332	379,332	379,332	366,301	7,555,729

Zone C

(million Rials)

Cost	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																
Under Surface Water and Groundwater																
Improvement of Irrigation Systems under Surface Water and Groundwater	101,516	101,516	101,516	101,516	101,516	101,516	101,516	101,516	101,516	101,516	101,516	101,516	101,516	101,516	101,516	1,522,746
Under Dam Construction																
Dam Construction	230,687	230,687	230,687	197,354	197,354	197,354	197,354	197,354	153,082	153,082	0	0	0	0	0	1,984,993
Development and Improvement under Dam Control	0	0	0	43,200	43,200	0	0	0	68,400	0	213,997	111,397	111,397	0	0	591,592
Economic Cost																
Improvement of Irrigation Systems under Surface Water and Groundwater	60,910	60,910	60,910	60,910	60,910	60,910	60,910	60,910	60,910	60,910	60,910	60,910	60,910	60,910	60,910	913,648
Dam Construction	138,412	138,412	138,412	118,412	118,412	118,412	118,412	118,412	91,849	91,849	0	0	0	0	0	1,786,494
Development and Improvement under Dam Control	0	0	0	25,920	25,920	0	0	0	41,040	0	128,398	66,838	66,838	0	0	354,955
Economic Cost in Total	199,322	199,322	199,322	205,242	205,242	179,322	179,322	179,322	193,799	152,759	189,308	127,748	127,748	60,910	60,910	2,459,599

Zone D

(million Rials)

Cost	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																
Under Surface Water and Groundwater																
Improvement of Irrigation Systems under Surface Water and Groundwater	6,130	6,130	6,130	6,130	6,130	6,130	6,130	6,130	6,130	6,130	6,130	6,130	6,130	6,130	6,130	91,955
Economic Cost																
Improvement of Irrigation Systems under Surface Water and Groundwater	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	55,173
Economic Cost in Total	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	3,678	55,173

Zone E

(million Rials)

Cost	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																
Under Surface Water and Groundwater																
Improvement of Irrigation Systems under Surface Water and Groundwater	171,908	171,908	171,908	171,908	171,908	171,908	171,908	171,908	171,908	171,908	171,908	171,908	171,908	171,908	171,908	2,578,615
Economic Cost																
Improvement of Irrigation Systems under Surface Water and Groundwater	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	1,547,169
Economic Cost in Total	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	103,145	1,547,169

Table 3.2.19 Annual Disbursement of Cost for Potable Water Supply Facilities in Case of Mid-Term Target Year by Zone

(million Rials)

Zone	Area	Mid-Term Annual Cost Disbursement Schedule for Potable Water Supply Facilities							
		1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total
A	Urban	27,608	27,608	27,608	27,608	27,608	27,608	27,608	193,254
	Rural	97,946	97,946	97,946	97,946	97,946	97,946	97,946	685,622
Sub-Total in Financial		125,554	125,554	125,554	125,554	125,554	125,554	125,554	878,876
Sub-Total in Economic		75,332	75,332	75,332	75,332	75,332	75,332	75,332	527,327
B	Urban	65,867	65,867	65,867	65,867	65,867	65,867	65,867	461,071
	Rural	112,040	112,040	112,040	112,040	112,040	112,040	112,040	784,281
Sub-Total in Financial		177,907	177,907	177,907	177,907	177,907	177,907	177,907	1,245,352
Sub-Total in Economic		106,744	106,744	106,744	106,744	106,744	106,744	106,744	747,209
C	Urban	32,894	32,894	32,894	32,894	32,894	32,894	32,894	230,261
	Rural	39,940	39,940	39,940	39,940	39,940	39,940	39,940	279,579
Sub-Total in Financial		72,834	72,834	72,834	72,834	72,834	72,834	72,834	509,840
Sub-Total in Economic		43,700	43,700	43,700	43,700	43,700	43,700	43,700	305,903
D	Urban	0	0	0	0	0	0	0	0
	Rural	11,532	11,532	11,532	11,532	11,532	11,532	11,532	80,725
Sub-Total in Financial		11,532	11,532	11,532	11,532	11,532	11,532	11,532	80,725
Sub-Total in Economic		6,919	6,919	6,919	6,919	6,919	6,919	6,919	48,434
E	Urban	61,514	61,514	61,514	61,514	933,374	933,374	933,374	3,046,179
	Rural	148,838	148,838	148,838	148,838	148,838	148,838	148,838	1,041,865
Sub-Total in Financial		210,352	210,352	210,352	210,352	1,082,212	1,082,212	1,082,212	4,088,044
Sub-Total in Economic		126,211	126,211	126,211	126,211	649,327	649,327	649,327	2,452,827
Grand Total	Urban	187,883	187,883	187,883	187,883	1,059,743	1,059,743	1,059,743	3,930,765
	Rural	410,296	410,296	410,296	410,296	410,296	410,296	410,296	2,872,072
Sub-Total in Financial		598,179	598,179	598,179	598,179	1,470,039	1,470,039	1,470,039	6,802,837
Sub-Total in Economic		358,907	358,907	358,907	358,907	882,023	882,023	882,023	4,081,700

Table 3.2.20 Annual Disbursement of Cost for Potable Water Supply Facilities in Case of Long Term Target Year by Zone

(million Rials)

Zone	Area	Long Term Annual Cost Disbursement Schedule for Potable Water Supply Facilities															
		8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year	16th year	17th year	18th year	19th year	20th year	21st year	22nd year	Total
		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
A	Urban	24,619	24,619	24,619	24,619	24,619	24,619	24,619	24,619	24,619	24,619	24,619	24,619	24,619	24,619	24,619	369,286
	Rural	62,671	62,671	62,671	125,084	125,084	125,084	125,084	125,084	125,084	125,084	125,084	125,084	125,084	125,084	125,084	1,689,017
Sub-Total in Financial		87,290	87,290	87,290	149,703	149,703	149,703	149,703	149,703	149,703	149,703	149,703	149,703	149,703	149,703	149,703	2,058,302
Sub-Total in Economic		52,374	52,374	52,374	89,822	89,822	89,822	89,822	89,822	89,822	89,822	89,822	89,822	89,822	89,822	89,822	1,234,981
B	Urban	50,659	50,659	50,659	50,659	50,659	50,659	50,659	50,659	50,659	50,659	50,659	50,659	50,659	50,659	50,659	759,885
	Rural	78,423	78,423	78,423	78,423	78,423	78,423	78,423	78,423	78,423	78,423	78,423	78,423	78,423	78,423	78,423	1,176,351
Sub-Total in Financial		129,082	129,082	129,082	129,082	129,082	129,082	129,082	129,082	129,082	129,082	129,082	129,082	129,082	129,082	129,082	1,936,236
Sub-Total in Economic		77,449	77,449	77,449	77,449	77,449	77,449	77,449	77,449	77,449	77,449	77,449	77,449	77,449	77,449	77,449	1,161,738
C	Urban	18,894	18,894	18,894	18,894	18,894	31,002	31,002	31,002	31,002	31,002	31,002	31,002	31,002	31,002	31,002	404,492
	Rural	27,961	27,961	27,961	27,961	27,961	27,961	27,961	27,961	27,961	27,961	27,961	27,961	27,961	27,961	27,961	419,414
Sub-Total in Financial		46,855	46,855	46,855	46,855	46,855	58,963	58,963	58,963	58,963	58,963	58,963	58,963	58,963	58,963	58,963	823,906
Sub-Total in Economic		28,113	28,113	28,113	28,113	28,113	35,378	35,378	35,378	35,378	35,378	35,378	35,378	35,378	35,378	35,378	494,344
D	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rural	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	121,075
Sub-Total in Financial		8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	8,072	121,075
Sub-Total in Economic		4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	72,648
E	Urban	40,251	40,251	40,251	40,251	40,251	40,251	40,251	40,251	40,251	40,251	40,251	40,251	40,251	40,251	40,251	603,765
	Rural	104,186	104,186	104,186	104,186	104,186	104,186	104,186	104,186	104,186	104,186	104,186	104,186	104,186	104,186	104,186	1,562,787
Sub-Total in Financial		144,437	144,437	144,437	144,437	144,437	144,437	144,437	144,437	144,437	144,437	144,437	144,437	144,437	144,437	144,437	2,166,552
Sub-Total in Economic		86,662	86,662	86,662	86,662	86,662	86,662	86,662	86,662	86,662	86,662	86,662	86,662	86,662	86,662	86,662	1,299,933
Grand Total	Urban	134,423	134,423	134,423	134,423	134,423	146,531	146,531	146,531	146,531	146,531	146,531	146,531	146,531	146,531	146,531	2,137,428
	Rural	281,313	281,313	281,313	343,726	343,726	343,726	343,726	343,726	343,726	343,726	343,726	343,726	343,726	343,726	343,726	4,968,644
Sub-Total in Financial		415,736	415,736	415,736	478,149	478,149	490,257	490,257	490,257	490,257	490,257	490,257	490,257	490,257	490,257	490,257	7,106,071
Sub-Total in Economic		249,442	249,442	249,442	286,889	286,889	294,154	294,154	294,154	294,154	294,154	294,154	294,154	294,154	294,154	294,154	4,263,644

Table 3.2.21 Annual Disbursement of Cost for Dams for Potable Water Supply

Zone E in Mid-Term Target Year Component (million Rials)

Cost	-5th Year	-4th Year	-3rd Year	-2nd Year	-1st Year	Base Year	1st year	2nd year	3rd year	4th year	Total Cost
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Financial Cost											
Shafreh Bijar Dam	78,227	78,227	78,227	78,227	78,227	78,227	78,227	78,227	78,227	78,227	782,274
Economic Cost											
Shafreh Bijar Dam	46,936	46,936	46,936	46,936	46,936	46,936	46,936	46,936	46,936	46,936	469,364

Zone A in Long Term Target Year Component (million Rials)

Cost	1st year	2nd year	3rd year	4th year	5th year	6st year	7ndh year	Total Cost
	2010	2011	2012	2013	2014	2015	2016	
Financial Cost								
Hasankhan Dam	14,711	14,711	14,711	14,711	14,711	14,711	14,711	102,975
Economic Cost								
Hasankhan Dam	8,826	8,826	8,826	8,826	8,826	8,826	8,826	61,785

Zone C in Long Term Target Year Component (million Rials)

Cost	8th year	9th year	10th year	11th year	12th year	Total Cost
	2017	2018	2019	2020	2021	
Financial Cost						
Befrajerd Dam	47,142	47,142	47,142	47,142	47,142	235,712
Economic Cost						
Befrajerd Dam	28,285	28,285	28,285	28,285	28,285	141,427

3.2.3 Economic Evaluation

The economic evaluation is to be made by using a cash flow of the economic benefit and the economic cost of the projects under4 the said conditions. The Operation and Maintenance costs (OM Cost) are assumed at 0.5 for both the dam construction and the other works expediently. Project life is set at 30 years from each target year. And, the discount rate is adopted at 10 % based on suggestion of the World Bank (= the International Bank for Rehabilitation and Development, the IBRD). The evaluation results are shown in the following table.

Table 3.2.22 Evaluation Results by Zone

Zone	Target Year	Indices		
		NPV	EIRR	B/C
A	Mid-Term Target Year	-333,900	8.85%	0.88
	Long Term Target Year	-324,482	9.17%	0.90
B	Mid-Term Target Year	-43,634	9.71%	0.96
	Long Term Target Year	37,874	10.14%	1.02
C	Mid-Term Target Year	-680,013	5.48%	0.87
	Long Term Target Year	-682,239	6.68%	0.60
D	Mid-Term Target Year	19,007	14.13%	1.36
	Long Term Target Year	43,297	15.94%	1.38
E	Mid-Term Target Year	-748,772	4.75%	0.56
	Long Term Target Year	-453,531	8.15%	0.79

(Note) NPV: million Rials.

3.3 ECONOMIC EVALUATION BY PROVINCE

3.3.1 Identification of Economic Benefit

1) Identification of Agricultural Benefit

a) Identification of Farm Gate Prices of Crops

Farm gate price of crops should be same in both the economic evaluation by zone and by province. Accordingly, the farm gate price of crops estimated in previous sub-clause can be applied for the economic evaluation by province.

b) Effect of Irrigation System Improvement

In the case of this Project, there are 2 components as irrigation improvement effects in the economic evaluation by provinces too as same as in the economic evaluation by zones. The first one is to evaluate the effect of improvement of an agricultural productivity derived from the irrigation improvement for farm lands under control of surface water and groundwater. And the others are to evaluate the effect of agricultural production to be newly developed by using water from dams, the effect of improvement of an agricultural productivity derived from the irrigation improvement for current farm lands using water from the same dams. The latter ones are to be as one component because that those are the effects of agricultural production derived from the same dams.

The former one is expected from improvement of farm lands from traditional irrigation systems to modern irrigation systems, and the latter one is expected to generate new agricultural production from rain-fed area or fallow area (because of lack of water) due to be developed as new modern irrigation farm lands.

i) Effects of Irrigation System Improvement of Farm Lands under Surface Water and Groundwater

Current agricultural areas by irrigated and rain-fed farm land are as shown in the following table in each Province by crops.

Table 3.3.1 Current Agricultural Area by Crops, Irrigated and Rain-fed Farm Lands and Provinces

(ha)

Province	Wheat			Barley			Paddy			Pulses		
	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total
E.Azarbaijan	14,720	115,773	130,493	2,509	17,739	20,248	2,076	14,777	16,853	1,009	7,634	8,643
Ardebil	4,234	16,988	21,222	1,528	6,124	7,652	260	1,166	1,426	127	520	647
Tehran	115	144	259	94	117	211	108	134	242	70	86	156
Zanjan	16,565	68,798	85,363	8,324	34,475	42,799	1,822	7,460	9,282	4,986	20,749	25,735
Qazvin	1,188	1,549	2,737	811	1,050	1,861	895	1,113	2,008	425	531	956
Kordestan	14,818	151,818	166,636	2,121	20,634	22,755	25	106	131	290	2,949	3,239
Gilan	347	482	829	226	304	530	209,046	3,475	212,521	117	148	265
Hamedan	1,606	13,308	14,914	437	2,560	2,997	0	0	0	32	247	279
Total	53,593	368,860	422,453	16,050	83,003	99,053	214,232	28,231	242,463	7,056	32,864	39,920

Province	Alfalfa			Other Crops			Orchard			Total		
	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total
E.Azarbaijan	21,504	166,533	188,037	9,662	72,234	81,896	10,199	80,854	91,053	61,679	475,544	537,223
Ardebil	7,720	29,961	37,681	5,247	21,738	26,985	2,286	9,125	11,411	21,402	85,622	107,024
Tehran	822	1,022	1,844	630	784	1,414	941	1,170	2,111	2,780	3,457	6,237
Zanjan	27,293	114,889	142,182	15,167	58,176	73,343	11,821	48,948	60,769	85,978	353,495	439,473
Qazvin	628	901	1,529	3,761	4,708	8,469	740	977	1,717	8,448	10,829	19,277
Kordestan	18,574	189,056	207,630	6,415	65,563	71,978	2,720	26,391	29,111	44,963	456,517	501,480
Gilan	216	328	544	1,201	38,696	39,897	179	37,609	37,788	211,332	81,042	292,374
Hamedan	1,698	11,987	13,685	721	6,024	6,745	539	2,949	3,488	5,033	37,075	42,108
Total	78,455	514,677	593,132	42,804	267,923	310,727	29,425	208,023	237,448	441,615	1,503,581	1,945,196

Source: WRMC (MG).

Net agricultural production by each Province can be estimated the agricultural area indicated in the above table multiplied by the net unit farm gate price as shown in Table 3.2.4. Namely, these are the economic benefit in case of "Without-Project" in agricultural sector. Estimated results are shown in the following table in case of Province.

Table 3.3.2 Estimated Current Amount of Agricultural Production by Provinces, Irrigated and Rain-fed Farm Land, and Crops

(million Rials)

Province	Wheat			Barley			Paddy			Pulses		
	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total
East Azarbaijan	9,206	-17,451	-8,246	352	2	354	1,174	0	1,174	4,045	-3,019	1,026
Ardebil	2,648	-2,561	87	214	1	215	147	0	147	509	-206	303
Tehran	72	-22	50	13	0	13	61	0	61	281	-34	247
Zanjan	10,360	-10,370	-11	1,167	4	1,171	1,031	0	1,031	19,986	-8,206	11,781
Qazvin	743	-233	509	114	0	114	506	0	506	1,704	-210	1,494
Kordestan	9,267	-22,885	-13,618	297	3	300	14	0	14	1,162	-1,166	-4
Gilan	217	-73	144	32	0	32	118,262	0	118,262	469	-59	410
Hamedan	1,004	-2,006	-1,002	61	0	62	0	0	0	128	-98	31
Total	33,517	-55,601	-22,084	2,250	10	2,261	121,196	0	121,196	28,284	-12,997	15,287

Province	Alfalfa			Other Crops			Orchard			Overall Target Provinces		
	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total	Irrigated Farm Land	Rain-fed Farm Land	Total
East Azarbaijan	489,919	712,388	1,202,307	145,986	-582,947	-436,961	266,412	-667,781	-401,368	917,094	-558,808	358,286
Ardebil	175,882	128,166	304,048	79,278	-175,431	-96,153	59,714	-75,364	-15,651	318,393	-125,395	192,998
Tehran	18,727	4,372	23,099	9,519	-6,327	3,192	24,580	-9,663	14,917	53,253	-11,674	41,579
Zanjan	621,808	491,467	1,113,275	229,163	-469,495	-240,333	308,781	-404,266	-95,485	1,192,296	-400,866	791,430
Qazvin	14,308	3,854	18,162	56,826	-37,995	18,831	19,330	-8,069	11,261	93,530	-42,653	50,877
Kordestan	423,166	808,736	1,231,901	96,926	-529,110	-432,184	71,050	-217,966	-146,915	601,883	37,611	639,495
Gilan	4,921	1,403	6,324	18,146	-312,287	-294,140	4,676	-310,616	-305,940	146,723	-621,631	-474,908
Hamedan	38,685	51,277	89,962	10,894	-48,615	-37,721	14,079	-24,356	-10,277	64,852	-23,797	41,055
Total	1,787,416	2,201,663	3,989,080	646,738	-2,162,208	-1,515,470	768,623	-1,718,081	-949,458	3,388,024	-1,747,213	1,640,811

Here, agricultural productivity per unit agricultural area should be made to clear. Because that, if the irrigated farm land will be increased in the future at the time of mid-term target (2016) and of long term target (2031), kinds of crops to be planted are unknown.

The productivity can be identified by total production shown in Table 3.3.2 divided by the agricultural area shown in Table 3.3.1. As already discussed in the other Chapter, the irrigation efficiencies in mid-term target year of 2016 and long term target year of 2031 are set as 40 % and 50 % respectively. Accordingly, agricultural productivity per ha should be increased too. The increasing is to be made by proportion

of improved irrigation efficiency against current irrigation efficiency. Following table shows their estimation results in the existing case, in the case of mid-term target year, and in the case of long term target year.

Table 3.3.3 Unit Agricultural Productivity by Province

Province	Irrigated Farm Land (ha)	Current Irrigation Efficiency (%)	Productivity (Rials/ha)		
			Existing Productivity	Productivity in 2016	Productivity in 2031
East Azarbaijan	61,679	32.69	14,868,822	18,192,213	22,740,267
Ardebil	21,402	33.65	14,876,776	17,684,159	22,105,199
Tehran	2,780	32.79	19,155,856	23,364,854	29,206,067
Zanjan	85,978	31.91	13,867,455	17,381,726	21,727,157
Qazvin	8,448	32.88	11,071,266	13,467,251	16,834,063
Kordestan	44,963	35.58	13,386,190	15,051,028	18,813,785
Gilan	211,332	35.07	694,275	950,316	1,088,904
Hamedan	5,033	34.10	12,885,394	15,114,915	18,893,644
Total/Overall Average	441,615	34.04	6,889,833	9,346,083	11,635,232

In the above table, because that the irrigation efficiency of a part of Gilan Province is keeping 42 % at present, so that it this case it is set at 48 % for the mid-term target year, and 55 % for the long term target year.

Gross agricultural production can be estimated by production amount per unit area (ha), in other words “agricultural productivity per unit agricultural area” shown in the above table multiplying the current and improved farm lands’ area in irrigation systems under the surface water and groundwater. This means an economic gross agricultural benefit. Estimation results shown in the table hereunder.

Table 3.3.4 Economic Agricultural Benefit in Total under Surface Water and Groundwater by Province

Province	Traditional Irrigation Farm Land (ha)	Improved Irrigated Farm Land in 2016 (ha)	Improved Irrigated Farm Land in 2031 (ha)	Total Agricultural Production (million Rials)		
				Current Production	Production in 2016	Production in 2031
East Azarbaijan	58,946	15,793	36,618	876,458	928,944	1,164,694
Ardebil	18,120	4,334	10,663	269,567	281,734	346,644
Tehran	2,794	750	1,772	53,521	56,678	71,330
Zanjan	86,599	25,650	52,873	1,200,908	1,291,049	1,616,474
Qazvin	8,555	2,222	4,982	94,715	100,039	123,425
Kordestan	44,109	5,511	22,002	590,451	599,626	709,869
Gilan	211,338	67,144	148,439	146,727	163,918	205,305
Hamedan	5,002	908	2,866	64,453	66,477	81,672
Total	435,463	122,312	280,215	3,296,799	3,488,466	4,319,414

In the above table, the area of farm lands are changed from those of traditional irrigation farm lands to those in Mid-Term target year and Long-Term target because that a part of farm lands would be shifted to those under dams control.

The current production in “Total Agricultural Production” expresses an economic agricultural benefit in terms of “Without Project”. Accordingly, the net economic agricultural benefits at the time of mid-term target year and at the time of long term target year are the amount by subtracting the amount of “Current Production” from the amount of the “Production” in 2016 and that in 2031 respectively. Following table shows its estimation results.

Table 3.3.5 Incremental Increased Agricultural Production of Farm Lands under Surface Water and Groundwater in Target Yeas by Province

Province	Incremental Increased Agricultural Production in Target Years (million Rials)	
	Production in 2016	Production in 2031
East Azarbaijan	52,486	288,237
Ardebil	12,167	77,077
Tehran	3,157	17,809
Zanjan	90,141	415,566
Qazvin	5,324	28,710
Kordestan	9,175	119,418
Gilan	17,192	58,578
Hamedan	2,024	17,220
Total	191,666	1,022,614

ii) Economic Agricultural Benefit of Newly Developed Farm Lands and Improved Farm Lands on Irrigation Systems under Dam Control

An across-the-board of Irrigation efficiency of 60 % is set for the newly developed farm lands and improved farm lands on irrigation systems under dam control. Accordingly, the irrigation efficiency of farm lands under the surface water and groundwater shown in Table 3.3.3 should be revised upwards. Following table shows the productivities of the newly developed farm lands and improved farm lands on irrigation system after completion of dams.

Table 3.3.6 Unit Agricultural Productivity of Farm Lands under Dam Control by Province

Province	Current Irrigation Efficiency (%)	Existing Productivity (Rials/ha)	Productivity after Dam Completion (Rials/ha)
East Azarbaijan	32.69	14,868,822	27,288,320
Ardebil	33.65	14,876,776	26,526,238
Tehran	32.79	19,155,856	35,047,280
Zanjan	31.91	13,867,455	26,072,589
Qazvin	32.88	11,071,266	20,200,876
Kordestan	35.58	13,386,190	22,576,542
Gilan	35.07	694,275	1,187,895
Hamedan	34.10	12,885,394	22,672,373
Total/Overall Average	34.04	6,889,833	12,143,341

And, the following table shows areas of newly developed farm lands and improved farm lands of traditional irrigation systems to the modern irrigation systems after completion of dams.

Table 3.3.7 Provincial Areas of Newly Developed Farm Land and Improved Farm Lands on Irrigation Systems under Dam Control after Completion of Dams

(ha)

Province/Dam	Farm Lands under Dam Control		
	Newly Developed Farm Lands	Improved Farm Lands on Irrigation Systems	Total Farm Lands under Dam Control
East Azarbaijan	34,300	4,190	38,490
Aydughmush	13,700	1,300	15,000
Sahand	10,300	600	10,900
Garmichay	2,300	1,200	3,500
Kalghan	1,500	1,090	2,590
Ostor	6,500	0	6,500
Ardebil	9,650	2,052	11,702
Givi	6,300	927	7,227
Sangabad	1,625	600	2,225
Niyakhram	675	225	900
Tabrizak	450	150	600
Hashtjin	600	150	750
Zanjan	75,652	7,684	83,336
Taham	0	400	400
Golabar	7,900	1,400	9,300
Talvar	29,500	0	29,500
Mushampa	26,000	4,000	30,000
Ramin	0	196	196
Mehtar	900	100	1,000
Ghezel Tappe	450	108	558
Mendagh	9,000	0	9,000
Songhor	900	900	1,800
Chasb	912	270	1,182
Alan	90	310	400
Qazvin	1,079	1,201	2,280
Burmanak	1,079	1,201	2,280
Kordestan	43,404	7,096	50,500
Hassankhan/Golblakh	800	0	800
Siazakh	21,246	754	22,000
Sange Siah	3,400	0	3,400
Sural	1,008	192	1,200
Babakhan	5,950	50	6,000
Sheikhe Besharat	0	1,500	1,500
Aledareh	0	2,100	2,100
Sir	6,000	0	6,000
Zardekamar	5,000	2,500	7,500
Total	164,085	22,223	186,308

Agricultural production, namely economic agricultural benefit of newly developed farm lands and improved farm lands on irrigation systems under dam control can be estimated by using unit agricultural productivity of farm lands under dam control

shown in Table 3.3.6 multiplying the above areas of farm lands under dam control. However, the said economic agricultural benefit should be based on "With-" and "Without-Project", so that the net benefit should be estimated taking current agricultural production into consideration for the improved farm lands on irrigation systems. Following table shows the estimated results.

Table 3.3.8 Provincial Economic Agricultural Benefit of Newly Developed Farm Land and Improved Farm Lands on Irrigation Systems under Dam Control after Completion of Dams

(million Rials)

Province/Dam	Farm Lands under Dam Control				
	Newly Developed Farm Lands	Improved Farm Lands on Irrigation Systems			Total Incremental Agricultural Production
		Current Production	Improved Production	Incremental Agricultural Production	
East Azarbaijan	935,989	62,300	114,338	52,038	988,027
Aydughmush	373,850	19,329	35,475	16,145	389,995
Sahand	281,070	8,921	16,373	7,452	288,521
Garmichay	62,763	17,843	32,746	14,903	77,667
Kalghan	40,932	16,207	29,744	13,537	54,470
Ostor	177,374	0	0	0	177,374
Ardebil	255,978	30,527	54,432	23,905	279,883
Givi	167,115	13,791	24,590	10,799	177,914
Sangabad	43,105	8,926	15,916	6,990	50,095
Niyakhram	17,905	3,347	5,968	2,621	20,526
Tabrizak	11,937	2,232	3,979	1,747	13,684
Hashtjin	15,916	2,232	3,979	1,747	17,663
Zanjan	1,972,443	106,558	200,342	93,784	2,066,228
Taham	0	5,547	10,429	4,882	4,882
Golabar	205,973	19,414	36,502	17,087	223,061
Talvar	769,141	0	0	0	769,141
Mushampa	677,887	55,470	104,290	48,821	726,708
Ramin	0	2,718	5,110	2,392	2,392
Mehtar	23,465	1,387	2,607	1,221	24,686
Ghezel Tappe	11,733	1,498	2,816	1,318	13,051
Mendagh	234,653	0	0	0	234,653
Songhor	23,465	12,481	23,465	10,985	34,450
Chasb	23,778	3,744	7,040	3,295	27,074
Alan	2,347	4,299	8,083	3,784	6,130
Qazvin	21,797	13,297	24,261	10,965	32,761
Burmanak	21,797	13,297	24,261	10,965	32,761
Kordestan	979,912	94,988	160,203	65,215	1,045,127
Hassankhan/Golblakh	18,061	0	0	0	18,061
Siazakh	479,661	10,093	17,023	6,930	486,591
Sange Siah	76,760	0	0	0	76,760
Sural	22,757	2,570	4,335	1,765	24,522
Babakhan	134,330	669	1,129	460	134,790
Sheikhe Besharat	0	20,079	33,865	13,786	13,786
Aledareh	0	28,111	47,411	19,300	19,300
Sir	135,459	0	0	0	135,459
Zardekamar	112,883	33,465	56,441	22,976	135,859
Total	4,166,120	307,670	553,576	245,906	4,412,026

2) Identification of Economic Benefit on Potable Water Supply

a) Potable Water Supply Volume

The potable water demand shown in the following table is arranged one on data coming from WRMC. They have a plan to supply of potable water based on these demands.

Table 3.3.9 Designed Supply Water Volume at Each Situation in Urban and Rural Areas by Province

($1,000\ m^3$)

Province	Potable Water Demand in Urban Area			Potable Water Demand in Rural Area		
	Current Demand	Demand in 2016	Demand in 2031	Current Demand	Demand in 2016	Demand in 2031
East Azarbaijan	16,303	20,818	28,537	20,765	30,566	45,266
Ardebil	6,201	8,716	12,057	6,986	10,269	15,194
Tehran	0	0	0	787	1,087	1,538
Zanjan	57,946	73,811	102,670	34,058	50,345	74,772
Qazvin	0	0	0	5,569	7,694	10,882
Kordestan	20,345	27,679	42,451	21,154	33,105	51,032
Gilan	151,605	193,187	262,227	113,045	150,338	206,278
Hamedan	0	0	0	4,026	6,340	9,809
Total	252,400	324,211	447,942	206,389	289,745	414,772

In this case also as same as the case of the economic evaluation by Zone, incremental increased water volume to be supplied should be made clear based on the concept of "With-" and "Without the Project" in the mid-term target year and long term target year. Estimation results are shown in the following table.

Table 3.3.10 Provincial Incremental Increased Potable Water Volume to Be Supplied in Target Years in Urban and Rural Areas

(1,000 m^3)

Province	Potable Water Demand in Urban Area		Potable Water Demand in Rural Area	
	Demand in 2016	Demand in 2031	Demand in 2016	Demand in 2031
East Azarbaijan	4,515	12,234	9,802	24,502
Ardebil	2,515	5,856	3,283	8,208
Tehran	0	0	300	751
Zanjan	15,865	44,724	16,286	40,714
Qazvin	0	0	2,126	5,314
Kordestan	7,334	22,106	11,951	29,878
Gilan	41,582	110,622	37,294	93,234
Hamedan	0	0	2,314	5,783
Total	71,811	195,542	83,355	208,383

b) Identification of Basic Unit of Economic Benefit on Potable Water Supply

As same as the case of economic evaluation by Zone, the basic unit of economic benefit for potable water supply is to be 3,649Rials/m^3 on the basis of the result of the field interview survey.

c) Estimation of Economic Benefit on Potable Water Supply

Then, the economic benefit under the completion of potable water supply facilities including the purification plant together with intake facilities and water distribution networks the incremental potable water volume to be supplied as discussed above can be estimated by using incremental potable water volume multiplying the said basic unit for estimation of economic benefit in each target year.

The result of estimation is as shown in the following table.

Table 3.3.11 Provincial Incremental Economic Benefit on Completion of Potable Water Supply Facilities in Urban and Rural Areas

(million Rials)

Zone	Potable Water Demand in Urban Area		Potable Water Demand in Rural Area	
	Demand in 2016	Demand in 2031	Demand in 2016	Demand in 2031
East Azarbaijan	16,474	44,641	35,765	89,403
Ardebil	9,178	21,368	11,980	29,949
Tehran	0	0	1,096	2,740
Zanjan	57,889	163,193	59,426	148,560
Qazvin	0	0	7,757	19,390
Kordestan	26,762	80,662	43,607	109,023
Gilan	151,727	403,647	136,081	340,200
Hamedan	0	0	8,443	21,102
Total	262,030	713,511	304,155	760,367

3.3.2 Identification of Economic Cost

The economic evaluation is to be made by comparison between economic benefit and economic cost as previously discussed. Accordingly, the financial cost resulted from cost estimation of the project should be converted into the economic cost.

In this case, the standard conversion factor for estimating a economic price of trading goods under the free competitive market, transfer items as taxes, shadow wage rate for unskilled labors, shadow land price rate for estimating economic price of lands to be acquired under free trading market and so on have to be considered. In this Project, a conversion factor of economic cost against

financial cost is assumed at 60 % against the financial cost based on similar projects in Iran as same manner in case of economic evaluation by Zone.

Annual disbursement by each province modified based on that in case of economic evaluation by zone is shown hereunder.

Table 3.3.12 Annual Disbursement of Cost for Development of Farm Lands under Surface Water and Groundwater, and Dam Construction Costs and Cost for Farm Lands under Dam Control in Case of Mid-Term Target Year by Province

East Azarbaijan

(million Rials)

Cost	-13th Year 1996	-12th Year 1997	-11th Year 1998	-10th Year 1999	-9th Year 2000	-8th Year 2001	-7th Year 2002	-6th Year 2003	-5th Year 2004	-4th Year 2005	-3rd Year 2006	-2nd Year 2007	-1st Year 2008	Base Year 2009	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost																						
Under Surface Water and Groundwater																						
Improvement of Irrigation Ssytems under Surface Water and Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	216,593	216,593	216,593	216,593	216,593	216,593	216,593	1,516,153
Dam Construction	114,707	114,707	114,707	114,707	114,707	263,918	318,304	318,304		253,200	253,200	291,029	291,029	241,426	241,426	241,426	241,426	92,215	0	0	0	3,712,651
Development and Improvement of Farm Lands	0	0	0	0	0	0	0	0	136,062	136,062	136,062	136,062	279,795	279,795	279,795	279,795	435,795	435,795	661,075	661,075	661,075	4,518,240
Economic Cost																						
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	129,956	129,956	129,956	129,956	129,956	129,956	129,956	909,692
Dam Construction	68,824	68,824	68,824	68,824	68,824	158,351	190,982	190,982	151,920	151,920	174,617	174,617	144,855	144,855	144,855	144,855	55,329	55,329	0	0	0	2,227,591
Development and Improvement of Farm Lands under Dam Control	0	0	0	0	0	0	0	0	81,637	81,637	81,637	81,637	167,877	167,877	167,877	167,877	261,477	261,477	396,645	396,645	396,645	2,710,944
Economic Cost in Total	68,824	68,824	68,824	68,824	68,824	158,351	190,982	190,982	233,557	233,557	256,254	256,254	312,732	312,732	442,688	442,688	446,762	446,762	526,601	526,601	526,601	5,848,226

Ardebil

(million Rials)

Cost	-5th Year 2004	-4th Year 2005	-3rd Year 2006	-2nd Year 2007	-1st Year 2008	Base Year 2009	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost														
Under Surface Water and Groundwater														
Improvement of Irrigation Ssytems under Surface Water and Groundwater							59,431	59,431	59,431	59,431	59,431	59,431	59,431	416,020
Sub-total for Dam Construction	118,307	118,307	118,307	118,307	118,307	118,307	118,307	118,307	0	0	0	0	0	946,453
Sub-total for Development and Improvement of Farm Lands	0	0	0	0	0	0	0	0	168,998	168,998	168,998	168,998	168,998	844,992
Economic Cost														
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	0	0	0	0	0	0	35,659	35,659	35,659	35,659	35,659	35,659	35,659	249,612
Dam Construction	70,984	70,984	70,984	70,984	70,984	70,984	70,984	70,984	0	0	0	0	0	567,872
Development and Improvement of Farm Lands under Dam Control	0	0	0	0	0	0	0	0	101,399	101,399	101,399	101,399	101,399	506,995
Economic Cost in Total	70,984	70,984	70,984	70,984	70,984	70,984	106,643	106,643	137,058	137,058	137,058	137,058	137,058	1,324,479

Tehran

(million Rials)

Cost	Base Year 2009	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost									
Under Surface Water and Groundwater									
Improvement of Irrigation Ssytems under Surface Water and Groundwater	0	3,428	3,428	3,428	3,428	3,428	3,428	3,428	23,999
Economic Cost									
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	0	2,057	2,057	2,057	2,057	2,057	2,057	2,057	14,399
Economic Cost in Total	0	2,057	2,057	2,057	2,057	2,057	2,057	2,057	14,399

Zanjan

(million Rials)

Cost	-10th Year 1999	-9th Year 2000	-8th Year 2001	-7th Year 2002	-6th Year 2003	-5th Year 2004	-4th Year 2005	-3rd Year 2006	-2nd Year 2007	-1st Year 2008	Base Year 2009	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost																			
Under Surface Water and Groundwater																			
Improvement of Irrigation Ssytems under Surface Water and Groundwater												345,260	345,260	345,260	345,260	345,260	345,260	345,260	2,416,820
Dam Construction	43,239	43,239	421,393	421,393	421,393	421,393	421,393	161,334	118,095	118,095	118,095	118,095	118,095	118,095	118,095	118,095	118,095	0	3,417,630
Development and Improvement of Farm Lands			0	0	0	0	0	321,818	430,058	430,058	430,058	430,058	430,058	430,058	430,058	430,058	430,058	468,458	4,660,800
Economic Cost																			
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	0	0	0	0	0	0	0	0	0	0	0	207,156	207,156	207,156	207,156	207,156	207,156	207,156	1,450,092
Dam Construction	25,943	25,943	252,836	252,836	252,836	252,836	252,836	96,800	70,857	70,857	70,857	70,857	70,857	70,857	70,857	70,857	70,857	0	2,050,578
Development and Improvement of Farm Lands under Dam Control	0	0	0	0	0	0	0	193,091	258,035	258,035	258,035	258,035	258,035	258,035	258,035	258,035	258,035	281,075	2,796,480
Economic Cost in Total	25,943	25,943	252,836	252,836	252,836	252,836	252,836	289,891	328,892	328,892	328,892	536,048	536,048	536,048	536,048	536,048	536,048	488,231	6,297,150

Qazvin

(million Rials)

Cost	Base Year 2009	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost									
Under Surface Water and Groundwater									
Improvement of Irrigation Ssytems under Surface Water and Groundwater	0	10,411	10,411	10,411	10,411	10,411	10,411	10,411	72,880
Economic Cost									
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	0	6,247	6,247	6,247	6,247	6,247	6,247	6,247	43,728
Economic Cost in Total	0	6,247	6,247	6,247	6,247	6,247	6,247	6,247	43,728

Kordestan

(million Rials)

Cost	-8th Year 2001	-7th Year 2002	-6th Year 2003	-5th Year 2004	-4th Year 2005	-3rd Year 2006	-2nd Year 2007	-1st Year 2008	Base Year 2009	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost																	
Under Surface Water and Groundwater																	
Improvement of Irrigation Ssytems under Surface Water and Groundwater										75,583	75,583	75,583	75,583	75,583	75,583	75,583	529,078
Dam Construction	117,277	117,277	117,277	117,277	117,277	117,277	0	45,767	45,767	81,999	81,999	81,999	0	0	0	0	1,041,190
Development and Improvement of Farm Lands	0	0	0	0	0	0	262,190	262,190	262,190	262,190	262,190	262,190	433,886	433,886	364,190	364,190	3,169,296
Economic Cost																	
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	0	0	0	0	0	0	0	0	0	45,350	45,350	45,350	45,350	45,350	45,350	45,350	317,447
Dam Construction	70,366	70,366	70,366	70,366	70,366	70,366	0	27,460	27,460	49,199	49,199	49,199	0	0	0	0	624,714
Development and Improvement of Farm Lands under Dam Control	0	0	0	0	0	0	157,314	157,314	157,314	157,314	157,314	157,314	260,332	260,332	218,514	218,514	1,901,578
Economic Cost in Total	70,366	70,366	70,366	70,366	70,366	70,366	157,314	184,774	184,774	251,863	251,863	251,863	305,681	305,681	263,864	263,864	2,843,738

Gilan (million Rials)

Cost	Base Year 2009	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	Total Cost
Financial Cost									
Under Surface Water and Groundwater									
Improvement of Irrigation Ssytems under Surface Water and Groundwater	0	307,156	307,156	307,156	307,156	307,156	307,156	307,156	2,150,091
Economic Cost									
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	0	184,294	184,294	184,294	184,294	184,294	184,294	184,294	1,290,055
Economic Cost in Total	0	184,294	184,294	184,294	184,294	184,294	184,294	184,294	1,290,055

Table 3.3.13 Annual Disbursement of Cost for Development of Farm Lands under Surface Water and Groundwater, and Dam Construction Costs and Cost for Farm Lands under Dam Control in Case of Long Term Target Year by Province

East Azarbaijan (million Rials)

Cost	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																
Under Surface Water and Groundwater																
Improvement of Irrigation Ssytems under Surface Water and Groundwater	133,276	133,276	133,276	133,276	133,276	133,276	133,276	133,276	133,276	133,276	133,276	133,276	133,276	133,276	133,276	1,999,138
Economic Cost																
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	1,199,483
Economic Cost in Total	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	79,966	1,199,483

Ardebil (million Rials)

Cost	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																
Under Surface Water and Groundwater																
Improvement of Irrigation Ssytems under Surface Water and Groundwater	40,509	40,509	40,509	40,509	40,509	40,509	40,509	40,509	40,509	40,509	40,509	40,509	40,509	40,509	40,509	607,636
Sub-total for Dam Construction	173,822	173,822	173,822	140,489	140,489	140,489	140,489	140,489	96,217	96,217	0	0	0	0	0	1,416,343
Sub-total for Development and Improvement of Farm Lands	0	0	0	43,200	43,200	0	0	0	68,400	0	186,800	84,200	84,200	0	0	510,000
Economic Cost																
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	24,305	24,305	24,305	24,305	24,305	24,305	24,305	24,305	24,305	24,305	24,305	24,305	24,305	24,305	24,305	364,582
Dam Construction	104,293	104,293	104,293	84,293	84,293	84,293	84,293	84,293	57,730	57,730	0	0	0	0	0	849,806
Development and Improvement of Farm Lands under Dam Control	0	0	0	25,920	25,920	0	0	0	41,040	0	112,080	50,520	50,520	0	0	306,000
Economic Cost in Total	128,599	128,599	128,599	134,519	134,519	108,599	108,599	108,599	123,076	82,036	136,385	74,825	74,825	24,305	24,305	1,520,387

Tehran

(million Rials)

Cost	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																
Under Surface Water and Groundwater																
Improvement of Irrigation Ssytems under Surface Water and Groundwater	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	32,707
Economic Cost																
Improvement of Irrigation Ssytems of Farm Lands under Surface Water and Groundwater	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	19,624
Economic Cost in Total	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	1,308	19,624

Zanjan

(million Rials)

Cost	1st year 2010	2nd year 2011	3rd year 2012	4th year 2013	5th year 2014	6th year 2015	7th year 2016	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																							
Under Surface Water and Groundwater																							
Improvement of Irrigation Systems under Surface Water and Groundwater								170,398	170,398	170,398	170,398	170,398	170,398	170,398	170,398	170,398	170,398	170,398	170,398	170,398	170,398	170,398	2,555,968
Dam Construction	306,907	306,907	306,907	306,907	306,907	306,907	347,441	294,961	294,961	294,961	221,133	221,133	88,642	88,642	88,642	88,642	40,534	40,534	40,534	40,534	40,534	0	4,121,382
Development and Improvement under Dam Control								233,600	233,600	233,600	391,760	233,600	518,480	518,480	353,600	353,600	417,968	353,600	353,600	353,600	353,600	252,416	5,155,104
Economic Cost																							
Improvement of Irrigation Systems under Surface Water and Groundwater	0	0	0	0	0	0	0	102,239	102,239	102,239	102,239	102,239	102,239	102,239	102,239	102,239	102,239	102,239	102,239	102,239	102,239	102,239	1,533,581
Dam Construction	184,144	184,144	184,144	184,144	184,144	184,144	208,465	176,977	176,977	176,977	132,680	132,680	53,185	53,185	53,185	53,185	24,320	24,320	24,320	24,320	24,320	0	2,443,964
Development and Improvement of Farm Lands under Dam Control	0	0	0	0	0	0	0	140,160	140,160	140,160	235,056	140,160	311,088	311,088	212,160	212,160	250,781	212,160	212,160	212,160	212,160	151,450	3,093,062
Economic Cost in Total	184,144	184,144	184,144	184,144	184,144	184,144	208,465	419,376	419,376	419,376	469,974	375,078	466,512	466,512	367,584	367,584	377,340	338,719	338,719	338,719	338,719	253,688	7,070,607

Qazvin

(million Rials)

Cost	8th year 2017	9th year 2018	10th year 2019	11th year 2020	12th year 2021	13th year 2022	14th year 2023	15th year 2024	16th year 2025	17th year 2026	18th year 2027	19th year 2028	20th year 2029	21st year 2030	22nd year 2031	Total Cost
Financial Cost																
Under Surface Water and Groundwater																
Improvement of Irrigation Systems under Surface Water and Groundwater	6,044	6,044	6,044	6,044	6,044	6,044	6,044	6,044	6,044	6,044	6,044	6,044	6,044	6,044	6,044	90,664
Dam Construction	56,865	56,865	56,865	56,865	56,865	56,865	56,865	56,865	56,865	56,865	0	0	0	0	0	568,650
Development and Improvement under Dam Control	0	0	0	0	0	0	0	0	0	0	27,197	27,197	27,197	0	0	81,592
Economic Cost																
Improvement of Irrigation Systems of Farm Lands under Surface Water and Groundwater	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	54,398
Dam Construction	34,119	34,119	34,119	34,119	34,119	34,119	34,119	34,119	34,119	34,119	0	0	0	0	0	341,190
Development and Improvement under Dam Control	0	0	0	0	0	0	0	0	0	0	16,318	16,318	16,318	0	0	48,955
Economic Cost in Total	37,746	37,746	37,746	37,746	37,746	37,746	37,746	37,746	37,746	37,746	19,945	19,945	19,945	3,627	3,627	444,544

Kordestan

(million Rials)

Cost	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year	16th year	17th year	18th year	19th year	20th year	21st year	22nd year	Total Cost
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Financial Cost																			
Under Surface Water and Groundwater																			
Improvement of Irrigation Systems under Surface Water and Groundwater				109,483	109,483	109,483	109,483	109,483	109,483	109,483	109,483	109,483	109,483	109,483	109,483	109,483	109,483	109,483	1,642,251
Dam Construction	45,767	45,767	148,330	240,430	240,430	240,430	240,430	240,430	148,330	148,330	102,563	102,563	0	0	0	0	0	0	1,943,797
Development and Improvement under Dam Control	0	0	0	0	0	0	0	0	139,200	139,200	172,200	105,000	344,800	344,800	344,800	344,800	344,800	344,800	2,624,400
Economic Cost																			
Improvement of Irrigation Systems under Surface Water and Groundwater	0	0	0	65,690	65,690	65,690	65,690	65,690	65,690	65,690	65,690	65,690	65,690	65,690	65,690	65,690	65,690	65,690	985,351
Dam Construction	27,460	27,460	88,998	144,258	144,258	144,258	144,258	144,258	88,998	88,998	61,538	61,538	0	0	0	0	0	0	1,166,278
Development and Improvement under Dam Control	0	0	0	0	0	0	0	0	83,520	83,520	103,320	63,000	206,880	206,880	206,880	206,880	206,880	206,880	1,574,640
Economic Cost in Total	27,460	27,460	88,998	209,948	209,948	209,948	209,948	209,948	238,208	238,208	230,548	190,228	272,570	272,570	272,570	272,570	272,570	272,570	3,726,269

Gilan

(million Rials)

Cost	8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year	16th year	17th year	18th year	19th year	20th year	21st year	22nd year	Total Cost
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Financial Cost																
Under Surface Water and Groundwater																
Improvement of Irrigation Systems under Surface Water and Groundwater	173,585	173,585	173,585	173,585	173,585	173,585	173,585	173,585	173,585	173,585	173,585	173,585	173,585	173,585	173,585	2,603,778
Economic Cost																
Improvement of Irrigation Systems of Farm Lands under Surface Water and Groundwater	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	1,562,267
Economic Cost in Total	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	104,151	1,562,267

Table 3.3.14 Annual Disbursement of Cost for Potable Water Supply Facilities in Case of Mid-Term Target Year by Province

(million Rials)

Province	Area	Mid-Term Annual Cost Disbursement Schedule for Potable Water Supply Facilities							
		1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	Total
		2010	2011	2012	2013	2014	2015	2016	
East Azerbaijan	Urban	21,421	21,421	21,421	21,421	21,421	21,421	21,421	149,950
	Rural	53,579	53,579	53,579	53,579	53,579	53,579	53,579	375,054
Sub-Total in Financial		75,001	75,001	75,001	75,001	75,001	75,001	75,001	525,004
Sub-Total in Economic		45,000	45,000	45,000	45,000	45,000	45,000	45,000	315,002
Ardebil	Urban	11,012	11,012	11,012	11,012	11,012	11,012	11,012	77,083
	Rural	14,854	14,854	14,854	14,854	14,854	14,854	14,854	103,977
Sub-Total in Financial		25,866	25,866	25,866	25,866	25,866	25,866	25,866	181,060
Sub-Total in Economic		15,519	15,519	15,519	15,519	15,519	15,519	15,519	108,636
Tehran	Urban	0	0	0	0	0	0	0	0
	Rural	3,801	3,801	3,801	3,801	3,801	3,801	3,801	26,606
Sub-Total in Financial		3,801	3,801	3,801	3,801	3,801	3,801	3,801	509,840
Sub-Total in Economic		2,281	2,281	2,281	2,281	2,281	2,281	2,281	15,964
Zanjan	Urban	62,566	62,566	62,566	62,566	62,566	62,566	62,566	437,963
	Rural	88,695	88,695	88,695	88,695	88,695	88,695	88,695	620,864
Sub-Total in Financial		151,261	151,261	151,261	151,261	151,261	151,261	151,261	1,058,827
Sub-Total in Economic		90,757	90,757	90,757	90,757	90,757	90,757	90,757	635,296
Qazvin	Urban	3,132	3,132	3,132	3,132	3,132	3,132	3,132	21,922
	Rural	10,237	10,237	10,237	10,237	10,237	10,237	10,237	71,660
Sub-Total in Financial		13,369	13,369	13,369	13,369	13,369	13,369	13,369	93,582
Sub-Total in Economic		8,021	8,021	8,021	8,021	8,021	8,021	8,021	56,149
Kordestan	Urban	26,415	26,415	26,415	26,415	26,415	26,415	26,415	184,908
	Rural	75,990	75,990	75,990	75,990	75,990	75,990	75,990	531,933
Sub-Total in Financial		102,406	102,406	102,406	102,406	102,406	102,406	102,406	716,841
Sub-Total in Economic		61,444	61,444	61,444	61,444	61,444	61,444	61,444	430,105
Gilan	Urban	62,145	62,145	62,145	62,145	934,005	934,005	934,005	3,050,593
	Rural	148,838	148,838	148,838	148,838	148,838	148,838	148,838	1,060,131
Sub-Total in Financial		210,983	210,983	210,983	210,983	1,082,843	1,082,843	1,082,843	4,088,044
Sub-Total in Economic		126,590	126,590	126,590	126,590	649,706	649,706	649,706	2,455,475
Grand Total	Urban	186,691	186,691	186,691	186,691	1,058,551	1,058,551	1,058,551	3,922,419
	Rural	395,994	395,994	395,994	395,994	395,994	395,994	395,994	2,790,225
Sub-Total in Financial		582,686	582,686	582,686	582,686	1,454,546	1,454,546	1,454,546	7,173,198
Sub-Total in Economic		349,611	349,611	349,611	349,611	872,727	872,727	872,727	4,016,627

Table 3.3.15 Annual Disbursement of Cost for Potable Water Supply Facilities in Case of Long Term Target Year by Province

(million Rials)

Province	Area	Long Term Annual Cost Disbursement Schedule for Potable Water Supply Facilities															
		8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year	16th year	17th year	18th year	19th year	20th year	21st year	22nd year	Total
		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
East Azerbaijan	Urban	14,940	14,940	14,940	14,940	14,940	14,940	14,940	14,940	14,940	14,940	14,940	14,940	14,940	14,940	14,940	224,107
	Rural	37,503	37,503	37,503	37,503	37,503	37,503	37,503	37,503	37,503	37,503	37,503	37,503	37,503	37,503	37,503	562,546
Sub-Total in Financial		52,444	52,444	52,444	52,444	52,444	52,444	52,444	52,444	52,444	52,444	52,444	52,444	52,444	52,444	52,444	786,653
Sub-Total in Economic		31,466	31,466	31,466	31,466	31,466	31,466	31,466	31,466	31,466	31,466	31,466	31,466	31,466	31,466	31,466	471,992
Ardebil	Urban	540	540	540	540	540	12,648	12,648	12,648	12,648	12,648	12,648	12,648	12,648	12,648	12,648	129,179
	Rural	10,397	10,397	10,397	10,397	10,397	10,397	10,397	10,397	10,397	10,397	10,397	10,397	10,397	10,397	10,397	155,958
Sub-Total in Financial		10,937	10,937	10,937	10,937	10,937	23,045	23,045	23,045	23,045	23,045	23,045	23,045	23,045	23,045	23,045	285,137
Sub-Total in Economic		6,562	6,562	6,562	6,562	6,562	13,827	13,827	13,827	13,827	13,827	13,827	13,827	13,827	13,827	13,827	171,082
Tehran	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rural	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	39,903
Sub-Total in Financial		2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	2,660	39,903
Sub-Total in Economic		1,596	1,596	1,596	1,596	1,596	1,596	1,596	1,596	1,596	1,596	1,596	1,596	1,596	1,596	1,596	23,942
Zanjan	Urban	51,863	51,863	51,863	51,863	51,863	51,863	51,863	51,863	51,863	51,863	51,863	51,863	51,863	51,863	51,863	777,941
	Rural	62,085	62,085	62,085	62,085	62,085	62,085	62,085	62,085	62,085	62,085	62,085	62,085	62,085	62,085	62,085	931,281
Sub-Total in Financial		113,948	113,948	113,948	113,948	113,948	113,948	113,948	113,948	113,948	113,948	113,948	113,948	113,948	113,948	113,948	1,709,222
Sub-Total in Economic		68,369	68,369	68,369	68,369	68,369	68,369	68,369	68,369	68,369	68,369	68,369	68,369	68,369	68,369	68,369	1,025,533
Qazvin	Urban	1,810	1,810	1,810	1,810	1,810	1,810	1,810	1,810	1,810	1,810	1,810	1,810	1,810	1,810	1,810	27,150
	Rural	7,165	7,165	7,165	7,165	7,165	7,165	7,165	7,165	7,165	7,165	7,165	7,165	7,165	7,165	7,165	107,482
Sub-Total in Financial		8,975	8,975	8,975	8,975	8,975	8,975	8,975	8,975	8,975	8,975	8,975	8,975	8,975	8,975	8,975	134,632
Sub-Total in Economic		5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	80,779
Kordestan	Urban	23,559	23,559	23,559	23,559	23,559	23,559	23,559	23,559	23,559	23,559	23,559	23,559	23,559	23,559	23,559	353,385
	Rural	43,985	43,985	43,985	106,398	106,398	106,398	106,398	106,398	106,398	106,398	106,398	106,398	106,398	106,398	106,398	1,408,730
Sub-Total in Financial		67,544	67,544	67,544	129,957	129,957	129,957	129,957	129,957	129,957	129,957	129,957	129,957	129,957	129,957	129,957	1,762,115
Sub-Total in Economic		40,526	40,526	40,526	77,974	77,974	77,974	77,974	77,974	77,974	77,974	77,974	77,974	77,974	77,974	77,974	1,057,269
Gilan	Urban	40,651	40,651	40,651	40,651	40,651	40,651	40,651	40,651	40,651	40,651	40,651	40,651	40,651	40,651	40,651	609,765
	Rural	106,012	106,012	106,012	106,012	106,012	106,012	106,012	106,012	106,012	106,012	106,012	106,012	106,012	106,012	106,012	1,590,185
Sub-Total in Financial		146,663	146,663	146,663	146,663	146,663	146,663	146,663	146,663	146,663	146,663	146,663	146,663	146,663	146,663	146,663	2,199,950
Sub-Total in Economic		87,998	87,998	87,998	87,998	87,998	87,998	87,998	87,998	87,998	87,998	87,998	87,998	87,998	87,998	87,998	1,319,970
Grand Total	Urban	133,363	133,363	133,363	133,363	133,363	145,471	145,471	145,471	145,471	145,471	145,471	145,471	145,471	145,471	145,471	2,121,527
	Rural	269,809	269,809	269,809	332,222	332,222	332,222	332,222	332,222	332,222	332,222	332,222	332,222	332,222	332,222	332,222	4,796,085
Sub-Total in Financial		403,172	403,172	403,172	465,585	465,585	477,693	477,693	477,693	477,693	477,693	477,693	477,693	477,693	477,693	477,693	6,917,612
Sub-Total in Economic		241,903	241,903	241,903	279,351	279,351	286,616	286,616	286,616	286,616	286,616	286,616	286,616	286,616	286,616	286,616	4,150,567

Table 3.3.16 Annual Disbursement of Cost for Dams for Potable Water Supply

Zone E in Mid-Term Target Year Component (million Rials)

Cost	-5th Year	-4th Year	-3rd Year	-2nd Year	-1st Year	Base Year	1st year	2nd year	3rd year	4th year	Total Cost
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Financial Cost											
Shafreh Bijar Dam	78,227	78,227	78,227	78,227	78,227	78,227	78,227	78,227	78,227	78,227	782,274
Economic Cost											
Shafreh Bijar Dam	46,936	46,936	46,936	46,936	46,936	46,936	46,936	46,936	46,936	46,936	469,364

Zone A in Long Term Target Year Component (million Rials)

Cost	1st year	2nd year	3rd year	4th year	5th year	6th year	7ndh year	Total Cost
	2010	2011	2012	2013	2014	2015	2016	
Financial Cost								
Hasankhan Dam	14,711	14,711	14,711	14,711	14,711	14,711	14,711	102,975
Economic Cost								
Hasankhan Dam	8,826	8,826	8,826	8,826	8,826	8,826	8,826	61,785

Zone C in Long Term Target Year Component (million Rials)

Cost	8th year	9th year	10th year	11th year	12th year	Total Cost
	2017	2018	2019	2020	2021	
Financial Cost						
Befrajerd Dam	47,142	47,142	47,142	47,142	47,142	235,712
Economic Cost						
Befrajerd Dam	28,285	28,285	28,285	28,285	28,285	141,427

3.3.3 Economic Evaluation

The econpomic evaluation is to be made by using a cash flow of the economic benefit and the economic cost of the projects under4 the said conditions. The Operation and Maintenance costs (OM Cost) are assumed at 0.5 for both the dam construction and the other works expediently. Project life is set at 30 years from each target year. And, the discount rate is adopted at 10 % based on suggestion of the World Bank (= the International Bank for Rehabilitation and Development, the IBRD). The evaluation results are shown in the following table.

Table 3.3.17 Evaluation Results by Province

Province	Target Year	Indices		
		NPV	EIRR	B/C
East Azerbaijan	Mid-Term Target Year	-725,305	6.23%	0.60
	Long Term Target Year	-593,061	7.62%	0.69
Ardebil	Mid-Term Target Year	-279,575	6.11%	0.62
	Long Term Target Year	-379,209	6.67%	0.64
Tehran	Mid-Term Target Year	6,308	13.32%	1.29
	Long Term Target Year	37,595	18.49%	2.10
Zanjan	Mid-Term Target Year	163,704	11.00%	1.09
	Long Term Target Year	168,008	10.57%	1.06
Qazvin	Mid-Term Target Year	13,340	12.36%	1.20
	Long Term Target Year	-9,112	9.56%	0.96
Kordestan	Mid-Term Target Year	-160,826	8.74%	0.88
	Long Term Target Year	-158,745	9.22%	0.91
Gilan	Mid-Term Target Year	-697,387	5.17%	0.59
	Long Term Target Year	-374,929	8.48%	0.83

(Note) NPV: million Rials.

3.4 CONCLUSION AND RECOMMENDATION

3.4.1 Conclusion

Only a part of the target areas keeps the EIRR reaching to a level of applied discount rate or exceeding the level of it in both the cases of economic evaluation by Zone and by Province. From this view point, it may be hard to say that the water distribution project including dam projects for the other part of areas are economically feasibile. However, the evaluation results for every zones and provinces have cleared of 5 % hurdle recommended by such international financing institutions as the World Bank. From the viewpoint that the said water distribution projects are public works, but not

the commercial works, promotion of the said water distribution projects for the target areas are significant from the viewpoint of "basic human needs" in line with the under going projects planned.

In comparison of EIRRs in mid-term target year and in long term target year, the EIRRs in long term target year are higher that those in mid-term target year in case of evaluation by Zone and by Province except Provinces of Zanjan and Qazvin. In other words, all the water distribution projects have rationality to continue until the long term target year.

Falling down of the EIRRs in Provinces of Zanjan and Qazvin from the case of mid-term target year to the long term target year has reasonable reasons.

In the Province of Zanjan at first, there are 11 dam construction projects. Among them, only 3 dams are planned to complete by the mid-term target year, and remaining 8 dams are planned to complete by the long term target year. Dam projects to be completed by the mid-term target year include the Talvar Dam Project, and this project has quite high economic effect of water distribution. Namely, farm lands, the area of 29,500 ha, under Talvar Dam control are all the newly developing farm lands, and this farm lands have quite high economic effect. Eight (8) dams to be completed by the long term target year also include high effective dam as the Mushampa Dam Project, but the among the farm lands, the area of 30,000 ha, under Mushampa Dam control, only 26,000 ha are the newly developing farm lands, and reaming farm lands under other 7 dam control are improved farm lands in irrigation in proportion ranged from several percent to 100 % to the total farm lands under dam control except 9,000 ha of newly developing farm lands under Mendagh Dam control. Dam project needs a large amount of funds, but it can not be expect to produce any irrigation effect (namely, agricultural productivity) until realization of irrigated farm lands. In that case too, the irrigation effect in newly developing farm lands is drastically higher that that in improved farm lands in irrigation. These are the reasons of falling down of the EIRR of 11.00% in mid-term target year to 10.56% in long term target year.

On the other hand, in the Province of Qazvin, only one Burmanak Dams planned to be constructed, but this dam is planned to be constructed by the long term target year, and among the farm lands, the area of 2,280ha, only the area of 1,079 ha with the proportion of 47 % are the newly developing farm lands. Accordingly, the reasons of falling down of the EIRR of 12.36% in mid-term target year to 9.56% in long term target year may be the same in case of the Province of Zanjan.

The EIRR in the Province of Gilan is resulted rather low as 5.17% in mid-term target year because the Shafreh Bijar Dam Project to be required a large amount of fund is included.

Also the EIRRs of the Province of East Azerbaijan are rather low as 6.23% in mid-term target year and 7.62% in long term target year because of affection of 5 dam construction projects to be completed by the mid-term target year.

Furthermore in the Province of Ardebil, the EIRRs are low as 6.11% in mid-term target year and 6.67% in long term target year because of affection of one dam to be completed by mid-term target year and 4 dams to be completed by long term target year.

On the other hand, the EIRR of the Province of Tehran is quite high as 13.32% in mid-term target year and 18.49% in long term target year. This is because that there is no any dam project included, nevertheless the province enjoys water distribution effects.

Zoning in case of the economic evaluation by Zone, based on the boundaries of water-shed, but the boundaries of provinces are not related to the water–shed boundaries. Because of this, the dams are located unevenly for the provinces. From this viewpoint, the economic evaluation by Zone may reveal the effect of the water distribution works more precisely than that by Province.

3.4.2 Recommendation

Paddy is a staple crop, so that this can not be replaced with other crops. However, it can not be sold with so much high price because of closely related to the human life. On the other hand, alfalfa as a fodder of cattle breeding or other stock farming has a high efficiency of production.

In this Project, the agricultural benefit is estimated based on current cropping under executing. If replacement of current crops to the high yield cash crops, it is self-evident that the economic indices will become higher than the resulted ones this time. From this viewpoint, suitable public guidance of farming business to farmers is to be expected.

SUPPORTING REPORT

PAPER 8

SATELLITE IMAGE ANALYSIS AND GIS

THE STUDY ON INTEGRATED WATER RESOURCES MANAGEMENT FOR SEFIDRUD RIVER BASIN IN THE ISLAMIC REPUBLIC OF IRAN

SUPPORTING REPORT

PAPER 8. SATELLITE IMAGE ANALYSIS AND GIS

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Note: The Contents without any reference source were prepared by JICA Study Team.

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CHAPTER 1. GIS DATABASE

1.1 COORDINATE SYSTEM

The whole Sefidrud River Basin covers 45 to 51 degree of longitude of the globe. It exactly covered by two UTM zone (38N, the central meridian is 45 and 39N, the central meridian is 51 degree centigrade). Therefore the UTM coordinate system is not suitable for this study area. Based on the natural conditions, the JICA study team designed the standard coordinate system as follows.

Table 1.1.1 Coordinate System of Sefidrud Study

Item	Specifications
Projection Item	Sefid_TM
Spheroid	WGS84
Datum	WGS84
Central Meridian Longitude	48
Central Meridian Latitude	0
Scale Factor	0.9996
False East	500000
False North	0

1.2 GIS DATABASE

According to above research, JICA study team designed a GIS database in the study. The contents of the GIS database are shown in following table.

Table 1.2.1 Coordinate System of Sefidrud Study

Data Type			Data Source	Attributions
Satellite Image Data	ALOS Satellite Image	Raster	Satellite 2007	15m resolution
	ASTER DEM	Raster	Satellite 2007	15m elevation
Topographical Data	Administration boundaries	Polygon	Topographic Map (1:250,000)	Name and Type
	Road	Line	Topographic Map (1:250,000)	Road Name and Payment Condition Code
	River	Line	Topographic Map (1:250,000)	River Name, River Class Code
	Water Body	Polygon	Topographic Map (1:250,000)	Name
	Villages	Point	Topographic Map (1:250,000)	Name, Type and Statistic Data
	Contour Line	Line	Topographic Map (1:250,000)	Elevation
River Infrastructure data	Irrigation Network	Polygon	WRMC	Name Classification
	Ditch	Point	WRMC	Type
	Well, Dam, Qanat, Discharge Station, Rainfall Station, Spring, Pump	Point	WRMC	Type and Name
Other Data	Land Use	Polygon	Land Use Map (1:100,000) MOJA	Type and Name
	Geology and Fault Line	Polygon, Line	Geological Map (1/250,000)	Geological Classification
	Soil Distribution	Polygon	Soil Map (1:250,000)	Soil Type
	Isoheytal Data	Line	Isoheytal Map	Average Rainfall

Here are three sample maps generated from above GIS data.

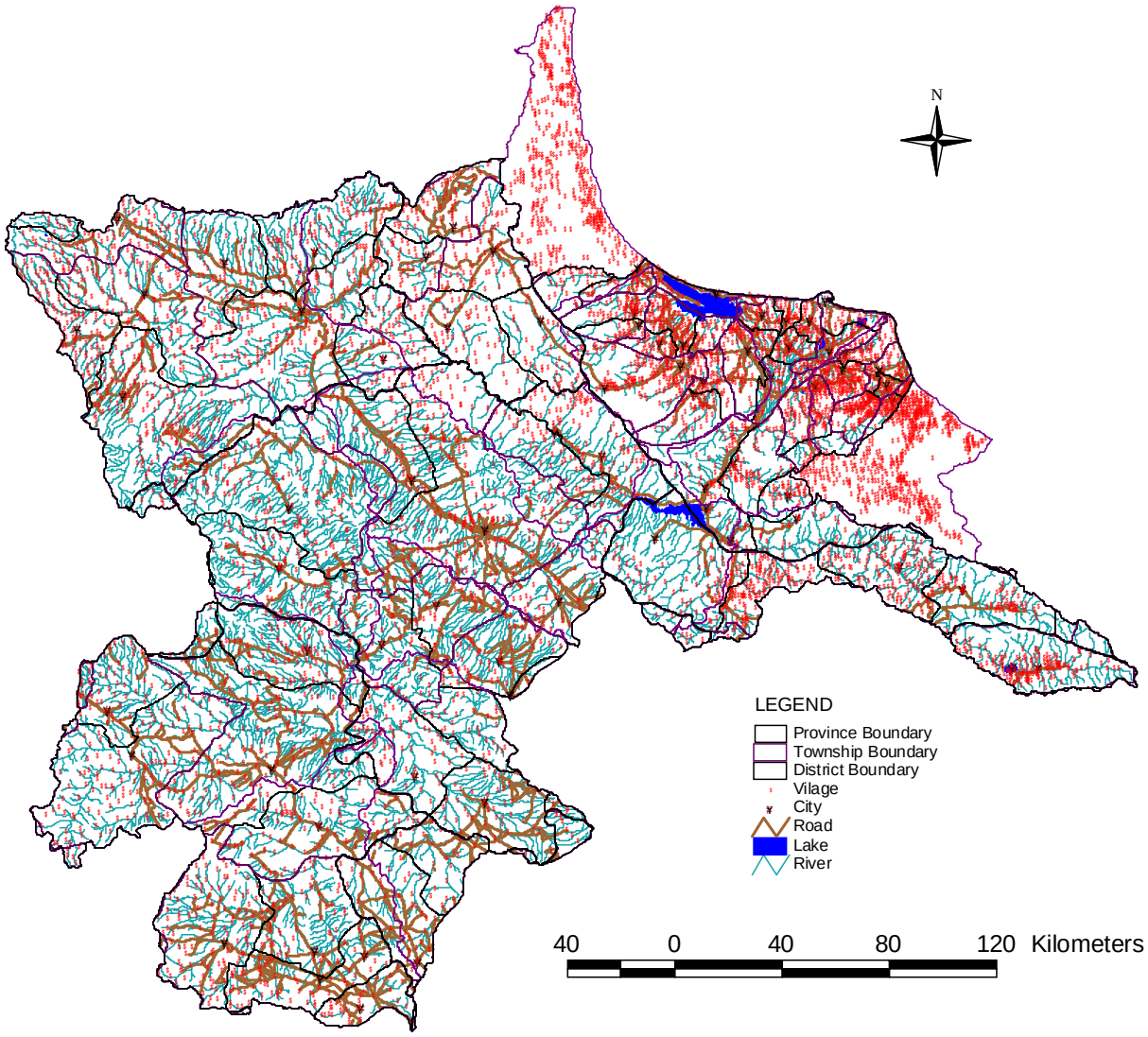


Figure 1.2.1 Sample Map Generated from Topographical Data

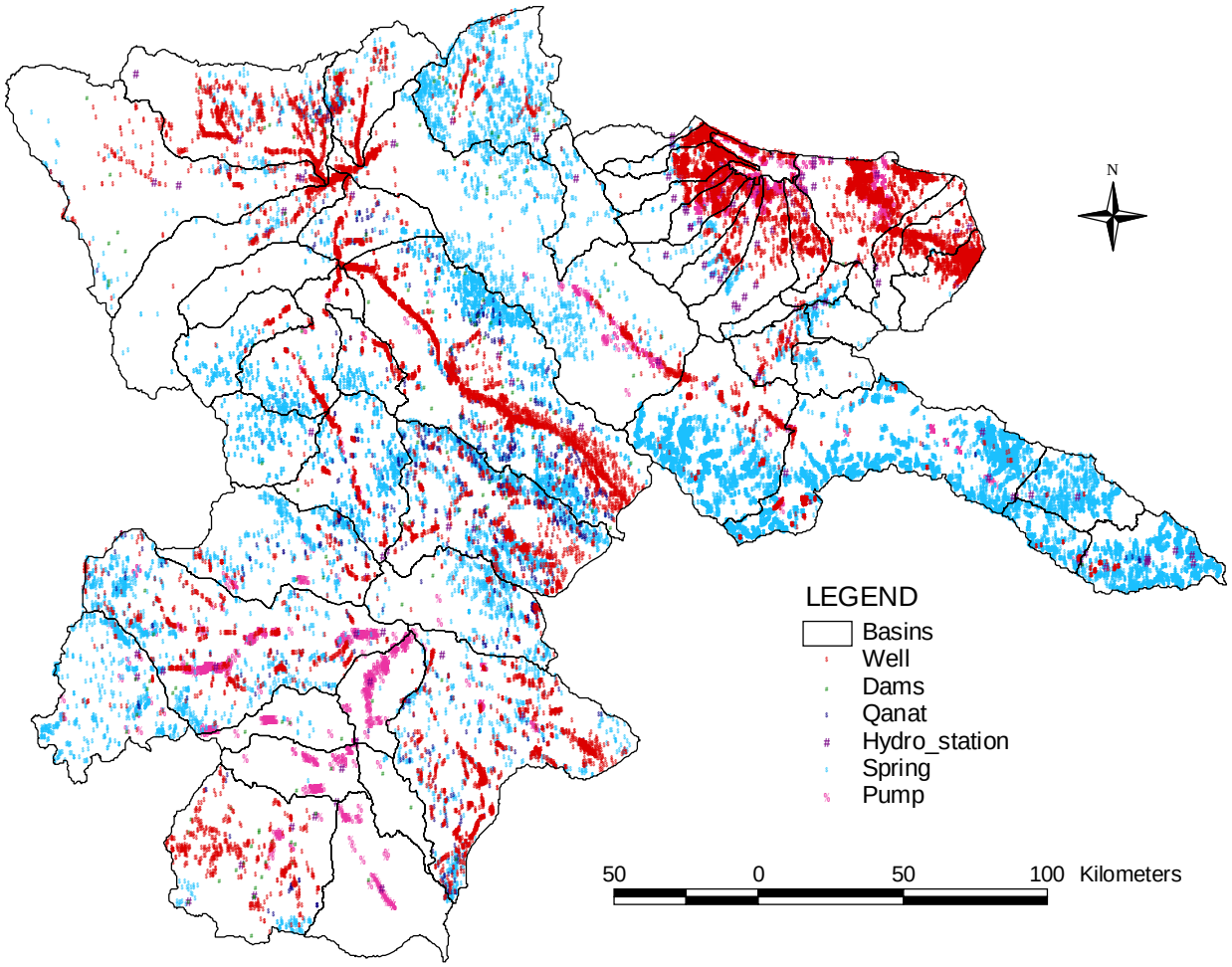


Figure 1.2.2 Sample Map Generated from River Infrastructure Data

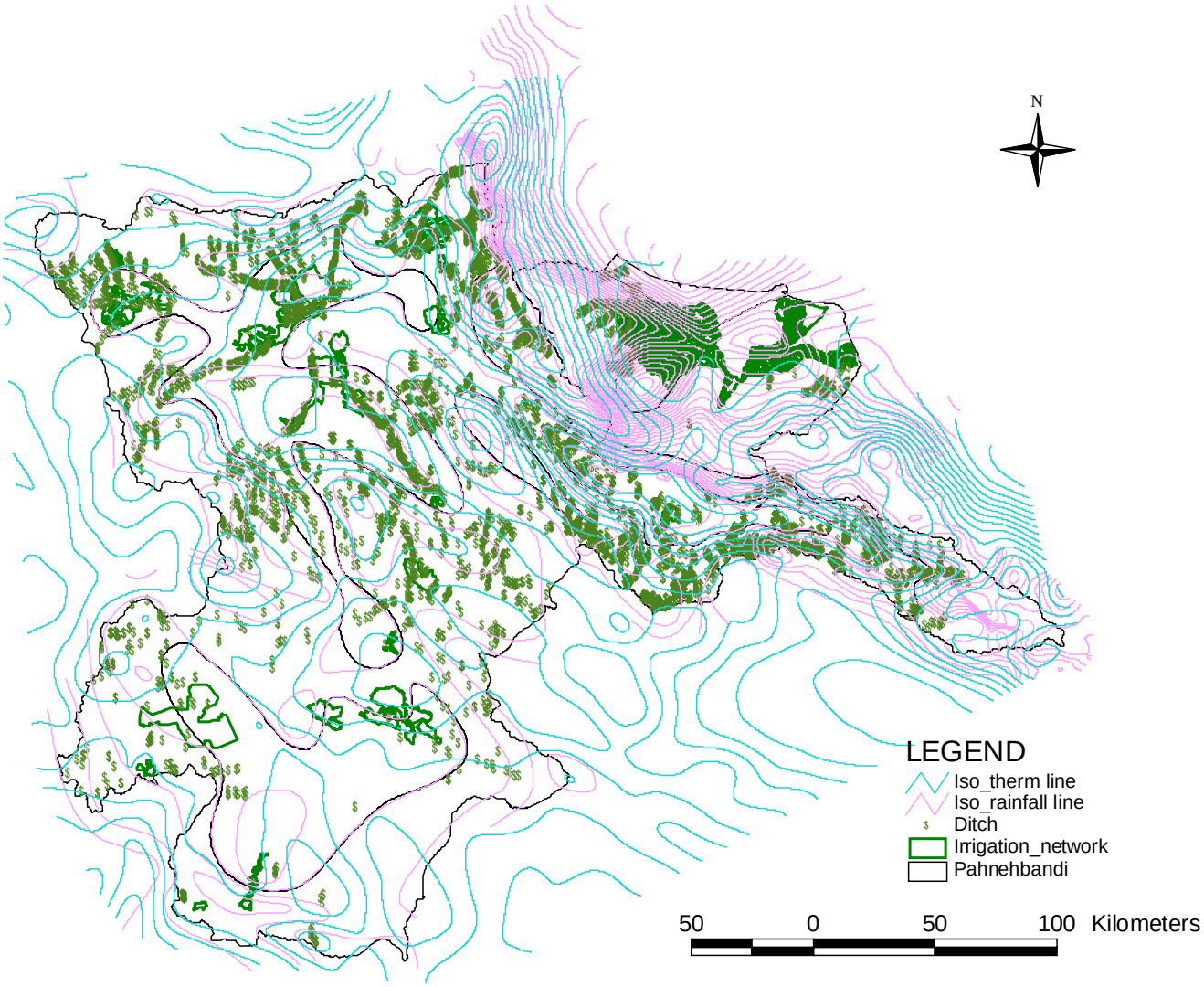


Figure 1.2.3 Sample Map Generated from Other Data

1.3 MOJA LANDUSE DATA

Landuse, especially agriculture landuse is an important factor for estimating the water requirement in this study. At first, the study team collected a 1:250,000 scale landuse data from MOJA. This data was created by using ETM+ satellite image in 2000. The sample map of MOJA landuse data is as follow.

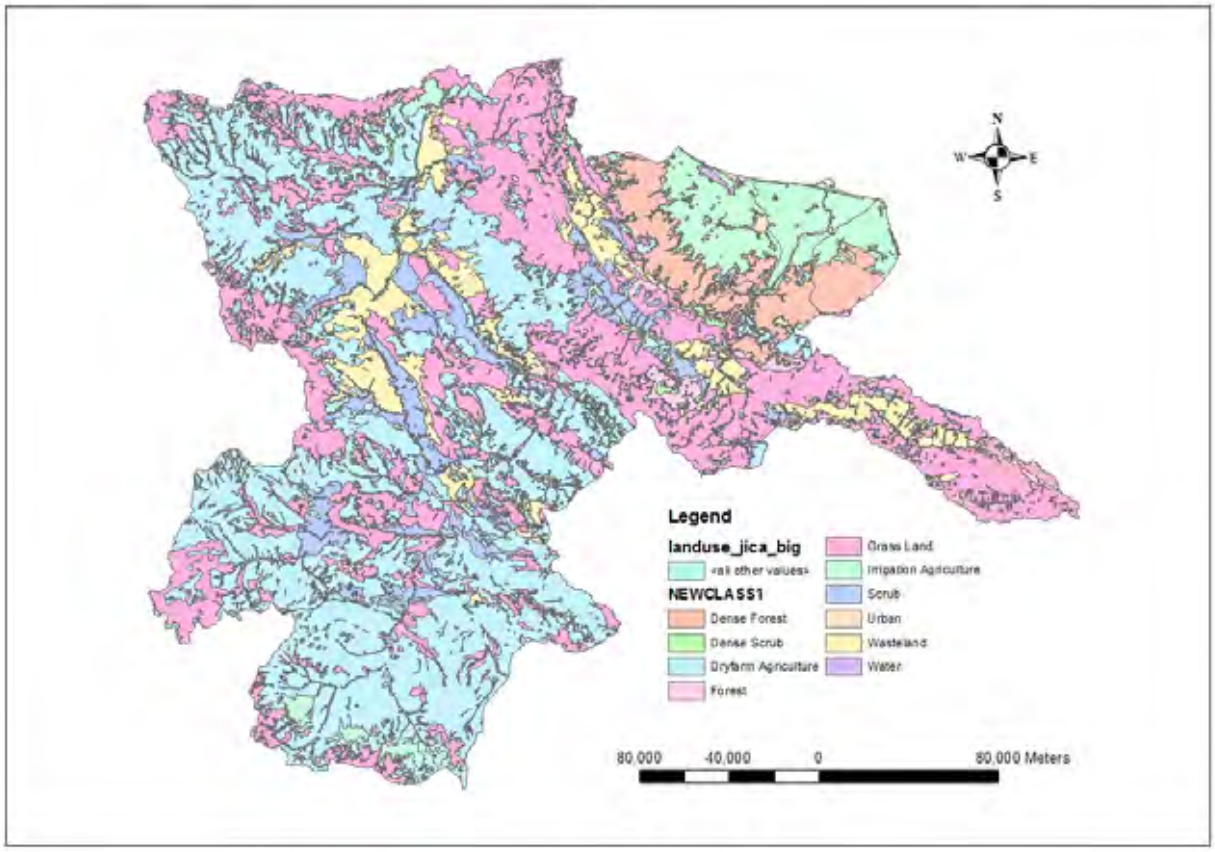


Figure 1.3.1 Landuse data from MOJA (1:250,000)

In order to make a consensuses with the simulation program that using by JICA study team, the landuse data item was reclassified as follow.

Table 1.3.1 Comparison Between MOJA Landuse Class and JICA Landuse Class

MOJA LANDUSE CLASS	JICA LANDUSE CLASS	MOJA LANDUSE CLASS	JICA LANDUSE CLASS
denseforest	Dense Forest	mix(goodrange_modrange)	Grass Land
lowforest	Dense Scrub	mix(modange_dryfarming_follow)	
mix(dryfarmig_follow_poorrange)	Dryfarm Agriculture	mix(modforest_modrange)	
mix(dryfarming_follow)		mix(modrange_dryfarming_follow)	
mix(dryfarming_follow_agri)		mix(modrange_goodrange)	
mix(dryfarming_follow_goodrange)		mix(poorrange_dryfarming_follow)	
mix(dryfarming_follow_goodrange_Orchard)		modrange	
mix(dryfarming_follow_modrange)		Agriculture	Irrigation Agriculture
mix(dryfarming_follow_modrange_agri)		mix(agri_dryfarming_follow)	
mix(dryfarming_follow_Orchard)		mix(agri_dryfarming_follow_modrange)	
mix(dryfarming_follow_Orchard_modrange)		mix(agri_modrange)	
mix(dryfarming_follow_poorrange)		mix(agri_Orchard)	
mix(dryframing_modrange)		mix(agri_Orchard_modrange)	
mix(follow_dryfarming)		mix(agri_urban)	
mix(goodrange_agri)		mix(Orchard_agri)	
mix(goodrange_agri_Orchard)		mix(Orchard_agri_modrange)	
mix(goodrange_Orchard)		mix(Orchard_dryfarming_follow_modrange)	
mix(lowforest_agri)		mix(Orchard_goodrange)	
mix(modforest_agri)		mix(Orchard_modrange)	
mix(modrange_agri)		mix(Orchard_poorrange)	
mix(modrange_agri_Orchard)		Orchard	
mix(modrange_dryfarming_follow_agri)		poorrange	Scrub
mix(modrange_Orchard)		verylowforest	
mix(modrange_Orchard_dryfarming_follow)		airport	Urban
mix(modrange-agri)		mix(urban_agri)	
mix(poorrange_dryfarming_follow_agri)		mix(urban_shorline)	
mix(verylowforest_agri)		urban	
mix(verylowforest_goodrange)		bareland	Wasteland
mix(woodland1_agri)		Floodway	
mix(lowforest_goodrange)	Forest	mix(bareland_poorrange)	
mix(lowforest_modrange)		mix(modrange_poorrange)	
mix(woodland1_goodrange)		mix(poorrange_bareland)	
mix(woodland1_modrange)		mix(poorrange_modrange)	
mix(woodland1_poorrange)		mix(poorrange_modrange_dryfarming_follow)	
modforest		mix(porrange_f	
woodland1		ollow)	
goodrange	Grass Land	rock	
mix(goodrange_dryfarming_follow)		water	Water

The landuse area was summarized as follows.

Table 1.3.2 Landuse Area Summary (w/o Anzali)

JICA_CLASS	MOJA_AREA（㎡）
Dense Forest	902,011,027.6
Dense Scrub	160,335,061.0
Dryfarm Agriculture	22,416,960,257.0
Forest	604,326,425.8
Grass Land	20,564,037,875.0
Irrigation Agriculture	4,539,105,406.0
Scrub	4,611,889,378.0
Urban	192,931,280.6
Wasteland	5,001,833,752.0
Water	73,234,745.3
Grand	59,066,665,208.3

Table 1.3.3 Landuse Area Summary (w/ Anzali)

JICA_CLASS	MOJA_AREA（㎡）
Dense Forest	3,078,983,062.0
Dense Scrub	197,523,518.3
Dryfarm Agriculture	22,643,049,899.8
Forest	606,690,750.1
Grass Land	20,817,478,936.8
Irrigation Agriculture	6,787,747,335.0
Scrub	4,611,296,363.4
Urban	396,224,122.3
Wasteland	5,001,828,674.4
Water	141,904,023.2
Grand Total	64,282,726,685.3

Through the GIS analysis of overlay the landuse and sub-basin data, the landuse area can be summarized by sub-basin number. The results are as follows.

Table 1.3.4 Landuse Area Summary by Sub-Basin Number (1/ 4, w/o Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
1	Dryfarm Agriculture	10,017,785.1		Grass Land	123,340,876.8
	Forest	27,110.4		Scrub	42,415,796.8
				Urban	9,192,333.9
	Grass Land	196,950,568.5		Wasteland	230,126,492.0
	Irrigation Agriculture	8,447,538.7	12	Grass Land	72,884,124.7
	Scrub	5,483,570.1		Irrigation Agriculture	4,346,874.4
2	Dryfarm Agriculture	65,342,686.9	13	Dryfarm Agriculture	2,938,070.5
	Grass Land	211,220,484.9		Grass Land	92,362,876.2
	Irrigation Agriculture	124,383,580.0		Irrigation Agriculture	15,542,737.7
	Wasteland	18,892,451.6		Wasteland	58,923,978.2
3	Dryfarm Agriculture	44,211,550.5	14	Grass Land	13,600,587.3
	Grass Land	596,578,618.7		Irrigation Agriculture	744,651.9
	Irrigation Agriculture	27,137,257.0	15	Dryfarm Agriculture	1,675,288.7
	Scrub	825,645.2		Grass Land	4,033,387.9
4	Dryfarm Agriculture	378,027,101.0	16	Dryfarm Agriculture	3,499,888.8
	Grass Land	559,712,899.3		Grass Land	8,729,988.7
	Irrigation Agriculture	64,414,341.5	17	Dryfarm Agriculture	1,352,891,129.4
	Scrub	5,455,717.7		Grass Land	508,321,513.9
5	Dryfarm Agriculture	448,503,285.7		Irrigation Agriculture	123,345,260.3
	Grass Land	445,690,136.5		Scrub	666,525,812.9
	Irrigation Agriculture	132,718,201.2		Urban	446,070.1
	Scrub	823,796.5		Wasteland	789,173,702.3
	Urban	336,692.0		Water	553,818.4
6	Dryfarm Agriculture	201,830,355.4	18	Dryfarm Agriculture	700,391,406.3
	Grass Land	55,983,232.9		Grass Land	606,898,187.0
	Irrigation Agriculture	84,476,123.6		Irrigation Agriculture	51,810,426.8
	Urban	450,521.1		Scrub	151,896,624.4
	Wasteland	94,341,527.2		Urban	111,034.8
7	Dryfarm Agriculture	15,287,262.0		Wasteland	117,283,963.0
	Grass Land	35,643,338.7	19	Dense Forest	507,424,887.1
8	Dryfarm Agriculture	20,484,825.6		Dense Scrub	59,989,191.4
	Grass Land	150,249,216.3		Dryfarm Agriculture	67,767,467.0
	Irrigation Agriculture	35,338,487.4		Forest	43,487,257.2
9	Dryfarm Agriculture	11,409,006.3		Grass Land	161,900,327.4
	Grass Land	62,341,140.5		Irrigation Agriculture	96,977,499.4
	Irrigation Agriculture	29,579,767.8		Urban	2,520,635.5
	Scrub	1,983,954.7		Wasteland	27,731,101.8
10	Dryfarm Agriculture	527,367,314.5	20	Dryfarm Agriculture	1,106,678,098.9
	Grass Land	204,482,918.9		Grass Land	672,628,283.3
	Irrigation Agriculture	54,691,845.1		Irrigation Agriculture	134,522,595.1
	Scrub	6,782,495.9		Scrub	373,037,167.8
11	Dryfarm Agriculture	426,687,287.9		Urban	47,101,848.2

Table 1.3.5 Landuse Area Summary by Sub-Basin Number (2/ 4, w/o Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
	Irrigation Agriculture	66,691,850.2		Grass Land	585,089,654.3
	Wasteland	519,999,810.6		Irrigation Agriculture	83,090,458.7
	Water	23,583,708.4		Scrub	593,568,936.2
21	Dense Forest	844,618.2		Urban	2,702,058.8
	Dense Scrub	53,053,283.8		Wasteland	675,725,644.4
	Dryfarm Agriculture	3,218,195.4		Water	239,270.8
	Forest	290,230,949.8	27	Dryfarm Agriculture	516,834,435.1
	Grass Land	1,367,295,740.2		Urban	509,111.1
	Irrigation Agriculture	166,744,414.1		Wasteland	10,087,641.5
	Scrub	197,907,942.4	24	Dryfarm Agriculture	28,916,216.7
	Urban	4,562,250.3		Grass Land	123,723,319.6
	Wasteland	369,640,119.3		Irrigation Agriculture	5,360,600.2
	Water	22,438,557.4		Scrub	3,411,191.0
22	Dryfarm Agriculture	202,077,066.9	25	Dense Forest	3,604,872.0
	Grass Land	72,981,662.6		Dense Scrub	3,285,625.3
	Irrigation Agriculture	14,290,290.7		Dryfarm Agriculture	98,689,742.8
	Scrub	43,955,236.9		Forest	102,237,321.6
	Urban	405,417.7		Grass Land	2,601,350,176.1
	Wasteland	268,580,226.3		Irrigation Agriculture	205,338,536.1
23	Dense Forest	171,277,447.4		Scrub	160,758,652.0
	Dense Scrub	36,321,174.2		Urban	4,031,711.7
	Dryfarm Agriculture	149,331,275.4		Wasteland	726,485,443.7
	Forest	40,611,887.8	26	Dryfarm Agriculture	542,098,471.2
	Grass Land	6,515,360.6		Grass Land	585,089,654.3
	Irrigation Agriculture	6,543,104.2		Irrigation Agriculture	83,090,458.7
	Scrub	13,001,193.0		Scrub	593,568,936.2
	Urban	509,111.1		Urban	2,702,058.8
	Wasteland	10,087,641.5		Wasteland	675,725,644.4
24	Dryfarm Agriculture	28,916,216.7		Water	239,270.8
	Grass Land	123,723,319.6	27	Dryfarm Agriculture	516,834,435.1
	Irrigation Agriculture	5,360,600.2		Grass Land	531,941,091.9
	Scrub	3,411,191.0		Irrigation Agriculture	169,758,505.6
25	Dense Forest	3,604,872.0		Scrub	33,723,332.3
	Dense Scrub	3,285,625.3		Urban	10,017,086.7
	Dryfarm Agriculture	98,689,742.8		Wasteland	2,017,485.7
	Forest	102,237,321.6		Water	25,889,730.0
	Grass Land	2,601,350,176.1	28	Dryfarm Agriculture	8,364,100.8
	Irrigation Agriculture	205,338,536.1		Grass Land	61,120,923.9
	Scrub	160,758,652.0		Irrigation Agriculture	2,983,835.0
	Urban	4,031,711.7	29	Dryfarm Agriculture	33,012,024.5
	Wasteland	726,485,443.7		Grass Land	57,886,673.8
26	Dryfarm Agriculture	542,098,471.2		Irrigation Agriculture	2,893,273.5

Table 1.3.6 Landuse Area Summary by Sub-Basin Number (3/ 4, w/o Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
	Wasteland	2,330,317.8		Grass Land	33,096,551.5
30	Dryfarm Agriculture	618,399,455.1		Irrigation Agriculture	7,013,160.2
	Grass Land	359,211,707.5		Scrub	3,603,906.7
	Irrigation Agriculture	51,376,866.0		Wasteland	17,709,583.8
	Scrub	85,536,643.6	39	Dryfarm Agriculture	10,633,064.3
	Urban	1,931,343.8		Grass Land	16,687,737.0
	Wasteland	82,195,508.8		Scrub	3,443,012.7
	Water	65,471.9	40	Dryfarm Agriculture	366,621,292.6
31	Dryfarm Agriculture	642,089.2		Grass Land	683,921,766.5
	Grass Land	67,700,724.7		Irrigation Agriculture	2,779,537.4
	Irrigation Agriculture	4,657,819.6	41	Dryfarm Agriculture	326,394,174.0
	Scrub	117,537.3		Grass Land	222,606,775.8
	Wasteland	54,267,170.5		Irrigation Agriculture	24,020,562.5
32	Dense Scrub	26,524.2		Urban	2,360,524.1
	Dryfarm Agriculture	737,252.9	42	Dryfarm Agriculture	684,245,258.4
	Forest	202,653.0		Grass Land	97,792,857.0
	Grass Land	236,699,403.5		Irrigation Agriculture	27,306,270.5
	Irrigation Agriculture	16,572,001.9		Scrub	52,505,006.7
	Wasteland	33,021,207.9		Wasteland	3,351,097.5
33	Dryfarm Agriculture	5,241,393.7	43	Dryfarm Agriculture	217,075,582.4
	Grass Land	51,411,188.0		Grass Land	2,398,211.9
	Irrigation Agriculture	4,884,720.6		Irrigation Agriculture	4,634,072.8
34	Dryfarm Agriculture	231,833,901.2		Scrub	26,863,541.4
	Grass Land	180,925,297.7		Wasteland	345,867.9
	Irrigation Agriculture	14,091,299.4		Water	411,569.4
	Scrub	24,059,233.0	44	Dryfarm Agriculture	1,432,606,165.3
35	Dryfarm Agriculture	218,705,941.9		Grass Land	169,074,544.4
	Grass Land	175,201,862.4		Irrigation Agriculture	49,623,335.4
	Irrigation Agriculture	17,006,256.7		Scrub	97,477,493.0
	Scrub	29,954,798.0		Urban	543,576.5
	Urban	793,587.6		Water	52,618.9
36	Grass Land	851,167,985.5	45	Dryfarm Agriculture	76,148,357.8
	Irrigation Agriculture	53,721,829.8		Grass Land	72,669,881.4
	Urban	686,140.1		Irrigation Agriculture	8,239,414.3
	Wasteland	37,157,480.3		Scrub	116,979,833.8
37	Dryfarm Agriculture	811,047,748.8	46	Dryfarm Agriculture	7,170,531.4
	Grass Land	815,583,237.6		Grass Land	90,634,579.9
	Irrigation Agriculture	60,517,322.9		Irrigation Agriculture	1,323,439.7
	Scrub	329,911,838.7	47	Dryfarm Agriculture	1,474,288,361.5
	Urban	5,572,951.7		Grass Land	245,173,221.5
	Wasteland	8,845,182.3		Irrigation Agriculture	294,655,439.4
38	Dryfarm Agriculture	81,250,880.2		Scrub	10,185,423.1

Table 1.3.7 Landuse Area Summary by Sub-Basin Number (4/ 4, w/o Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
	Urban	1,462,432.3		Grass Land	2,566,857,999.5
48	Dryfarm Agriculture	692,032,379.3		Irrigation Agriculture	232,871,391.6
	Grass Land	137,263,401.6		Scrub	668,564,475.2
	Irrigation Agriculture	73,876,505.0		Wasteland	555,053,614.2
	Scrub	28,650,212.1	62	Dense Forest	203,564,556.1
	Urban	9,967,880.3		Dense Scrub	1,244,830.6
49	Dryfarm Agriculture	76,149,861.1		Dryfarm Agriculture	11,156,554.0
	Irrigation Agriculture	2,365,318.7		Irrigation Agriculture	2,069,971.2
50	Dryfarm Agriculture	73,220,088.0		Wasteland	8,409,297.9
	Grass Land	66,742,182.4	63	Dryfarm Agriculture	752,393,387.6
	Irrigation Agriculture	31,255,542.6		Grass Land	222,505,188.6
	Urban	576,141.0		Irrigation Agriculture	86,004,812.2
51	Dryfarm Agriculture	1,749,740.1		Scrub	10,674,707.4
	Grass Land	40,633,003.0		Urban	5,349,660.7
	Irrigation Agriculture	6,399,390.2		Wasteland	23,673,300.0
52	Dryfarm Agriculture	204,888,768.6	64	Dryfarm Agriculture	460,140,073.4
	Grass Land	25,021,271.7		Grass Land	282,683,002.2
	Irrigation Agriculture	17,151,676.8		Irrigation Agriculture	17,879,797.8
	Urban	389,529.9		Scrub	162,427,823.4
56	Dense Forest	9,134,434.2	65	Dryfarm Agriculture	416,833,826.6
	Dense Scrub	204,080.9		Grass Land	5,255,164.2
	Forest	343.9		Irrigation Agriculture	23,807,841.0
	Grass Land	2,113,603.2	66	Dryfarm Agriculture	3,271,397,276.9
	Irrigation Agriculture	3,126,827.2		Grass Land	1,357,304,069.6
	Scrub	87,949.8		Irrigation Agriculture	248,133,406.7
	Wasteland	2,515,103.5		Scrub	636,841,624.1
57	Dense Forest	178,573.6		Urban	6,682,003.7
	Dryfarm Agriculture	70,492.4		Wasteland	231,695,922.1
	Irrigation Agriculture	107.0	67	Dryfarm Agriculture	311,366,231.6
59	Dense Forest	5,181,217.3		Grass Land	200,929,937.9
	Dryfarm Agriculture	18,171,740.1		Irrigation Agriculture	192,582,215.4
	Forest	45,459,824.2		Scrub	21,922,795.3
	Grass Land	531,869,723.8		Urban	2,706,395.5
	Irrigation Agriculture	35,195,951.5	53(DU-G)	Irrigation Agriculture	755,869,126.6
	Urban	4,541,413.2		Urban	29,189,177.3
60	Dryfarm Agriculture	1,871,508,382.7		Wasteland	18,897,285.9
	Grass Land	547,825,533.3	54(DU-F)	Irrigation Agriculture	176,904.9
	Irrigation Agriculture	115,486,176.8		Urban	37,971.4
	Urban	1,933,084.4	55(DU-D)	Irrigation Agriculture	338,655,601.9
61	Dense Scrub	6,210,351.0		Urban	31,348,040.0
	Dryfarm Agriculture	720,607,416.2		Wasteland	13,351,309.5
	Forest	81,890,408.4		Grand	59,040,782,457.8

Table 1.3.8 Landuse Area Summary by Sub-Basin Number (1/ 4, w/ Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
1	Dryfarm Agriculture	10,017,785.1		Irrigation Agriculture	66,691,850.2
	Forest	27,110.4		Scrub	42,415,796.8
	Grass Land	196,950,568.5		Urban	9,192,333.9
	Irrigation Agriculture	8,447,538.7		Wasteland	230,126,492.0
	Scrub	5,483,570.1	12	Grass Land	72,884,124.7
2	Dryfarm Agriculture	65,342,686.9		Irrigation Agriculture	4,346,874.4
	Grass Land	211,220,484.8	13	Dryfarm Agriculture	2,938,070.5
	Irrigation Agriculture	124,383,580.0		Grass Land	92,817,623.4
	Wasteland	18,892,451.6		Irrigation Agriculture	15,542,737.7
3	Dryfarm Agriculture	44,211,550.5		Wasteland	58,923,978.2
	Grass Land	596,578,618.7	14	Grass Land	13,600,587.3
	Irrigation Agriculture	27,137,257.0		Irrigation Agriculture	744,651.9
	Scrub	825,645.2	15	Dryfarm Agriculture	1,675,288.7
4	Dryfarm Agriculture	378,027,101.0		Grass Land	4,033,387.9
	Grass Land	559,712,899.3	16	Dryfarm Agriculture	3,499,888.8
	Irrigation Agriculture	64,414,341.5		Grass Land	8,729,988.7
	Scrub	5,455,717.7	17	Dryfarm Agriculture	1,352,891,129.4
5	Dryfarm Agriculture	448,503,285.7		Grass Land	508,321,513.9
	Grass Land	445,690,136.4		Irrigation Agriculture	123,345,260.3
	Irrigation Agriculture	132,718,201.2		Scrub	666,525,812.9
	Scrub	823,796.5		Urban	446,070.1
	Urban	336,692.0		Wasteland	789,173,702.3
6	Dryfarm Agriculture	201,830,355.4		Water	553,818.4
	Grass Land	55,983,232.9	18	Dryfarm Agriculture	700,391,406.3
	Irrigation Agriculture	84,476,123.6		Grass Land	606,898,187.0
	Urban	450,521.1		Irrigation Agriculture	51,810,426.8
	Wasteland	94,341,527.2		Scrub	151,896,624.4
7	Dryfarm Agriculture	15,287,262.0		Urban	111,034.8
	Grass Land	35,643,338.7		Wasteland	117,283,963.0
8	Dryfarm Agriculture	20,484,825.6	19	Dense Forest	508,814,514.3
	Grass Land	150,249,216.3		Dense Scrub	59,989,028.9
	Irrigation Agriculture	35,338,487.4		Dryfarm Agriculture	67,767,466.9
9	Dryfarm Agriculture	11,409,006.3		Forest	43,487,257.2
	Grass Land	62,341,140.5		Grass Land	161,955,752.1
	Irrigation Agriculture	29,579,767.8		Irrigation Agriculture	96,977,499.4
	Scrub	1,983,954.7		Urban	2,520,635.5
10	Dryfarm Agriculture	527,367,314.6		Wasteland	27,731,101.8
	Grass Land	204,482,918.9	20	Dryfarm Agriculture	1,106,678,098.9
	Irrigation Agriculture	54,691,845.1		Grass Land	672,628,283.3
	Scrub	6,782,495.9		Irrigation Agriculture	134,522,595.1
11	Dryfarm Agriculture	426,687,287.9		Scrub	373,037,167.8
	Grass Land	123,340,876.8		Urban	47,101,848.2

Table 1.3.9 Landuse Area Summary by Sub-Basin Number (2/ 4, w/ Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
	Wasteland	519,999,810.6		Irrigation Agriculture	83,090,458.7
	Water	23,583,708.4		Scrub	593,568,936.2
21	Dense Forest	844,618.2		Urban	2,702,058.8
	Dense Scrub	53,053,283.8		Wasteland	675,725,644.4
	Dryfarm Agriculture	3,218,195.4		Water	239,270.8
	Forest	290,230,949.8	27	Dryfarm Agriculture	516,834,435.1
	Grass Land	1,367,413,430.6		Grass Land	531,941,091.9
	Irrigation Agriculture	166,744,414.1		Irrigation Agriculture	169,758,505.6
	Scrub	197,907,942.4		Scrub	33,723,332.3
	Urban	4,562,250.3		Urban	10,017,086.7
	Wasteland	369,640,119.3		Wasteland	2,017,485.7
	Water	22,438,557.4		Water	25,889,730.0
22	Dryfarm Agriculture	202,077,066.9	28	Dryfarm Agriculture	8,364,100.8
	Grass Land	72,981,662.6		Grass Land	61,120,923.9
	Irrigation Agriculture	14,290,290.7		Irrigation Agriculture	2,983,835.0
	Scrub	43,955,236.9	29	Dryfarm Agriculture	33,012,024.5
	Urban	405,417.7		Grass Land	57,886,673.8
	Wasteland	268,580,226.3		Irrigation Agriculture	2,893,273.5
23	Dense Forest	171,277,447.4		Wasteland	2,330,317.8
	Dense Scrub	36,321,174.2	30	Dryfarm Agriculture	618,399,455.1
	Dryfarm Agriculture	151,959,721.4		Grass Land	359,211,707.5
	Forest	40,611,887.8		Irrigation Agriculture	51,376,866.0
	Grass Land	6,515,360.7		Scrub	85,536,643.6
	Irrigation Agriculture	6,543,104.2		Urban	1,931,343.8
	Scrub	12,930,217.7		Wasteland	82,195,508.8
	Urban	509,111.1		Water	65,471.9
	Wasteland	10,087,641.5	31	Dryfarm Agriculture	642,089.2
24	Dryfarm Agriculture	28,916,216.7		Grass Land	67,700,724.7
	Grass Land	123,723,319.6		Irrigation Agriculture	4,657,819.6
	Irrigation Agriculture	5,360,600.2		Scrub	117,537.3
	Scrub	3,411,191.0		Wasteland	54,267,170.5
25	Dense Forest	3,604,872.0	32	Dense Scrub	26,524.2
	Dense Scrub	3,285,625.3		Dryfarm Agriculture	737,252.9
	Dryfarm Agriculture	99,023,382.9		Forest	202,653.0
	Forest	102,237,321.6		Grass Land	236,699,403.5
	Grass Land	2,602,913,650.6		Irrigation Agriculture	16,572,001.9
	Irrigation Agriculture	205,339,539.7		Wasteland	33,021,207.9
	Scrub	160,758,565.8	33	Dryfarm Agriculture	5,241,393.7
	Urban	4,031,711.7		Grass Land	51,411,188.0
	Wasteland	726,485,458.8		Irrigation Agriculture	4,884,720.6
26	Dryfarm Agriculture	542,098,471.2	34	Dryfarm Agriculture	231,833,901.2
	Grass Land	585,089,654.3		Grass Land	180,925,297.7

Table 1.3.10 Landuse Area Summary by Sub-Basin Number (3/ 4, w/ Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
	Irrigation Agriculture	14,091,299.4		Scrub	26,863,541.4
	Scrub	24,059,233.0		Wasteland	345,867.9
35	Dryfarm Agriculture	218,705,941.9		Water	411,569.4
	Grass Land	175,201,862.4	44	Dryfarm Agriculture	1,432,606,165.3
	Irrigation Agriculture	17,006,256.7		Grass Land	169,074,544.4
	Scrub	29,954,798.0		Irrigation Agriculture	49,623,335.4
	Urban	793,587.6		Scrub	97,477,493.0
36	Dryfarm Agriculture	104.1		Urban	543,576.5
	Grass Land	851,172,423.8		Water	52,618.9
	Irrigation Agriculture	53,721,829.8	45	Dryfarm Agriculture	76,148,357.8
	Scrub	2,503.3		Grass Land	72,669,881.4
	Urban	686,140.1		Irrigation Agriculture	8,239,414.3
	Wasteland	37,157,480.3		Scrub	116,979,833.8
37	Dryfarm Agriculture	811,047,748.8	46	Dryfarm Agriculture	7,170,531.4
	Grass Land	815,583,237.6		Grass Land	90,634,579.9
	Irrigation Agriculture	60,517,322.9		Irrigation Agriculture	1,323,439.7
	Scrub	329,911,838.7	47	Dryfarm Agriculture	1,474,288,361.5
	Urban	5,572,951.7		Grass Land	245,173,221.4
	Wasteland	8,845,182.3		Irrigation Agriculture	294,655,439.4
38	Dryfarm Agriculture	81,250,880.2		Scrub	10,185,423.1
	Grass Land	33,096,551.5		Urban	1,462,432.3
	Irrigation Agriculture	7,013,160.2	48	Dryfarm Agriculture	692,032,379.3
	Scrub	3,603,906.7		Grass Land	137,263,401.6
	Wasteland	17,709,583.8		Irrigation Agriculture	73,876,505.0
39	Dryfarm Agriculture	10,633,064.3		Scrub	28,650,212.1
	Grass Land	16,687,737.0		Urban	9,967,880.3
	Scrub	3,443,012.7	49	Dryfarm Agriculture	76,149,861.1
40	Dryfarm Agriculture	366,621,292.6		Irrigation Agriculture	2,365,318.7
	Grass Land	683,921,766.6	50	Dryfarm Agriculture	73,220,088.0
	Irrigation Agriculture	2,779,537.4		Grass Land	66,742,182.4
41	Dryfarm Agriculture	326,394,173.9		Irrigation Agriculture	31,255,542.6
	Grass Land	222,606,775.8		Urban	576,141.0
	Irrigation Agriculture	24,020,562.5	51	Dryfarm Agriculture	1,749,740.1
	Urban	2,360,524.1		Grass Land	40,633,003.0
42	Dryfarm Agriculture	684,245,258.4		Irrigation Agriculture	6,399,390.2
	Grass Land	97,792,857.0	52	Dryfarm Agriculture	204,888,768.4
	Irrigation Agriculture	27,306,270.5		Grass Land	25,021,271.7
	Scrub	52,505,006.7		Irrigation Agriculture	17,151,676.8
	Wasteland	3,351,097.5		Urban	389,529.9
43	Dryfarm Agriculture	217,075,582.5	56	Dense Forest	1,561,209,277.9
	Grass Land	2,398,211.9		Dense Scrub	37,114,684.8
	Irrigation Agriculture	4,634,072.8		Dryfarm Agriculture	227,600,832.8

Table 1.3.11 Landuse Area Summary by Sub-Basin Number (4/ 4, w/ Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
	Forest	343.5		Scrub	10,674,707.4
	Grass Land	251,917,251.4		Urban	5,349,660.7
	Irrigation Agriculture	377,085,140.7		Wasteland	23,673,300.1
	Scrub	87,950.6	64	Dryfarm Agriculture	460,140,073.5
	Urban	22,268,292.4		Grass Land	282,683,002.2
	Wasteland	2,515,100.9		Irrigation Agriculture	17,879,797.8
	Water	68,163.8		Scrub	162,427,823.4
57	Dense Forest	624,137,040.3	65	Dryfarm Agriculture	416,833,826.6
	Dryfarm Agriculture	166,393.2		Grass Land	5,255,164.2
	Forest	2,500,065.2		Irrigation Agriculture	23,807,841.0
	Grass Land	12,875,051.1	66	Dryfarm Agriculture	3,271,397,276.9
	Irrigation Agriculture	132,731,319.7		Grass Land	1,357,304,069.5
	Urban	15,720,854.3		Irrigation Agriculture	248,133,406.7
59	Dense Forest	5,181,217.3		Scrub	636,841,624.1
	Dense Scrub	278,015.8		Urban	6,682,003.7
	Dryfarm Agriculture	18,217,475.3		Wasteland	231,695,922.1
	Forest	45,459,238.9	67	Dryfarm Agriculture	311,366,231.6
	Grass Land	533,650,880.1		Grass Land	200,929,937.9
	Irrigation Agriculture	35,195,951.5		Irrigation Agriculture	192,582,215.4
	Urban	4,541,413.2		Scrub	21,922,795.3
60	Dryfarm Agriculture	1,871,508,382.7		Urban	2,706,395.5
	Grass Land	547,825,533.3	53(DU-G)	Irrigation Agriculture	965,670,677.1
	Irrigation Agriculture	115,486,176.8		Urban	93,144,414.0
	Urban	1,933,084.4		Wasteland	18,897,285.9
61	Dense Forest	3.4		Water	294,928.3
	Dense Scrub	6,210,351.0	54(DU-F)	Dense Forest	120,149.2
	Dryfarm Agriculture	720,607,416.2		Irrigation Agriculture	1,063,538,523.0
	Forest	81,890,408.4		Urban	79,237,722.3
	Grass Land	2,567,261,765.3		Water	58,344,759.1
	Irrigation Agriculture	232,871,391.6	55(DU-D)	Dense Forest	234,512.0
	Scrub	668,564,475.1		Irrigation Agriculture	809,045,598.2
	Wasteland	555,053,610.3		Urban	57,969,402.9
62	Dense Forest	203,559,410.1		Wasteland	13,351,309.5
	Dense Scrub	1,244,830.6		Water	9,961,426.8
	Dryfarm Agriculture	11,222,791.3		Grand	64,282,727,193.3
	Forest	43,514.4			
	Grass Land	614.9			
	Irrigation Agriculture	2,069,971.2			
	Wasteland	8,409,297.9			
63	Dryfarm Agriculture	752,393,387.6			
	Grass Land	222,505,188.6			
	Irrigation Agriculture	86,004,812.2			

1.4 UPDATE IRRIGATION AND DRY-FARMING DATA BY USING ALOS SATELLITE IMAGE

In order to get a high quality result of water requirement simulation, the agriculture landuse (irrigation and dry-farming) are upgrade by JICA study team by using 2008 ALOS satellite image. The upgrade work and methodologies are shown as follows.

1.4.1 Making Geodatabase and Feature Classes in Arc Catalog

In order to save digitized polygons (Irrigation areas and Dry farming areas), polygon feature classes within geodatabase were made as shown in Figure 1.4.1.

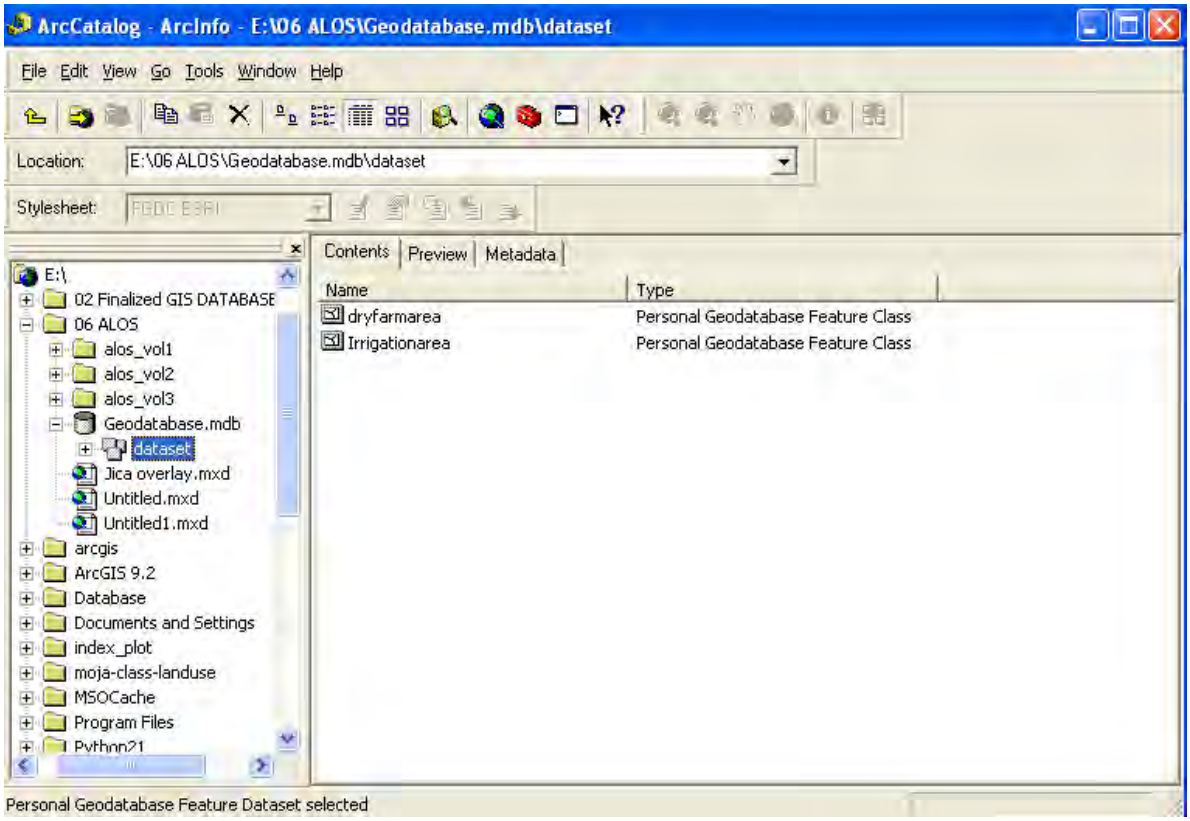


Figure 1.4.1 Preparation of Polygon Feature Classes for Irrigation areas and Dry farming areas

1.4.2 Digitizing Irrigation and Dry Farming Areas

Digitizing is the process of converting features on a paper map or raster image into vector format.

1) Vector Data

Vector data represent geographic phenomena with points, lines, and polygons. Points are pairs of x and y coordinates, lines are sets of coordinate pairs that define a shape, and polygons are sets of coordinate pairs defining boundaries that enclose areas as shown in Figure 1.4.2.

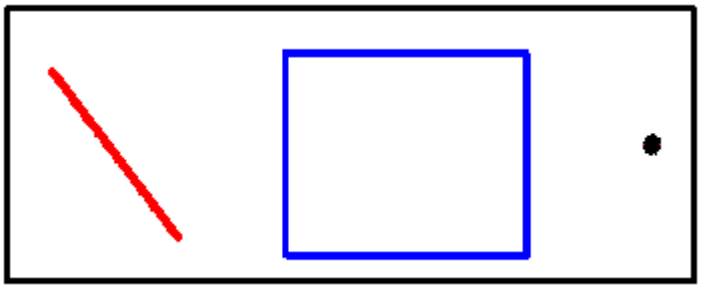


Figure 1.4.2 Examples of Vector Data

2) Raster Data

Raster data (image) is a matrix (grid) of cells. Each cell has a width and height and is a portion of the entire area represented by the raster. The dimension of the cells can be as large or as small as necessary to represent the area and the features within the area, such as a square kilometer, square meter, or even square centimeter Figure 1.4.3.

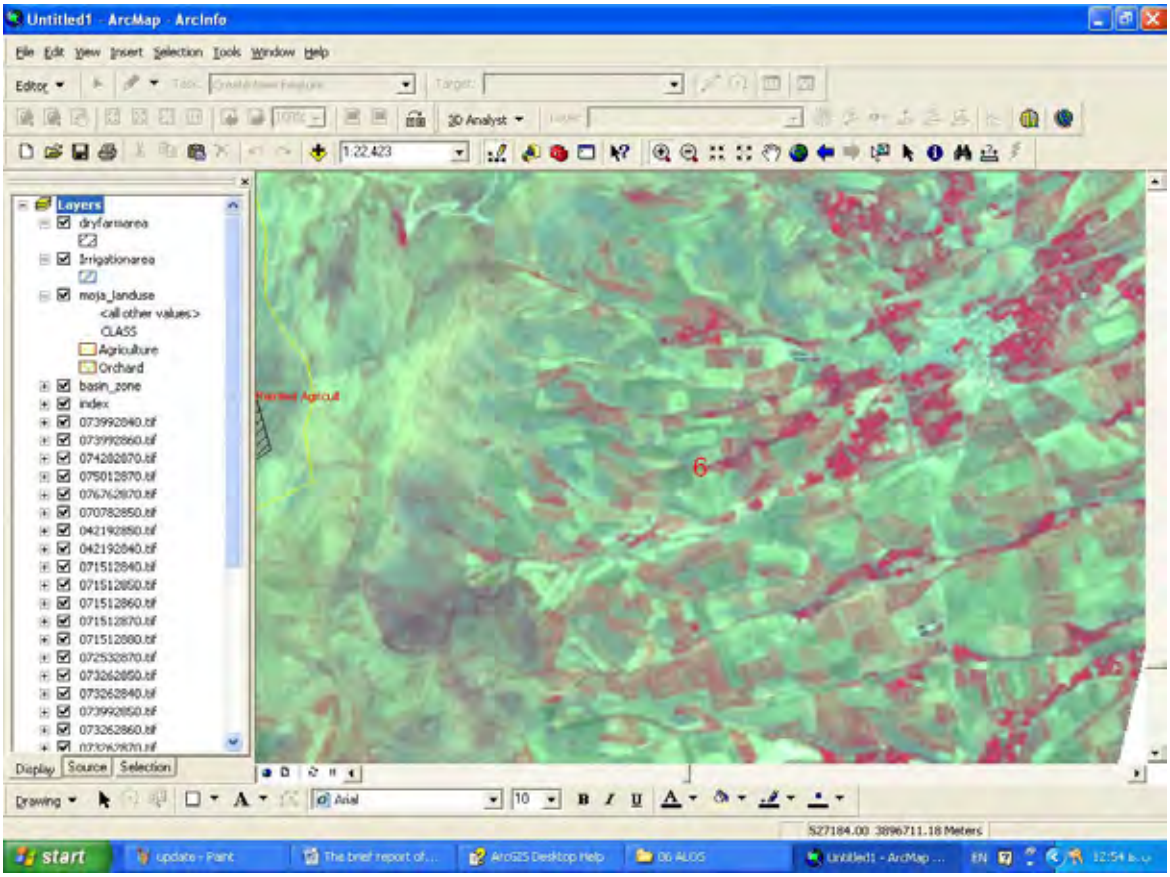


Figure 1.4.3 Examples of Raster Data

3) Digitizing Process

Editor toolbar was used to make polygon features of irrigation and dry farming areas on images as shown in Figure 1.4.4, and then these features were saved in above mentioned feature classes.

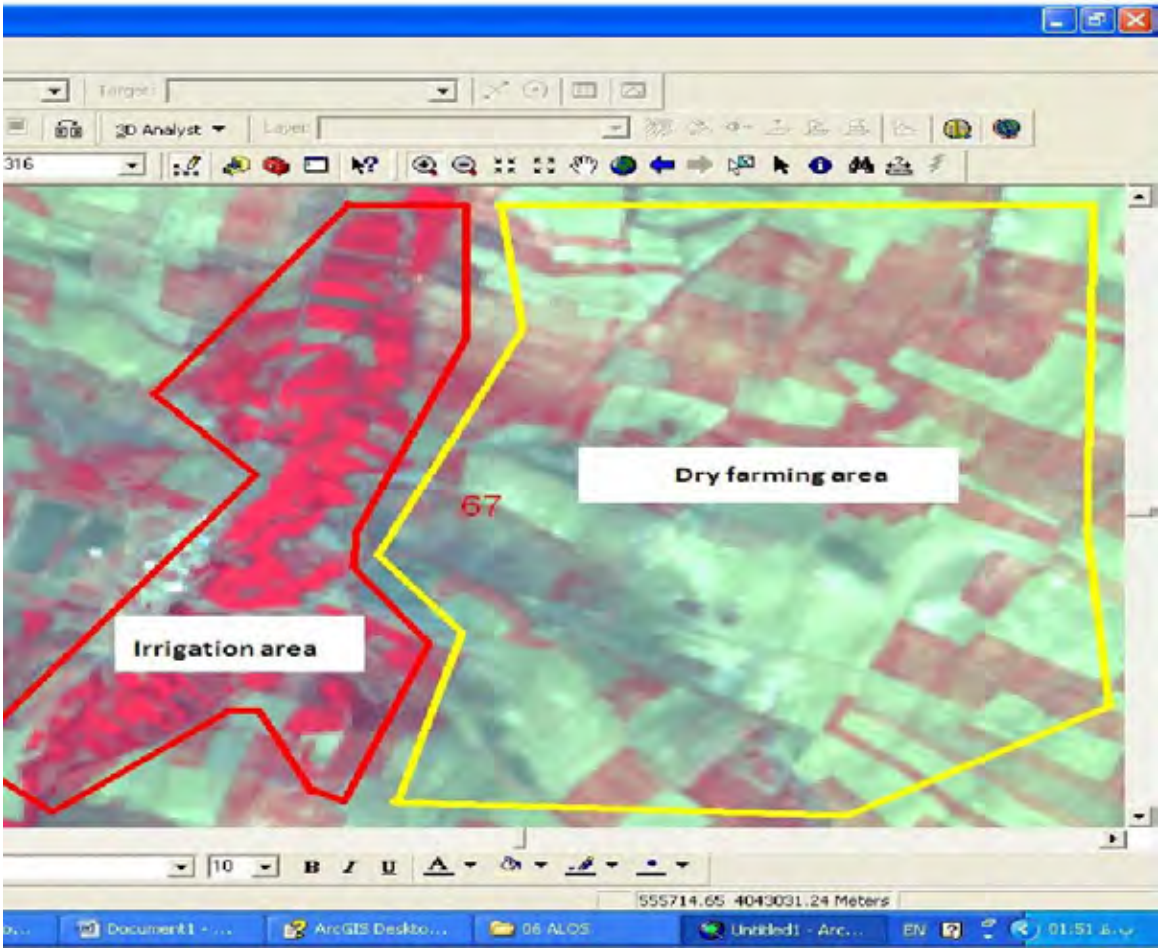


Figure 1.4.4 Polygon Features for Irrigation areas and Dry farming areas

1.4.3 Dissolving Polygon Features Within "MOJA-Class-Landuse" According to "New Class" Field

Dissolve operation creates a new feature by merging adjacent polygons, lines, or regions that have the same value for a specified item. In other words, you can use Dissolve when you want to aggregate features based on a specified attribute or attributes (fields).

1) Conceptual View of Dissolve Operation

The following figure indicates that how many polygon features in input features layer can be dissolved into one polygon feature within output features layer as shown in Figure 1.4.5.

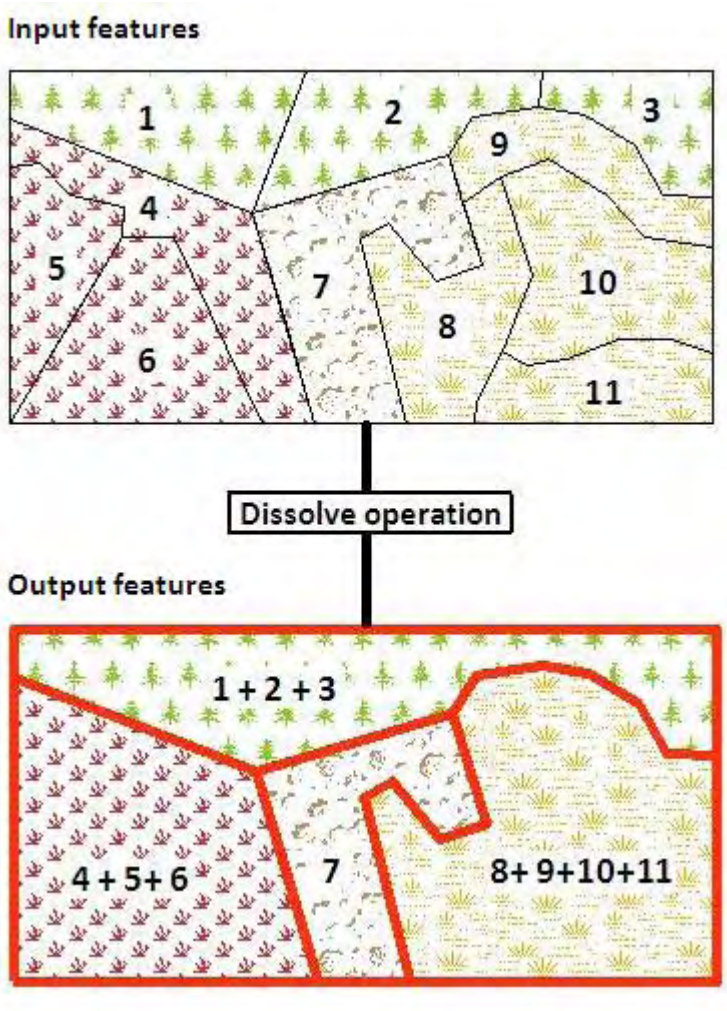


Figure 1.4.5 Dissolve Operation of Polygon Features

2) Dissolve Operation into Arc Map

In order to perform this task, we used the dissolve tool within Generalization toolset from data management tools to dissolve polygon features within “MOJA-Class-Landuse” according to “new class” field and make a new polygon feature class named “JICA-Class-Landuse” was made . Toolsets and tools are contained within toolboxes. Toolsets are used to group collections of tools together into logical groupings. A tool is a geoprocessing operation that performs a geoprocessing task. There are hundreds of system tools available, categorized into toolsets for ease of access. When you run a tool, you simply open the tool's dialog box, supply values for the tool's required parameters and any optional parameters, and then run the tool. Figure 1.4.6 shows dissolve tool's dialog box.

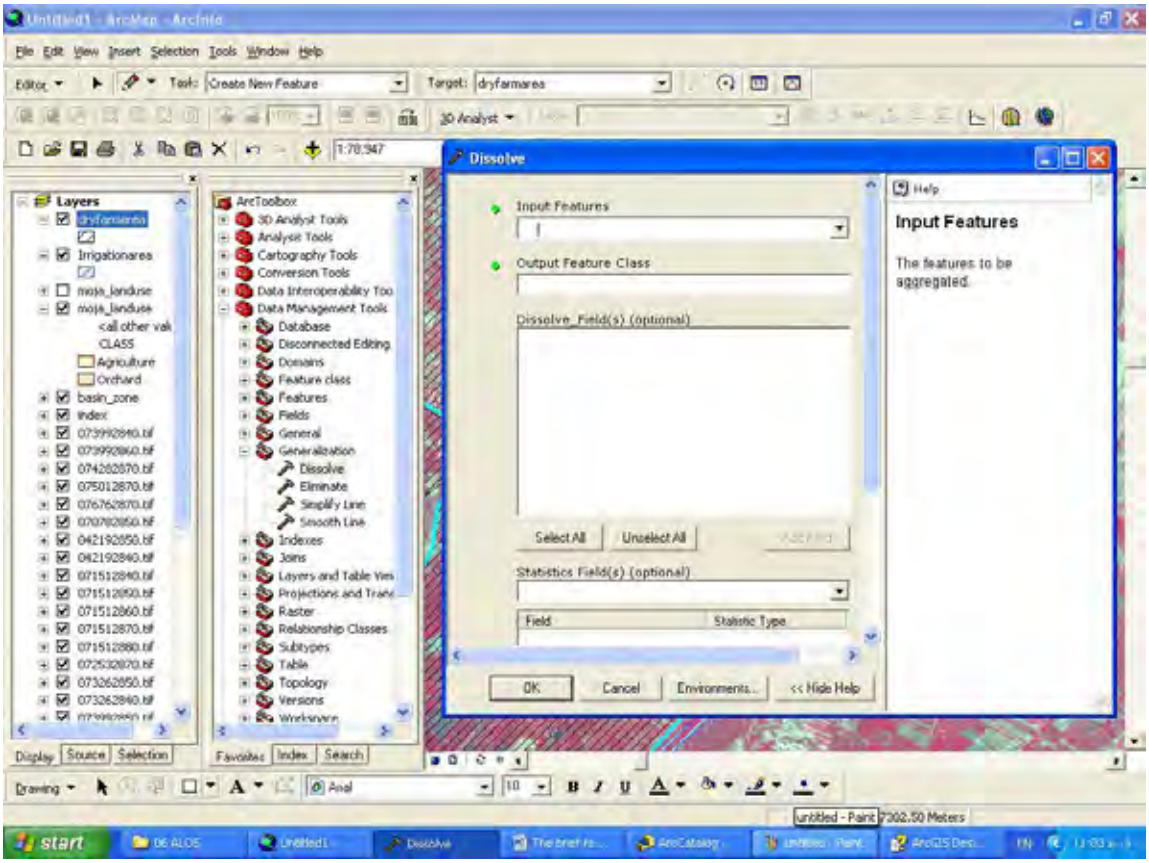


Figure 1.4.6 Dissolve Operation into Arc Map

1.4.4 Overlay (Update Operation) of "JICA-Class-Landuse" Layer with "Irrigation Agriculture" Layer

Overlay operation is intended to combine, erase, modify, or update spatial features in multiple feature classes and to make a new feature class.

1) Conceptual view of overlay analysis

The following figure shows that how polygon features in Input features (Old Landuse) layer can be updated by polygons in feature within Update features (New Landuse) layer as shown in Figure 1.4.7.

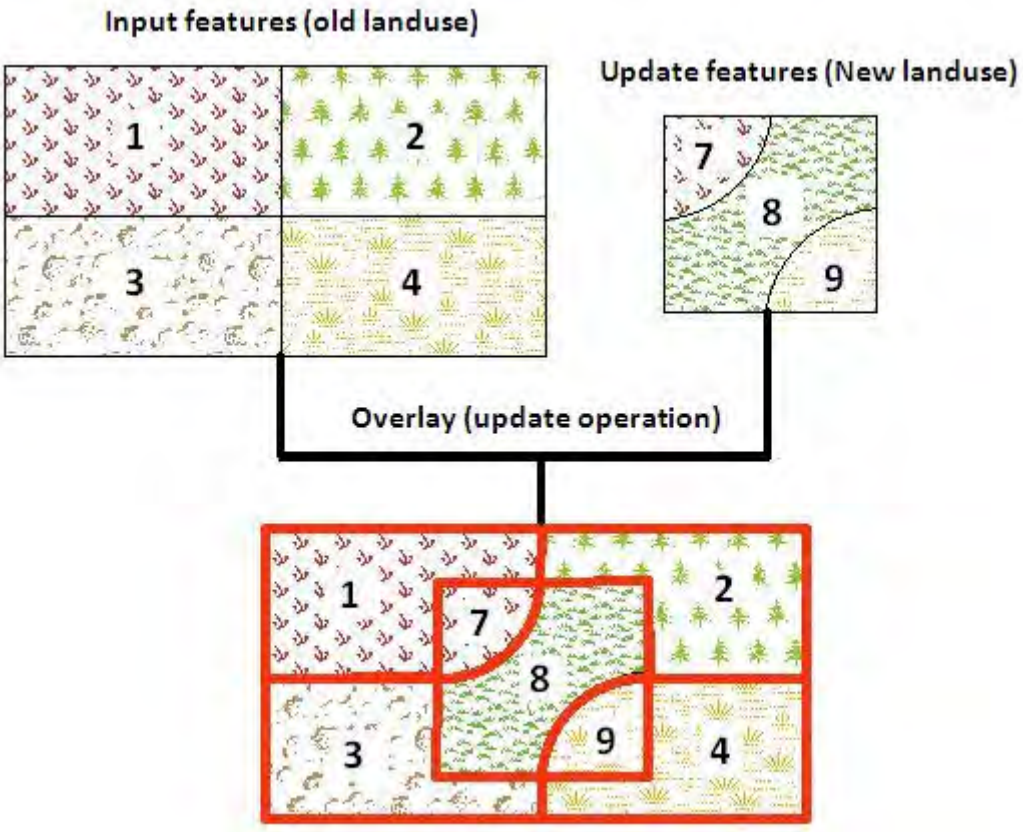


Figure 1.4.7 Concept of Updating Polygon Features

2) Overlay (Update Operation) into Arc Map

To meet this action, update tool within overlay toolset from analysis tools was used. We utilized overly – update tool to update "JICA-Class-Landuse" layer with "irrigation agriculture" layer. The result of this task is a new feature class named "jica_class_landuse_overlay1". The window for update is shown in Figure 1.4.8.

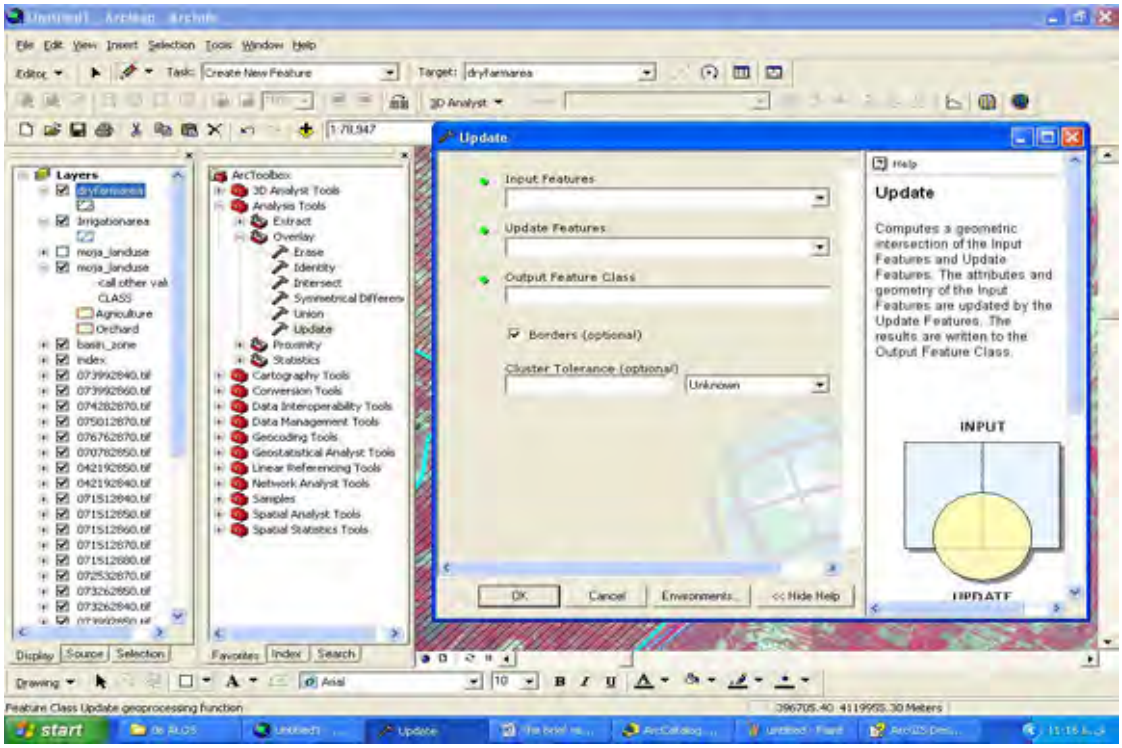


Figure 1.4.8 Updating Polygon Features

1.4.5 Setting of "New Class" Classification

Empty cells of the "new class" classifications should be filled up with the new classification in "jica_class_landuse_overlay1" with "irrigation agriculture" as shown in Figure 1.4.9.

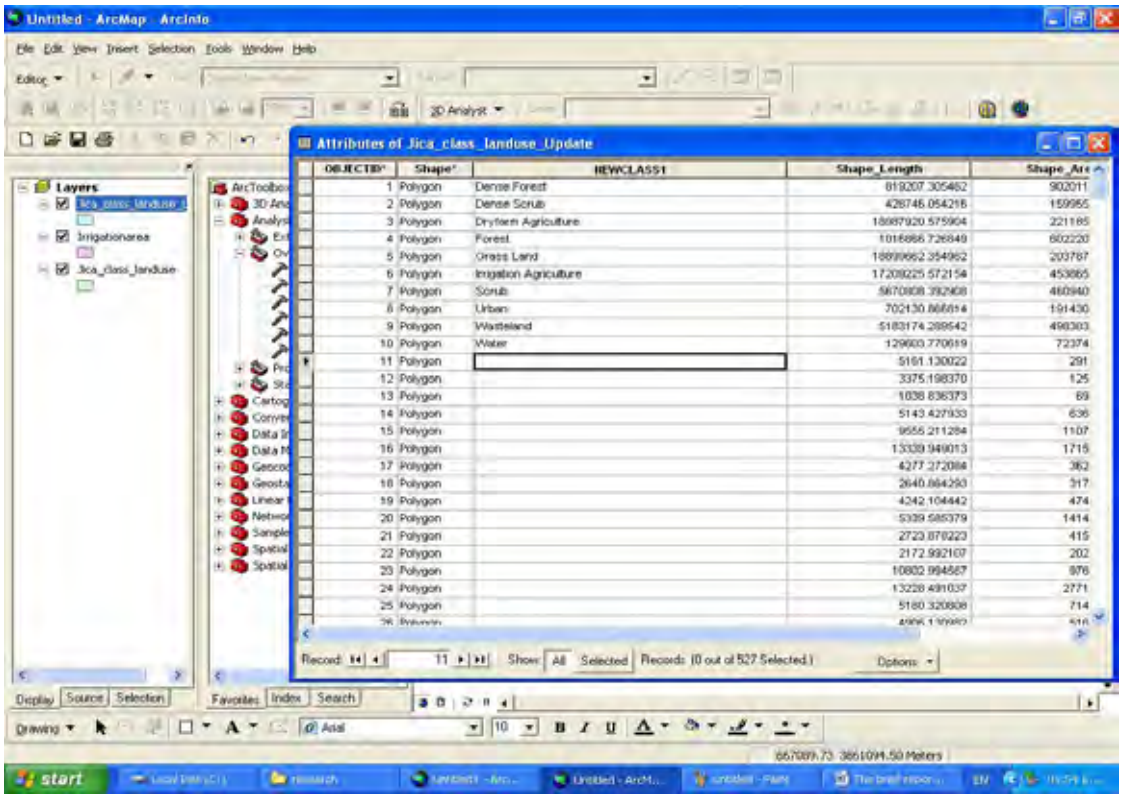


Figure 1.4.9 Filling up the New Class Classification

1.4.6 Dissolving Polygon Features within "jica_class_landuse_overlay1"

Polygon Features should be dissolved according to "new class" field as mentioned in a) at 3). The result will be the feature class named "jica_class_landuse_overlay1_dissolve".

1.4.7 Procedure for Dryfarm Agriculture

Above mentioned procedure was taken for the Dry farming agriculture" layer, applyng the name of "overly2" instead of "overlay1."

1.5 LANDUSE UPDATE RESULT

The new landuse that updated by JICA study team are as follows.

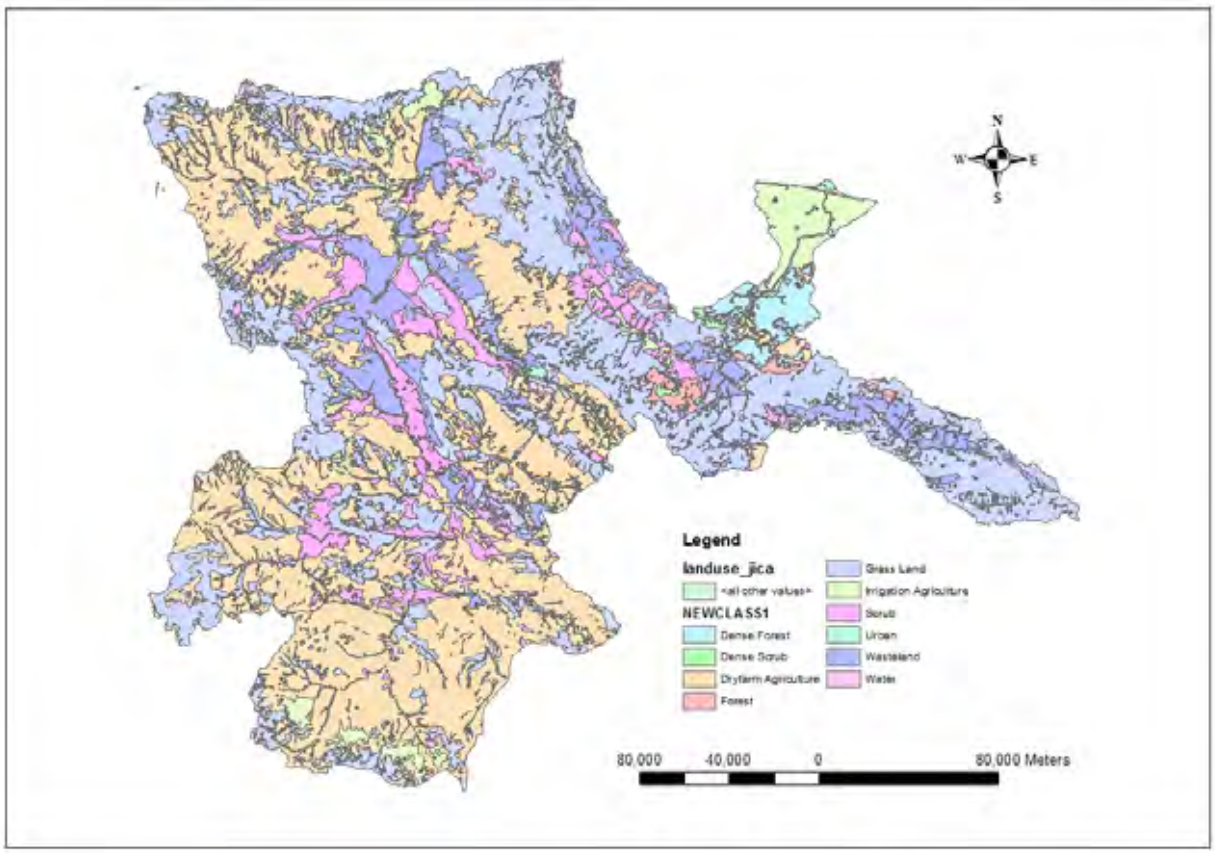


Figure 1.5.1 Updated Map of Landuse Data

The summary of the Landuse area that updated by JICA study team is as follow.

Table 1.5.1 Updated Landuse Area Summary (w/o Anzali)

JICA CLASS	JICA AREA (㎡)
Dense Forest	899,041,130.6
Dense Scrub	159,955,120.4
Dryfarm Agriculture	23,774,015,886.3
Forest	602,220,907.0
Grass Land	18,946,317,150.8
Irrigation Agriculture	5,123,688,283.4
Scrub	4,441,493,929.4
Urban	182,736,636.9
Wasteland	4,886,789,131.6
Water	60,407,031.9
Grand	59,066,665,208.3

Table 1.5.2 Updated Landuse Area Summary (w/ Anzali)

JICA CLASS	JICA AREA (㎡)
Dense Forest	3,076,013,165.0
Dense Scrub	197,143,577.7
Dryfarm Agriculture	23,999,948,919.5
Forest	604,585,231.3
Grass Land	19,199,758,305.6
Irrigation Agriculture	7,362,873,076.7
Scrub	4,440,900,915.1
Urban	386,029,478.6
Wasteland	4,886,784,054.5
Water	129,076,309.8
Grand	64,283,113,033.9

The summary of updated Landuse area by Reach Number is as follows.

Table 1.5.3 Updated Landuse Area Summary by Sub-Basin Number (1/ 4, w/o Anzali)

Reach No	JICA CLASS	JICA AREA (m^2)	Reach No	JICA CLASS	JICA AREA (m^2)
1	Dryfarm Agriculture	10,017,785.1		Irrigation Agriculture	72,441,648.9
	Forest	27,110.4		Scrub	42,415,796.8
	Grass Land	196,950,568.5		Urban	8,840,069.1
	Irrigation Agriculture	8,447,538.7		Wasteland	228,751,395.5
	Scrub	5,483,570.1	12	Dryfarm Agriculture	718.8
2	Dryfarm Agriculture	65,342,686.9		Grass Land	72,883,405.9
	Grass Land	211,220,484.9		Irrigation Agriculture	4,346,874.4
	Irrigation Agriculture	124,383,580.0	13	Dryfarm Agriculture	5,173,595.1
	Wasteland	18,892,451.6		Grass Land	85,605,327.4
3	Dryfarm Agriculture	78,445,247.4		Irrigation Agriculture	21,351,109.2
	Grass Land	562,039,991.3		Wasteland	57,637,630.8
	Irrigation Agriculture	27,510,116.0	14	Grass Land	13,600,587.3
	Scrub	757,716.7		Irrigation Agriculture	744,651.9
4	Dryfarm Agriculture	459,043,694.8	15	Dryfarm Agriculture	3,100,555.0
	Grass Land	455,481,385.0		Grass Land	2,608,121.6
	Irrigation Agriculture	87,925,526.5	16	Dryfarm Agriculture	5,403,828.4
	Scrub	5,455,717.7		Grass Land	6,794,751.4
5	Dryfarm Agriculture	454,029,487.2		Irrigation Agriculture	31,297.7
	Grass Land	420,450,427.8	17	Dryfarm Agriculture	1,350,950,313.6
	Irrigation Agriculture	152,485,408.0		Grass Land	495,797,205.1
	Scrub	823,796.5		Irrigation Agriculture	163,346,222.4
	Urban	336,692.0		Scrub	655,148,818.9
6	Dryfarm Agriculture	200,327,371.7		Urban	446,070.1
	Grass Land	55,983,232.9		Wasteland	775,023,753.1
	Irrigation Agriculture	85,979,107.3		Water	544,924.2
	Urban	450,521.1	18	Dryfarm Agriculture	700,349,947.1
	Wasteland	94,341,527.2		Grass Land	564,574,795.1
7	Dryfarm Agriculture	15,287,262.0		Irrigation Agriculture	101,437,398.0
	Grass Land	35,643,338.7		Scrub	151,347,434.5
8	Dryfarm Agriculture	46,727,091.5		Urban	111,034.8
	Grass Land	120,849,197.4		Wasteland	110,571,032.7
	Irrigation Agriculture	38,496,240.4	19	Dense Forest	507,424,887.1
9	Dryfarm Agriculture	11,409,006.3		Dense Scrub	59,989,191.4
	Grass Land	59,988,966.4		Dryfarm Agriculture	67,767,467.0
	Irrigation Agriculture	31,931,941.9		Forest	43,487,257.2
	Scrub	1,983,954.7		Grass Land	161,900,327.4
10	Dryfarm Agriculture	511,391,215.1		Irrigation Agriculture	96,977,499.4
	Grass Land	201,062,300.2		Urban	2,520,635.5
	Irrigation Agriculture	74,088,563.7		Wasteland	27,731,101.8
	Scrub	6,782,495.9	20	Dryfarm Agriculture	1,164,148,849.9
11	Dryfarm Agriculture	427,038,853.1		Grass Land	644,675,153.5
	Grass Land	118,966,874.1		Irrigation Agriculture	157,939,012.9

Table 1.5.4 Updated Landuse Area Summary by Sub-Basin Number (2/ 4, w/o Anzali)

Reach No	JICA CLASS	JICA AREA (m^2)	Reach No	JICA CLASS	JICA AREA (m^2)
	Scrub	369,849,763.7		Grass Land	567,642,992.7
	Urban	44,860,435.5		Irrigation Agriculture	92,177,452.1
	Wasteland	478,112,168.4		Scrub	570,290,024.7
	Water	17,966,128.3		Urban	2,699,601.4
21	Dense Forest	844,618.2		Wasteland	653,211,231.1
	Dense Scrub	53,053,283.8		Water	239,270.8
	Dryfarm Agriculture	2,216,474.2	27	Dryfarm Agriculture	635,009,831.4
	Forest	289,074,505.8		Grass Land	417,324,953.7
	Grass Land	1,343,898,849.1		Irrigation Agriculture	175,630,384.5
	Irrigation Agriculture	192,299,470.4		Scrub	33,723,332.3
	Scrub	197,907,942.4		Urban	7,787,188.9
	Urban	4,562,250.3		Wasteland	2,017,485.7
	Wasteland	369,640,119.3		Water	18,688,490.9
	Water	22,438,557.4	28	Dryfarm Agriculture	8,364,100.8
22	Dryfarm Agriculture	197,519,309.2		Grass Land	61,120,923.9
	Grass Land	72,981,662.6		Irrigation Agriculture	2,983,835.0
	Irrigation Agriculture	20,490,854.1	29	Dryfarm Agriculture	49,860,552.4
	Scrub	43,955,236.9		Grass Land	41,040,738.1
	Urban	405,417.7		Irrigation Agriculture	2,891,227.2
	Wasteland	266,937,420.5		Wasteland	2,329,771.8
23	Dense Forest	171,277,447.4	30	Dryfarm Agriculture	679,360,344.9
	Dense Scrub	36,321,174.2		Grass Land	307,033,594.3
	Dryfarm Agriculture	149,331,275.4		Irrigation Agriculture	59,027,828.6
	Forest	40,611,887.8		Scrub	78,594,627.6
	Grass Land	6,515,360.6		Urban	1,457,964.5
	Irrigation Agriculture	6,543,104.2		Wasteland	73,177,164.9
	Scrub	13,001,193.0		Water	65,471.9
	Urban	509,111.1	31	Dryfarm Agriculture	1,457,092.7
	Wasteland	10,087,641.5		Grass Land	61,777,877.3
24	Dryfarm Agriculture	28,802,420.3		Irrigation Agriculture	9,989,862.8
	Grass Land	119,947,928.5		Scrub	31,195.7
	Irrigation Agriculture	9,322,659.9		Wasteland	54,129,312.9
	Scrub	3,338,318.8	32	Dense Scrub	26,524.2
25	Dense Forest	3,604,872.0		Dryfarm Agriculture	737,252.9
	Dense Scrub	3,285,625.3		Forest	202,653.0
	Dryfarm Agriculture	98,429,324.8		Grass Land	236,699,403.5
	Forest	102,237,321.6		Irrigation Agriculture	16,572,001.9
	Grass Land	2,594,542,198.3		Wasteland	33,021,207.9
	Irrigation Agriculture	219,327,846.2	33	Dryfarm Agriculture	24,036,842.4
	Scrub	160,758,652.0		Grass Land	32,615,739.3
	Urban	2,569,736.3		Irrigation Agriculture	4,884,720.6
	Wasteland	721,026,560.8	34	Dryfarm Agriculture	242,135,894.5
26	Dryfarm Agriculture	596,253,929.2		Grass Land	166,967,814.4

Table 1.5.5 Updated Landuse Area Summary by Sub-Basin Number (3/ 4, w/o Anzali)

Reach No	JICA CLASS	JICA AREA (m^2)	Reach No	JICA CLASS	JICA AREA (m^2)
	Irrigation Agriculture	17,746,789.3		Wasteland	345,867.9
	Scrub	24,059,233.0		Water	411,569.4
35	Dryfarm Agriculture	216,099,509.4	44	Dryfarm Agriculture	1,458,233,006.5
	Grass Land	175,091,068.4		Grass Land	137,017,920.6
	Irrigation Agriculture	19,723,483.0		Irrigation Agriculture	58,195,014.2
	Scrub	29,954,798.0		Scrub	95,404,807.0
	Urban	793,587.6		Urban	474,366.2
36	Grass Land	851,167,985.5		Water	52,618.9
	Irrigation Agriculture	53,721,829.8	45	Dryfarm Agriculture	82,839,190.0
	Urban	686,140.1		Grass Land	68,669,587.5
	Wasteland	37,157,480.3		Irrigation Agriculture	10,889,117.5
37	Dryfarm Agriculture	993,243,303.8		Scrub	111,639,592.3
	Grass Land	617,001,639.8	46	Dryfarm Agriculture	7,170,531.4
	Irrigation Agriculture	78,769,058.3		Grass Land	88,376,977.2
	Scrub	328,218,809.6		Irrigation Agriculture	3,581,042.4
	Urban	5,400,288.2	47	Dryfarm Agriculture	1,485,583,839.3
	Wasteland	8,845,182.3		Grass Land	220,867,549.1
38	Dryfarm Agriculture	80,294,637.6		Irrigation Agriculture	308,630,098.5
	Grass Land	32,235,080.1		Scrub	9,220,962.0
	Irrigation Agriculture	8,830,874.3		Urban	1,462,432.3
	Scrub	3,603,906.7	48	Dryfarm Agriculture	719,590,756.3
	Wasteland	17,709,583.8		Grass Land	112,856,184.3
39	Dryfarm Agriculture	10,633,064.3		Irrigation Agriculture	79,866,688.5
	Grass Land	16,687,737.0		Scrub	20,561,445.4
	Scrub	3,443,012.7		Urban	8,915,303.8
40	Dryfarm Agriculture	378,718,146.1	49	Dryfarm Agriculture	72,329,200.1
	Grass Land	639,891,853.6		Irrigation Agriculture	6,185,979.7
	Irrigation Agriculture	34,712,596.8	50	Dryfarm Agriculture	73,144,800.5
41	Dryfarm Agriculture	410,973,300.0		Grass Land	66,062,827.9
	Grass Land	127,231,116.6		Irrigation Agriculture	32,010,184.6
	Irrigation Agriculture	34,829,369.3		Urban	576,141.0
	Urban	2,348,250.5	51	Dryfarm Agriculture	1,749,740.1
42	Dryfarm Agriculture	729,012,493.1		Grass Land	40,633,003.0
	Grass Land	62,047,010.9		Irrigation Agriculture	6,399,390.2
	Irrigation Agriculture	34,167,586.6	52	Dryfarm Agriculture	201,369,698.4
	Scrub	36,622,302.0		Grass Land	22,305,630.2
	Wasteland	3,351,097.5		Irrigation Agriculture	23,387,447.8
43	Dryfarm Agriculture	211,400,523.2		Urban	388,470.5
	Grass Land	2,353,202.7	56	Dense Forest	9,134,434.2
	Irrigation Agriculture	10,354,141.3		Dense Scrub	204,080.9
	Scrub	26,863,541.4		Forest	343.9

Table 1.5.6 Updated Landuse Area Summary by Sub-Basin Number (4/ 4, w/o Anzali)

Reach No	JICA CLASS	JICA AREA (m^2)	Reach No	JICA CLASS	JICA AREA (m^2)
	Grass Land	2,113,578.0	66	Dryfarm Agriculture	3,659,433,674.0
	Irrigation Agriculture	3,129,455.9		Grass Land	1,019,121,232.2
	Scrub	87,949.8		Irrigation Agriculture	251,402,570.6
	Wasteland	2,515,103.5		Scrub	587,747,280.1
57	Dense Forest	178,573.6		Urban	4,560,805.4
	Dryfarm Agriculture	70,492.4		Wasteland	229,788,740.9
	Irrigation Agriculture	107.0	67	Dryfarm Agriculture	330,407,157.9
59	Dense Forest	2,211,320.4		Grass Land	180,446,495.7
	Dryfarm Agriculture	28,808,328.2		Irrigation Agriculture	194,182,270.6
	Forest	45,459,824.2		Scrub	21,775,511.2
	Grass Land	500,501,757.9		Urban	2,706,395.5
	Irrigation Agriculture	59,018,078.5	53(DU-G)	Irrigation Agriculture	755,869,126.6
	Urban	4,541,413.2		Urban	29,189,177.3
60	Dryfarm Agriculture	1,895,718,839.9		Wasteland	18,897,285.9
	Grass Land	468,793,567.5	54(DU-F)	Irrigation Agriculture	176,904.9
	Irrigation Agriculture	170,311,960.5		Urban	37,971.4
	Urban	1,928,809.5	55(DU-D)	Irrigation Agriculture	338,655,601.9
61	Dense Scrub	5,830,410.4		Urban	31,348,040.0
	Dryfarm Agriculture	751,754,496.8		Wasteland	13,351,309.5
	Forest	80,941,333.6		Grand	59,041,292,292.5
	Grass Land	2,479,266,371.1			
	Irrigation Agriculture	300,579,471.2			
	Scrub	667,582,621.7			
	Wasteland	546,100,990.3			
62	Dense Forest	203,564,556.1			
	Dense Scrub	1,244,830.6			
	Dryfarm Agriculture	11,156,554.0			
	Irrigation Agriculture	2,069,971.2			
	Wasteland	8,409,297.9			
63	Dryfarm Agriculture	764,976,837.3			
	Grass Land	205,129,636.5			
	Irrigation Agriculture	91,479,289.5			
	Scrub	9,992,332.5			
	Urban	5,349,660.7			
	Wasteland	23,673,300.0			
64	Dryfarm Agriculture	494,333,558.4			
	Grass Land	275,622,775.1			
	Irrigation Agriculture	30,658,637.9			
	Scrub	122,541,778.6			
65	Dryfarm Agriculture	410,662,728.2			
	Grass Land	4,020,028.4			
	Irrigation Agriculture	31,214,075.1			

Table 1.5.7 Updated Landuse Area Summary by Sub-Basin Number (1/ 4, w/ Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
1	Dryfarm Agriculture	10,017,785.1		Irrigation Agriculture	72,441,648.9
	Forest	27,110.4		Scrub	42,415,796.8
	Grass Land	196,950,568.5		Urban	8,840,069.1
	Irrigation Agriculture	8,447,538.7		Wasteland	228,751,395.5
	Scrub	5,483,570.1	12	Dryfarm Agriculture	718.8
2	Dryfarm Agriculture	65,342,686.9		Grass Land	72,883,405.9
	Grass Land	211,220,484.8		Irrigation Agriculture	4,346,874.4
	Irrigation Agriculture	124,383,580.0	13	Dryfarm Agriculture	5,173,595.1
	Wasteland	18,892,451.6		Grass Land	86,060,074.6
3	Dryfarm Agriculture	78,445,247.4		Irrigation Agriculture	21,351,109.2
	Grass Land	562,039,991.3		Wasteland	57,637,630.8
	Irrigation Agriculture	27,510,116.0	14	Grass Land	13,600,587.3
	Scrub	757,716.7		Irrigation Agriculture	744,651.9
4	Dryfarm Agriculture	459,043,694.8	15	Dryfarm Agriculture	3,100,555.0
	Grass Land	455,481,385.0		Grass Land	2,608,121.6
	Irrigation Agriculture	87,925,526.5	16	Dryfarm Agriculture	5,403,828.4
	Scrub	5,455,717.7		Grass Land	6,794,751.4
5	Dryfarm Agriculture	454,029,487.2		Irrigation Agriculture	31,297.7
	Grass Land	420,450,427.7	17	Dryfarm Agriculture	1,350,950,313.6
	Irrigation Agriculture	152,485,408.0		Grass Land	495,797,205.1
	Scrub	823,796.5		Irrigation Agriculture	163,346,222.4
	Urban	336,692.0		Scrub	655,148,818.9
6	Dryfarm Agriculture	200,327,371.7		Urban	446,070.1
	Grass Land	55,983,232.9		Wasteland	775,023,753.1
	Irrigation Agriculture	85,979,107.3		Water	544,924.2
	Urban	450,521.1	18	Dryfarm Agriculture	700,349,947.1
	Wasteland	94,341,527.2		Grass Land	564,574,795.1
7	Dryfarm Agriculture	15,287,262.0		Irrigation Agriculture	101,437,398.0
	Grass Land	35,643,338.7		Scrub	151,347,434.5
8	Dryfarm Agriculture	46,727,091.5		Urban	111,034.8
	Grass Land	120,849,197.4		Wasteland	110,571,032.7
	Irrigation Agriculture	38,496,240.4	19	Dense Forest	508,814,514.3
9	Dryfarm Agriculture	11,409,006.3		Dense Scrub	59,989,028.9
	Grass Land	59,988,966.4		Dryfarm Agriculture	67,767,466.9
	Irrigation Agriculture	31,931,941.9		Forest	43,487,257.2
	Scrub	1,983,954.7		Grass Land	161,955,752.1
10	Dryfarm Agriculture	511,391,215.1		Irrigation Agriculture	96,977,499.4
	Grass Land	201,062,300.2		Urban	2,520,635.5
	Irrigation Agriculture	74,088,563.7		Wasteland	27,731,101.8
	Scrub	6,782,495.9	20	Dryfarm Agriculture	1,164,148,849.9
11	Dryfarm Agriculture	427,038,853.1		Grass Land	644,675,153.5
	Grass Land	118,966,874.1		Irrigation Agriculture	157,939,012.9

Table 1.5.8 Updated Landuse Area Summary by Sub-Basin Number (2/ 4, w/ Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
	Scrub	369,849,763.7	26	Dryfarm Agriculture	596,253,929.2
	Urban	44,860,435.5		Grass Land	567,642,992.7
	Wasteland	478,112,168.4		Irrigation Agriculture	92,177,452.1
	Water	17,966,128.3		Scrub	570,290,024.7
21	Dense Forest	844,618.2		Urban	2,699,601.4
	Dense Scrub	53,053,283.8		Wasteland	653,211,231.1
	Dryfarm Agriculture	2,216,474.2		Water	239,270.8
	Forest	289,074,505.8	27	Dryfarm Agriculture	635,009,831.4
	Grass Land	1,344,016,539.6		Grass Land	417,324,953.7
	Irrigation Agriculture	192,299,470.4		Irrigation Agriculture	175,630,384.5
	Scrub	197,907,942.4		Scrub	33,723,332.3
	Urban	4,562,250.3		Urban	7,787,188.9
	Wasteland	369,640,119.3		Wasteland	2,017,485.7
	Water	22,438,557.4		Water	18,688,490.9
22	Dryfarm Agriculture	197,519,309.2	28	Dryfarm Agriculture	8,364,100.8
	Grass Land	72,981,662.6		Grass Land	61,120,923.9
	Irrigation Agriculture	20,490,854.1		Irrigation Agriculture	2,983,835.0
	Scrub	43,955,236.9	29	Dryfarm Agriculture	49,860,552.4
	Urban	405,417.7		Grass Land	41,040,738.1
	Wasteland	266,937,420.5		Irrigation Agriculture	2,891,227.2
23	Dense Forest	171,277,447.4		Wasteland	2,329,771.8
	Dense Scrub	36,321,174.2	30	Dryfarm Agriculture	679,360,344.9
	Dryfarm Agriculture	151,959,721.4		Grass Land	307,033,594.3
	Forest	40,611,887.8		Irrigation Agriculture	59,027,828.6
	Grass Land	6,515,360.7		Scrub	78,594,627.6
	Irrigation Agriculture	6,543,104.2		Urban	1,457,964.5
	Scrub	12,930,217.7		Wasteland	73,177,164.9
	Urban	509,111.1		Water	65,471.9
	Wasteland	10,087,641.5	31	Dryfarm Agriculture	1,457,092.7
24	Dryfarm Agriculture	28,802,420.3		Grass Land	61,777,877.3
	Grass Land	119,947,928.5		Irrigation Agriculture	9,989,862.8
	Irrigation Agriculture	9,322,659.9		Scrub	31,195.7
	Scrub	3,338,318.8		Wasteland	54,129,312.9
25	Dense Forest	3,604,872.0	32	Dense Scrub	26,524.2
	Dense Scrub	3,285,625.3		Dryfarm Agriculture	737,252.9
	Dryfarm Agriculture	98,762,964.9		Forest	202,653.0
	Forest	102,237,321.6		Grass Land	236,699,403.5
	Grass Land	2,596,105,672.9		Irrigation Agriculture	16,572,001.9
	Irrigation Agriculture	219,328,849.8		Wasteland	33,021,207.9
	Scrub	160,758,565.8	33	Dryfarm Agriculture	24,036,842.4
	Urban	2,569,736.3		Grass Land	32,615,739.3
	Wasteland	721,026,575.9		Irrigation Agriculture	4,884,720.6
			34	Dryfarm Agriculture	242,135,894.5

Table 1.5.9 Updated Landuse Area Summary by Sub-Basin Number (3/ 4, w/ Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
	Grass Land	166,967,814.4		Grass Land	2,353,202.7
	Irrigation Agriculture	17,746,789.3		Irrigation Agriculture	10,354,141.3
	Scrub	24,059,233.0		Scrub	26,863,541.4
35	Dryfarm Agriculture	216,099,509.4		Wasteland	345,867.9
	Grass Land	175,091,068.4		Water	411,569.4
	Irrigation Agriculture	19,723,483.0	44	Dryfarm Agriculture	1,458,233,006.5
	Scrub	29,954,798.0		Grass Land	137,017,920.6
	Urban	793,587.6		Irrigation Agriculture	58,195,014.2
36	Dryfarm Agriculture	104.1		Scrub	95,404,807.0
	Grass Land	851,172,423.8		Urban	474,366.2
	Irrigation Agriculture	53,721,829.8		Water	52,618.9
	Scrub	2,503.3	45	Dryfarm Agriculture	82,839,190.0
	Urban	686,140.1		Grass Land	68,669,587.5
	Wasteland	37,157,480.3		Irrigation Agriculture	10,889,117.5
37	Dryfarm Agriculture	993,243,303.8		Scrub	111,639,592.3
	Grass Land	617,001,639.8	46	Dryfarm Agriculture	7,170,531.4
	Irrigation Agriculture	78,769,058.3		Grass Land	88,376,977.2
	Scrub	328,218,809.6		Irrigation Agriculture	3,581,042.4
	Urban	5,400,288.2	47	Dryfarm Agriculture	1,485,583,839.3
	Wasteland	8,845,182.3		Grass Land	220,867,549.1
38	Dryfarm Agriculture	80,294,637.6		Irrigation Agriculture	308,630,098.5
	Grass Land	32,235,080.1		Scrub	9,220,962.0
	Irrigation Agriculture	8,830,874.3		Urban	1,462,432.3
	Scrub	3,603,906.7	48	Dryfarm Agriculture	719,590,756.3
	Wasteland	17,709,583.8		Grass Land	112,856,184.3
39	Dryfarm Agriculture	10,633,064.3		Irrigation Agriculture	79,866,688.5
	Grass Land	16,687,737.0		Scrub	20,561,445.4
	Scrub	3,443,012.7		Urban	8,915,303.8
40	Dryfarm Agriculture	378,718,146.1	49	Dryfarm Agriculture	72,329,200.1
	Grass Land	639,891,853.7		Irrigation Agriculture	6,185,979.7
	Irrigation Agriculture	34,712,596.8	50	Dryfarm Agriculture	73,144,800.5
41	Dryfarm Agriculture	410,973,299.9		Grass Land	66,062,827.9
	Grass Land	127,231,116.6		Irrigation Agriculture	32,010,184.6
	Irrigation Agriculture	34,829,369.3		Urban	576,141.0
	Urban	2,348,250.5	51	Dryfarm Agriculture	1,749,740.1
42	Dryfarm Agriculture	729,012,493.1		Grass Land	40,633,003.0
	Grass Land	62,047,010.9		Irrigation Agriculture	6,399,390.2
	Irrigation Agriculture	34,167,586.6	52	Dryfarm Agriculture	201,369,698.3
	Scrub	36,622,302.0		Grass Land	22,305,630.2
	Wasteland	3,351,097.5		Irrigation Agriculture	23,387,447.8
43	Dryfarm Agriculture	211,400,523.2		Urban	388,470.5

Table 1.5.10 Updated Landuse Area Summary by Sub-Basin Number (4/ 4, w/ Anzali)

Reach No	JICA CLASS	MOJA AREA (m^2)	Reach No	JICA CLASS	MOJA AREA (m^2)
56	Dense Forest	1,561,209,277.9	63	Dryfarm Agriculture	764,976,837.3
	Dense Scrub	37,114,684.8		Grass Land	205,129,636.5
	Dryfarm Agriculture	227,600,832.8		Irrigation Agriculture	91,479,289.5
	Forest	343.5		Scrub	9,992,332.5
	Grass Land	251,917,226.1		Urban	5,349,660.7
	Irrigation Agriculture	377,085,166.0		Wasteland	23,673,300.1
	Scrub	87,950.6	64	Dryfarm Agriculture	494,333,558.5
	Urban	22,268,292.4		Grass Land	275,622,775.1
	Wasteland	2,515,100.9		Irrigation Agriculture	30,658,637.9
	Water	68,163.8		Scrub	122,541,778.6
57	Dense Forest	624,137,040.3	65	Dryfarm Agriculture	410,662,728.2
	Dryfarm Agriculture	166,393.2		Grass Land	4,020,028.4
	Forest	2,500,065.2		Irrigation Agriculture	31,214,075.1
	Grass Land	12,875,051.1	66	Dryfarm Agriculture	3,659,433,674.0
	Irrigation Agriculture	132,731,319.7		Grass Land	1,019,121,232.2
	Urban	15,720,854.3		Irrigation Agriculture	251,402,570.6
59	Dense Forest	2,211,320.3		Scrub	587,747,280.1
	Dense Scrub	278,015.9		Urban	4,560,805.4
	Dryfarm Agriculture	28,854,063.4		Wasteland	229,788,740.9
	Forest	45,459,238.9	67	Dryfarm Agriculture	330,407,157.9
	Grass Land	502,282,914.3		Grass Land	180,446,495.7
	Irrigation Agriculture	58,897,226.1		Irrigation Agriculture	194,182,270.6
	Urban	4,541,413.2		Scrub	21,775,511.2
60	Dryfarm Agriculture	1,895,718,839.8		Urban	2,706,395.5
	Grass Land	468,793,567.5	53(DU-G)	Irrigation Agriculture	965,670,677.1
	Irrigation Agriculture	170,311,960.5		Urban	93,144,414.0
	Urban	1,928,809.5		Wasteland	18,897,285.9
61	Dense Forest	3.4		Water	294,928.3
	Dense Scrub	5,830,410.4	54(DU-F)	Dense Forest	120,149.2
	Dryfarm Agriculture	751,754,496.8		Irrigation Agriculture	1,063,538,523.0
	Forest	80,941,333.6		Urban	79,237,722.3
	Grass Land	2,479,670,136.9		Water	58,344,759.1
	Irrigation Agriculture	300,579,441.1	55(DU-D)	Dense Forest	234,512.0
	Scrub	667,582,621.7		Irrigation Agriculture	809,045,598.2
	Wasteland	546,100,986.5		Urban	57,969,402.9
62	Dense Forest	203,559,410.1		Wasteland	13,351,309.5
	Dense Scrub	1,244,830.6		Water	9,961,426.8
	Dryfarm Agriculture	11,222,791.3		Grand	64,283,113,542.0
	Forest	43,514.4			
	Grass Land	614.9			
	Irrigation Agriculture	2,069,971.2			
	Wasteland	8,409,297.9			

CHAPTER 2. LANDUSE STUDY ON USING SPOT SATELLITE IMAGE

In order to improving the data quality of water demand estimation, WRMC and JICA agreed to use new and high resolution satellite image to make more accurate land use data. The SPOT5 with 5 meter resolution and two seasons' data were selected. The process of land use study based on SPOT5 satellite image is as follows.

2.1 INTRODUCTION OF SPOT SATELLITE IMAGE

2.1.1 Introduction

SPOT imagery offers an optimum combination of resolution and coverage. A single SPOT scene covers a footprint of 3,600 km² at resolutions of 20 m to 2.5 m, with location accuracy up to 10 m. Such precise and synoptic coverage is ideal for applications at regional and local scales from1:100 000 to 1:10 000. In this study, the 5m resolution images are used for produce 1:25000 scale land use data.

The SPOT satellites have built up a global archive of millions of images since 1986. This archive is a vast storehouse of recent and historical data for multi-date analysis. The SPOT satellites can also be tasked to meet customs' specific time and place requirements. In this study, JICA team provide a range of study area, and two season of time on spring and Summer and ask the specific time and place order.

The specification of the satellite image is shown in following table.

Table 2.1.1 Specification of Satellite Image

Items	Specifications
Products	Panchromatic: 5 m Multispectral: 10 m color adjusted
Spectral Bands	P (panchromatic); B1 (green); B2 (red); B3 (near infrared); B4 (SWIR: short-wave infrared)
Footprint	60 km x 60 km
Tasking	April 2009 – June 2009, July 2009 – August 2009
Viewing Angle	Cross-track: +/- 27° Forward/backward stereo-viewing with SPOT 5
Location Accuracy	< 30 m (1 σ) with SPOT 5
Preprocessing Levels	1A, 2A

2.1.2 Planning of Image Photography

First of all, JICA Study Team work with WRMC and make a SPOT Image Processing Working Plan, the processing flow is as follow.

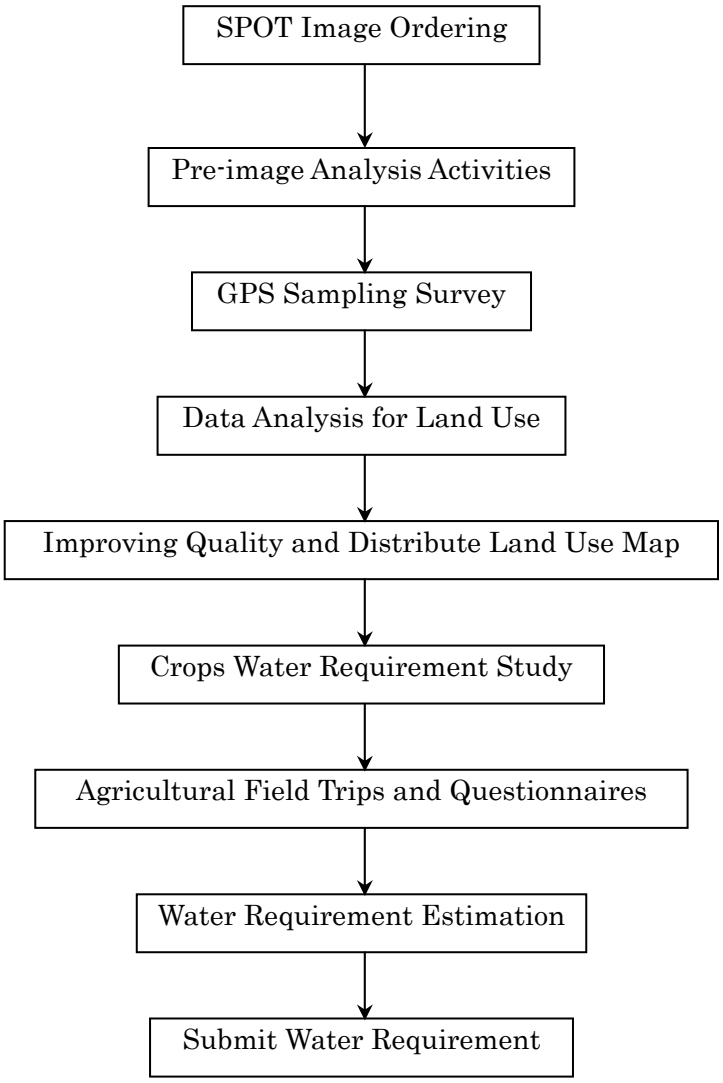


Figure 2.1.1 Flow of SPOT Image Processing

Description:

- SPOT Image Ordering: two seasons SPOT satellite image are ordered to cover main body of Shefidrud river basin including agricultural areas and plains. the mentioned area was covered by 20 frames of SPOT Image, so that total number of frames for two seasons are 40 frames. Other area outside of above 20 frames, for example, Guilan Plain and Eastern part of basin use the existing ASTER Archive Information.
- Pre-Image Process Activities: after receiving SPOT Image information, topological and radio metrical corrections work was done before remote sensing analysis.
- GPS Sampling Survey: A field trip and sampling data survey with GPS(+- 3m) and spectral study of crops are exacted. More than 30 points for each crop in each frame are selected.
- Data Analysis for Land use: Data analysis by remote sensing software with classification algorithms is operated. Initial version of land use data is generated.
- Improving Quality and Distribution Land use data: after calculation of error and upgrading the data quality by field check, a final version of land use data is submitted.
- Crop water requirement study: Estimation of ETC and ETO, and comparing them with

national document.

- Agricultural Field Trips and Questionnaires: to get a accurate water requirement data, a agricultural field trip team is departure with a questionnaire to the land owner.
- Water requirement estimation: using FAO program, the water requirement will be calculated by inputting ETO, rainfall, crop type and soil type.
- Submit water requirement: using irrigation efficiency, the water requirement for each reach number area are submitted.

Along with above working plan, a planning schedule is made as follows.

No.	Processing Items	Responsible Party	2009									2010		
			4	5	6	7	8	9	10	11	12	1	2	3
1	SPOT Image Order, Simulation Work	JICA	▲			▲								
2	Pre-analysis Activities	JICA and MG												
3	GPS Sampling Survey	MG												
4	Data Analysis for Land Use	MG												
5	Improving Quality and Distribute Land Use Map	MG												
6	Crops Water Reqirement Study	MG												
7	Agricultural Field Trips and Questionaires	MG												
8	Water Reqirement Estimation	MG												
9	Submit Water Reqirement	MG												

▲ : satellite image providing point

Figure 2.1.2 SPOT Image Processing Schedule

2.1.3 Specification for Each Satellite Image

JICA Study Team required SPOT Image and provided them to WRMC.

- Design: Totally 20 Frames of SPOT Image
- FIRST SEASON：2009/04/16～009/06/30
- SECOND SEASON： 2009/07/01～2009/09/30

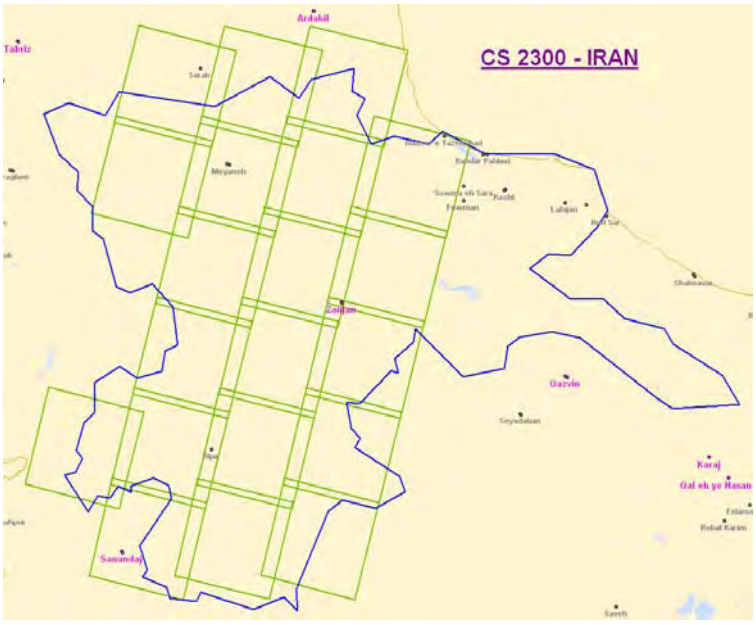


Figure 2.1.3 Plan of Shooting

2.1.4 Actual Satellite Image Photography

[First Season: From 16/4/2009 to 30/6/2009]

- First Offer to WRMC: 5 images at 1/5/2009
- Second Offer to WRMC: 15 images at 30/6/2009

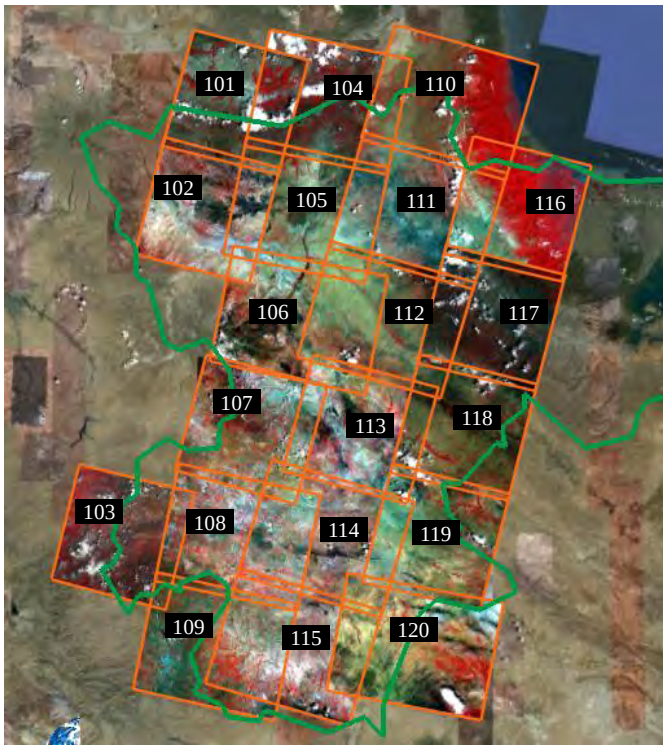


Figure 2.1.4 Location of 1st Shooting

[Second Season: From 1/7/2009 to 30/7/2009]

- Third Offer to WRMC: 14/8/2009

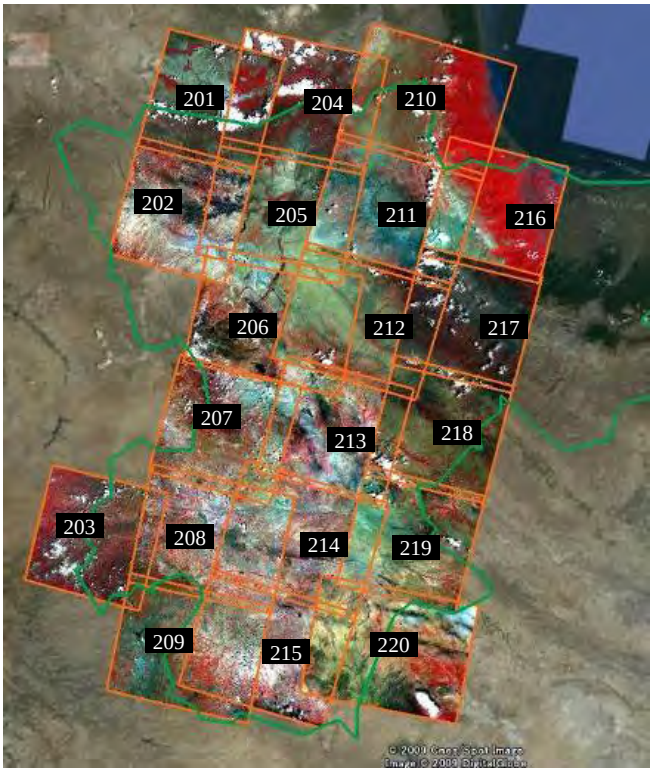


Figure 2.1.5 Location and Date of 2nd Shooting

Table 2.1.2 List of the Satellite Images in the First Season

Number	Image File Name	Number	Image File Name
101	140274_09Jun23_5mL1A	111	143275_09Jun12_5mL1A
102	140275_09Jun23_5mL1A	112	143276_09Jun12_5mL1A
103	140278_09Apr27_5mL1A	113	143277_09May07_5mL1A
104	141274_09May29_5mL1A	114	142278_09Apr21_5mL1A
105	141275_09May29_5mL1A	115	142279_09Apr21_5mL1A
106	142276_09Apr28_5mL1A	116	144275_09Jun18_5mL1A
107	141277_09Jun02_5mL1A	117	144276_09Jun18_5mL1A
108	141278_09May29_5mL1A	118	144277_09Jun18_5mL1A
109	142279_09May29_5mL1A	119	144278_09Jun18_5mL1A
110	143274_09Jun12_5mL1A	120	144279_09Apr23_5mL1A

Table 2.1.3 List of the Satellite Images in the Second Season

Number	Image File Name	Number	Image File Name
201	141276_09Jul09_5mL1A	211	144275_09Jul10_5mL1A
202	141277_09Jul09_5mL1A	212	144276_09Jul10_5mL1A
203	141278_09Jul09_5mL1A	213	144277_09Jul10_5mL1A
204	141279_09Jul09_5mL1A	214	144278_09Jul10_5mL1A
205	143274_09Jul14_5mL1A	215	144279_09Jul10_5mL1A
206	143275_09Jul14_5mL1A	216	140274_09Jul20_5mL1A
207	142276_09Jul04_5mL1A	217	140275_09Jul20_5mL1A
208	142277_09Jul04_5mL1A	218	140278_09Jul08_5mL1A
209	143278_09Jul04_5mL1A	219	141274_09Jul09_5mL1A
210	143279_09Jul04_5mL1A	220	141275_09Jul09_5mL1A

The specifications for each satellite image are as follow.

Table 2.1.4 Specifications of Satellite Images in the First Season (1/5)

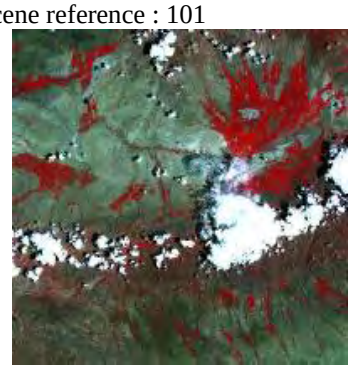
Image	Item	Description
Scene reference : 101 	Satellite :	Spot5
	K/J :	140 / 274
	Acquisition date :	23-06-2009
	Cloud % :	17%
	Cloud cover rating :	BBBCDDBA
	Shift along track (SAT) :	0
	Centre :	N37°50 E47°22
	Angle of incidence :	1.96°
	Spectral bands :	3

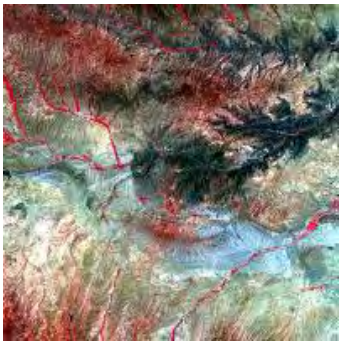
Image	Item	Description
Scene reference : 102 	Satellite :	Spot5
	K/J :	140 / 275
	Acquisition date :	23-06-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N37°21 E47°12
	Angle of incidence :	1.96°
	Spectral bands :	3

Image	Item	Description
Scene reference : 103 	Satellite :	Spot5
	K/J :	140 / 278
	Acquisition date :	27-04-2009
	Cloud % :	8%
	Cloud cover rating :	BBBBCBCB
	Shift along track (SAT) :	0
	Centre :	N35°53 E46°44
	Angle of incidence :	-4.84°
	Spectral bands :	3

Image	Item	Description
Scene reference : 104 	Satellite :	Spot5
	K/J :	141 / 274
	Acquisition date :	29-05-2009
	Cloud % :	18%
	Cloud cover rating :	DBDCBBBB
	Shift along track (SAT) :	0
	Centre :	N37°50 E47°53
	Angle of incidence :	-25.59°
	Spectral bands :	3

Table 2.1.5 Specifications of Satellite Images in the First Season (2/5)

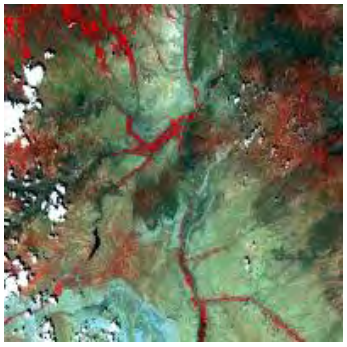
Image	Item	Description
Scene reference : 105 	Satellite :	Spot5
	K/J :	141 / 275
	Acquisition date :	29-05-2009
	Cloud % :	7%
	Cloud cover rating :	BBBBBBCB
	Shift along track (SAT) :	0
	Centre :	N37°21 E47°46
	Angle of incidence :	-25.59°
	Spectral bands :	3

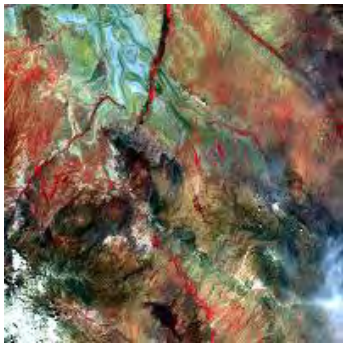
Image	Item	Description
Scene reference : 106 	Satellite :	Spot5
	K/J :	142 / 276
	Acquisition date :	28-04-2009
	Cloud % :	5%
	Cloud cover rating :	BABABBCB
	Shift along track (SAT) :	0
	Centre :	N36°52 E47°44
	Angle of incidence :	-30.59°
	Spectral bands :	3

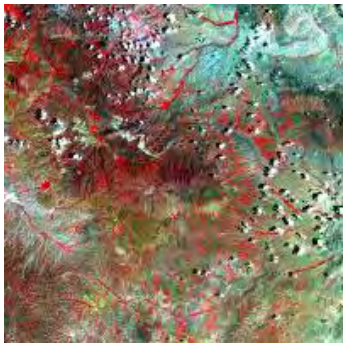
Image	Item	Description
Scene reference : 107 	Satellite :	Spot5
	K/J :	141 / 277
	Acquisition date :	02-06-2009
	Cloud % :	4%
	Cloud cover rating :	BBBBBBAB
	Shift along track (SAT) :	0
	Centre :	N36°22 E47°27
	Angle of incidence :	12.20°
	Spectral bands :	3

Image	Item	Description
Scene reference : 108 	Satellite :	Spot5
	K/J :	141 / 278
	Acquisition date :	29-05-2009
	Cloud % :	3%
	Cloud cover rating :	BBBBABAA
	Shift along track (SAT) :	0
	Centre :	N35°53 E47°23
	Angle of incidence :	-25.58°
	Spectral bands :	3

Table 2.1.6 Specifications of Satellite Images in the First Season (3/5)

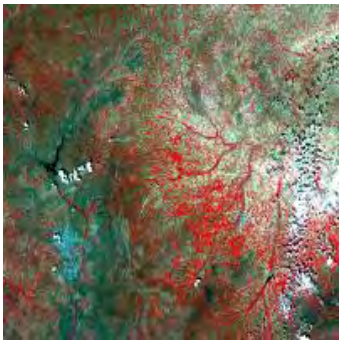
Image	Item	Description
Scene reference : 109 	Satellite :	Spot5
	K/J :	142 / 279
	Acquisition date :	29-05-2009
	Cloud % :	5%
	Cloud cover rating :	ABBBBCAB
	Shift along track (SAT) :	0
	Centre :	N35°23 E47°16
	Angle of incidence :	-25.58°
	Spectral bands :	3

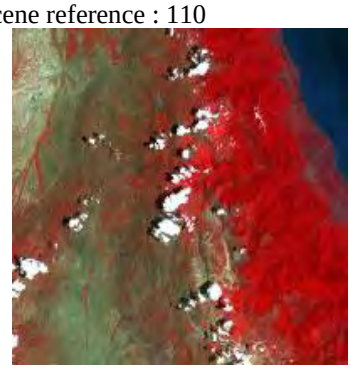
Image	Item	Description
Scene reference : 110 	Satellite :	Spot5
	K/J :	143 / 274
	Acquisition date :	12-06-2009
	Cloud % :	5%
	Cloud cover rating :	BBBBBBBB
	Shift along track (SAT) :	0
	Centre :	N37°50 E48°34
	Angle of incidence :	27.45°
	Spectral bands :	3

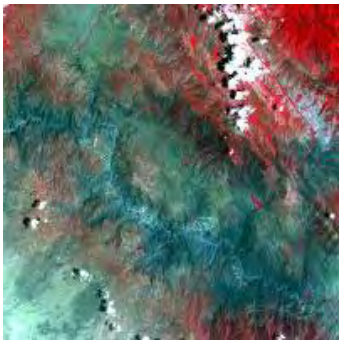
Image	Item	Description
Scene reference : 111 	Satellite :	Spot5
	K/J :	143 / 275
	Acquisition date :	12-06-2009
	Cloud % :	5%
	Cloud cover rating :	ACABBABB
	Shift along track (SAT) :	0
	Centre :	N37°21 E48°23
	Angle of incidence :	27.45°
	Spectral bands :	3

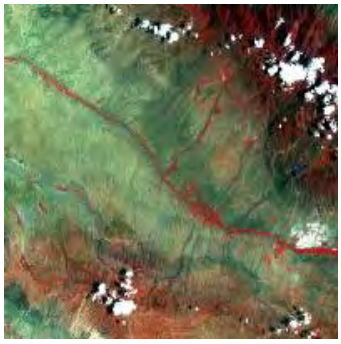
Image	Item	Description
Scene reference : 112 	Satellite :	Spot5
	K/J :	143 / 276
	Acquisition date :	12-06-2009
	Cloud % :	5%
	Cloud cover rating :	BCABABBB
	Shift along track (SAT) :	0
	Centre :	N36°52 E48°12
	Angle of incidence :	27.45°
	Spectral bands :	3

Table 2.1.7 Specifications of Satellite Images in the First Season (4/5)

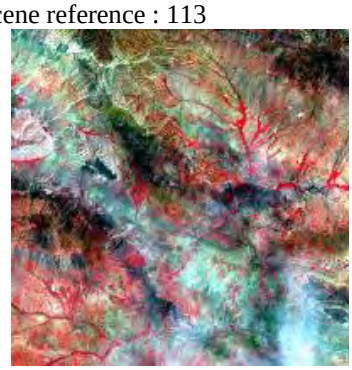
Image	Item	Description
Scene reference : 113 	Satellite :	Spot5
	K/J :	143 / 277
	Acquisition date :	07-05-2009
	Cloud % :	1%
	Cloud cover rating :	BAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N36°22 E48°04
	Angle of incidence :	16.04°
	Spectral bands :	3

Image	Item	Description
Scene reference : 114 	Satellite :	Spot5
	K/J :	142 / 278
	Acquisition date :	21-04-2009
	Cloud % :	4%
	Cloud cover rating :	BAABBBBB
	Shift along track (SAT) :	0
	Centre :	N35°53 E47°52
	Angle of incidence :	27.51°
	Spectral bands :	3

Image	Item	Description
Scene reference : 115 	Satellite :	Spot5
	K/J :	142 / 279
	Acquisition date :	21-04-2009
	Cloud % :	2%
	Cloud cover rating :	BBAAAABB
	Shift along track (SAT) :	0
	Centre :	N35°23 E47°41
	Angle of incidence :	27.51°
	Spectral bands :	3

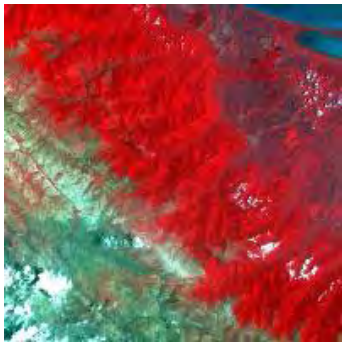
Image	Item	Description
Scene reference : 116 	Satellite :	Spot5
	K/J :	144 / 275
	Acquisition date :	18-06-2009
	Cloud % :	9%
	Cloud cover rating :	AAABBBDB
	Shift along track (SAT) :	0
	Centre :	N37°21 E48°58
	Angle of incidence :	7.12°
	Spectral bands :	3

Table 2.1.8 Specifications of Satellite Images in the First Season (5/5)

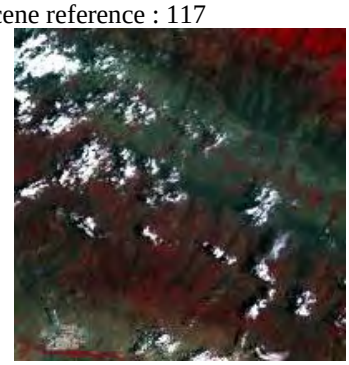
Image	Item	Description
Scene reference : 117 	Satellite :	Spot5
	K/J :	144 / 276
	Acquisition date :	18-06-2009
	Cloud % :	12%
	Cloud cover rating :	DACBBBBB
	Shift along track (SAT) :	0
	Centre :	N36°52 E48°48
	Angle of incidence :	7.12°
	Spectral bands :	3

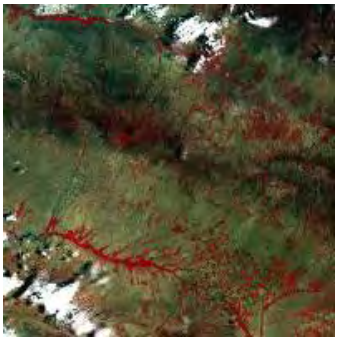
Image	Item	Description
Scene reference : 118 	Satellite :	Spot5
	K/J :	144 / 277
	Acquisition date :	18-06-2009
	Cloud % :	6%
	Cloud cover rating :	BCAABACA
	Shift along track (SAT) :	0
	Centre :	N36°22 E48°38
	Angle of incidence :	7.12°
	Spectral bands :	3

Image	Item	Description
Scene reference : 119 	Satellite :	Spot5
	K/J :	144 / 278
	Acquisition date :	18-06-2009
	Cloud % :	4%
	Cloud cover rating :	CABBAABA
	Shift along track (SAT) :	0
	Centre :	N35°53 E48°29
	Angle of incidence :	7.12°
	Spectral bands :	3

Image	Item	Description
Scene reference : 120 	Satellite :	Spot5
	K/J :	144 / 279
	Acquisition date :	23-04-2009
	Cloud % :	21%
	Cloud cover rating :	CDDBCBBC
	Shift along track (SAT) :	0
	Centre :	N35°23 E48°22
	Angle of incidence :	-30.47°
	Spectral bands :	3

Table 2.1.9 Specifications of Satellite Images in the Second Season (1/5)

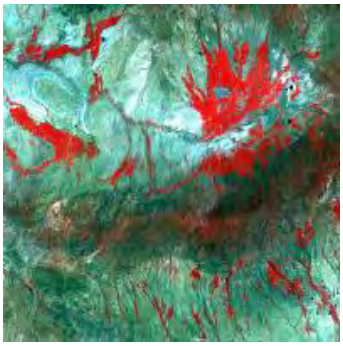
Image	Item	Description
Scene reference : 201 	Satellite :	Spot5
	K/J :	140 / 274
	Acquisition date :	20-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N37°50 E47°22
	Angle of incidence :	-28.47°
	Spectral bands :	3

Image	Item	Description
Scene reference : 202 	Satellite :	Spot5
	K/J :	140 / 275
	Acquisition date :	20-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N37°21 E47°14
	Angle of incidence :	-28.47°
	Spectral bands :	3

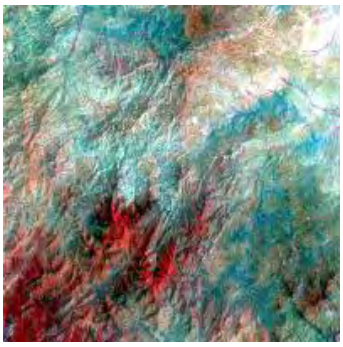
Image	Item	Description
Scene reference : 203 	Satellite :	Spot5
	K/J :	140 / 278
	Acquisition date :	08-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N35°53 E46°41
	Angle of incidence :	20.73°
	Spectral bands :	3

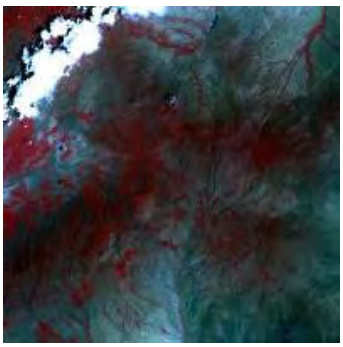
Image	Item	Description
Scene reference : 204 	Satellite :	Spot5
	K/J :	141 / 274
	Acquisition date :	09-07-2009
	Cloud % :	7%
	Cloud cover rating :	DABAAABA
	Shift along track (SAT) :	0
	Centre :	N37°50 E47°55
	Angle of incidence :	-7.29°
	Spectral bands :	3

Table 2.1.10 Specifications of Satellite Images in the Second Season (2/5)

Image	Item	Description
Scene reference : 205 	Satellite :	Spot5
	K/J :	141 / 275
	Acquisition date :	09-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N37°21 E47°46
	Angle of incidence :	-7.29°
	Spectral bands :	3

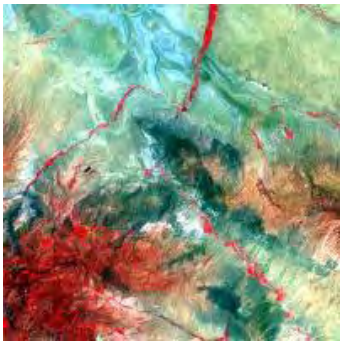
Image	Item	Description
Scene reference : 206 	Satellite :	Spot5
	K/J :	141 / 276
	Acquisition date :	09-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N36°52 E47°37
	Angle of incidence :	-7.29°
	Spectral bands :	3

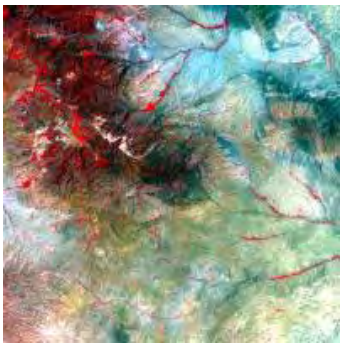
Image	Item	Description
Scene reference : 207 	Satellite :	Spot5
	K/J :	141 / 277
	Acquisition date :	09-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N36°22 E47°28
	Angle of incidence :	-7.29°
	Spectral bands :	3

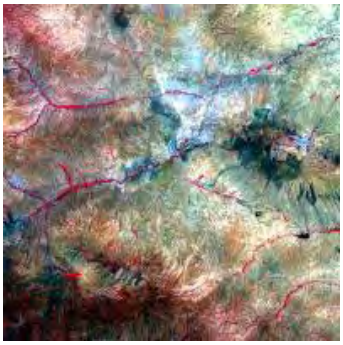
Image	Item	Description
Scene reference : 208 	Satellite :	Spot5
	K/J :	141 / 278
	Acquisition date :	09-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N35°53 E47°20
	Angle of incidence :	-7.29°
	Spectral bands :	3

Table 2.1.11 Specifications of Satellite Images in the Second Season (3/5)

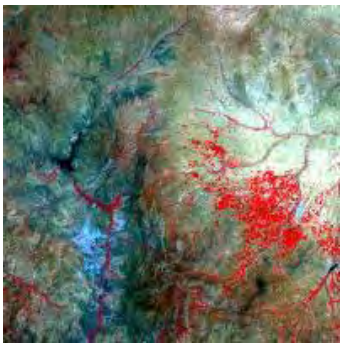
Image	Item	Description
Scene reference : 209 	Satellite :	Spot5
	K/J :	141 / 279
	Acquisition date :	09-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N35°23 E47°11
	Angle of incidence :	-7.29°
	Spectral bands :	3

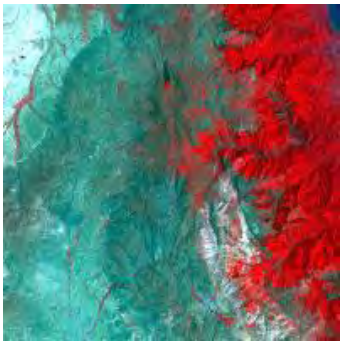
Image	Item	Description
Scene reference : 210 	Satellite :	Spot5
	K/J :	143 / 274
	Acquisition date :	14-07-2009
	Cloud % :	1%
	Cloud cover rating :	BAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N37°50 E48°32
	Angle of incidence :	3.28°
	Spectral bands :	3

Image	Item	Description
Scene reference : 211 	Satellite :	Spot5
	K/J :	143 / 275
	Acquisition date :	14-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N37°21 E48°22
	Angle of incidence :	3.28°
	Spectral bands :	3

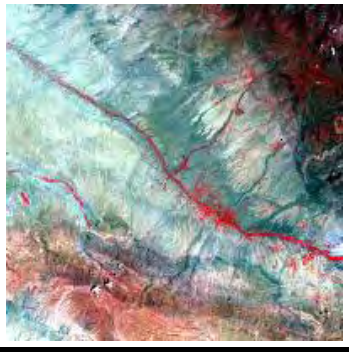
Image	Item	Description
Scene reference : 212 	Satellite :	Spot5
	K/J :	142 / 276
	Acquisition date :	04-07-2009
	Cloud % :	2%
	Cloud cover rating :	BABAAABB
	Shift along track (SAT) :	0
	Centre :	N36°52 E48°11
	Angle of incidence :	-10.06°
	Spectral bands :	3

Table 2.1.12 Specifications of Satellite Images in the Second Season (4/5)

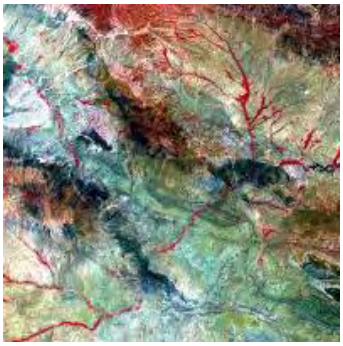
Image	Item	Description
Scene reference : 213 	Satellite :	Spot5
	K/J :	142 / 277
	Acquisition date :	04-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N36°22 E48°02
	Angle of incidence :	-10.06°
	Spectral bands :	3

Image	Item	Description
Scene reference : 214 	Satellite :	Spot5
	K/J :	143 / 278
	Acquisition date :	04-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N35°53 E47°53
	Angle of incidence :	-10.06°
	Spectral bands :	3

Image	Item	Description
Scene reference : 215 	Satellite :	Spot5
	K/J :	143 / 279
	Acquisition date :	04-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N35°23 E47°45
	Angle of incidence :	-10.06°
	Spectral bands :	3

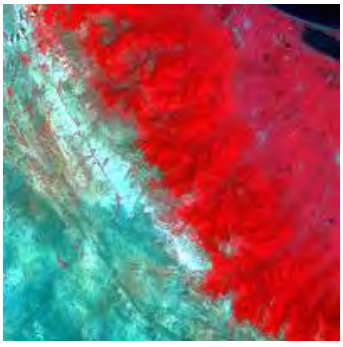
Image	Item	Description
Scene reference : 216 	Satellite :	Spot5
	K/J :	144 / 275
	Acquisition date :	10-07-2009
	Cloud % :	1%
	Cloud cover rating :	BAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N37°21 E48°53
	Angle of incidence :	-30.14°
	Spectral bands :	3

Table 2.1.13 Specifications of Satellite Images in the Second Season (5/5)

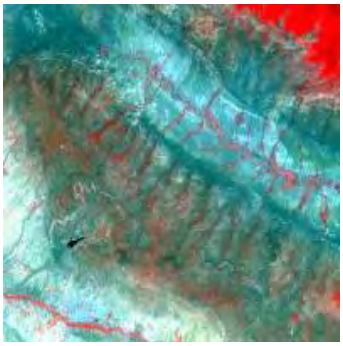
Image	Item	Description
Scene reference : 217 	Satellite :	Spot5
	K/J :	144 / 276
	Acquisition date :	10-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N36°52 E48°46
	Angle of incidence :	-30.14°
	Spectral bands :	3

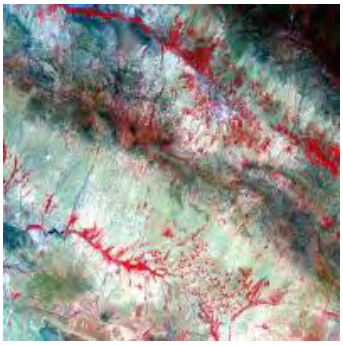
Image	Item	Description
Scene reference : 218 	Satellite :	Spot5
	K/J :	144 / 277
	Acquisition date :	10-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N36°22 E48°38
	Angle of incidence :	-30.14°
	Spectral bands :	3

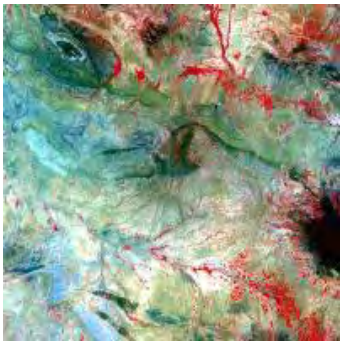
Image	Item	Description
Scene reference : 219 	Satellite :	Spot5
	K/J :	144 / 278
	Acquisition date :	10-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N35°53 E48°31
	Angle of incidence :	-30.14°
	Spectral bands :	3

Image	Item	Description
Scene reference : 220 	Satellite :	Spot5
	K/J :	144 / 279
	Acquisition date :	10-07-2009
	Cloud % :	0%
	Cloud cover rating :	AAAAAAAA
	Shift along track (SAT) :	0
	Centre :	N35°23 E48°24
	Angle of incidence :	-30.14°
	Spectral bands :	3

2.2 LANDUSE DATA GENERATION BY REMOTE SENSING

2.2.1 Methodology

For carrying out the project, an optimized methodology for achieving the best possible result on the task must be used into interpreting the satellite images. In this way all possible methods were examined and the followings were chosen for covering the methodology requirements.

- Using multi-temporal satellite imageries of SPOT, ASTER, IRS and Land-Sat to be used as main tool of crop identification.
- Collecting check points of different phenomenon in the area, chosen by the interpreters, to help them on better interpretation.
- Identification of microclimates in the region for getting better result.
- Collecting the Agricultural calendar of each region to identify the crops of different types.
- Using different maps in scales of 1:25K, 1:250K to create slop maps, aspect maps for differentiation rain feed lands from irrigated ones.

2.2.2 Design of the Work

As the study area is as wide as about 60,000 km^2, and it was divided into two stages to get a better output. In the first stage whole area was investigated and a land-use map of Level 2, according to USGS definitions, with the following objectives was created.

- Rocks and outcrops Regions
- Weak Pastures
- Medium pastures
- Forests
- Rain feed lands
- Irrigated farms
- Buildings
- Rivers
- Orchards
- Industrial complexes
- Water bodies both Natural and man made

For the second stage, investigations of Landuse Level 4 would be focused on the irrigated lands that are the most important part of the study. In this part all different major types of crops would be extracted out of satellite imageries to determine amount of water consumption in the irrigated farming. The items of Landuse Level 4 are shown as follows.

- Paddy
- Wheat and barley
- Alfalfa & Forage plants
- Vegetables
- Industrial Cultivation
- Corn
- Orchards

Then, the final areas would be transferred into a Geo database of the region and the water consumption ratios will be implemented into the areas and total water consumption in the whole study area would be determined. General flow chart is shown bellow.

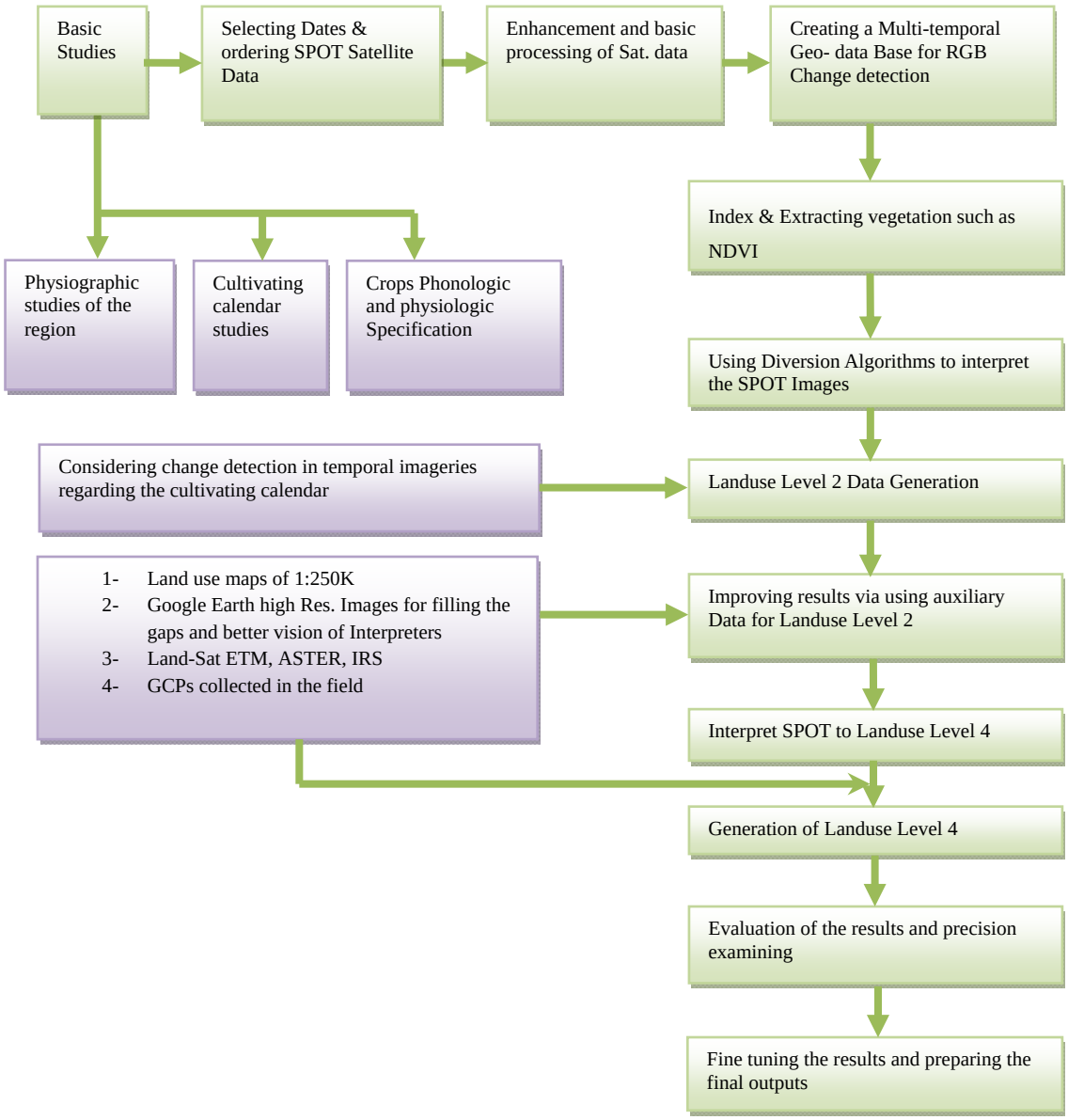


Figure 2.2.1 Flow of Satellite Image Analysis

4,500 points are selected as the checking points. Distribution of those points are shown in

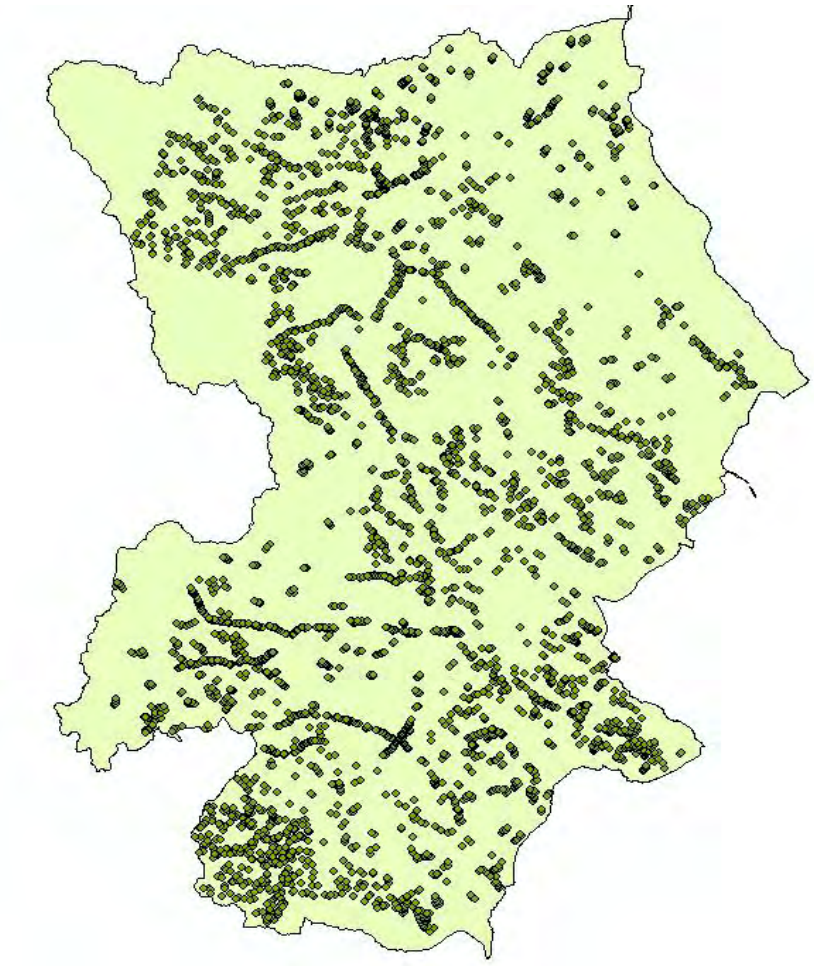


Figure 2.2.2 Distribution of Checking Points

2.2.3 Progress of the Work

At the time of 30th of November, 2009, the first stage has been finished and just fine tuning of the results is undertaking. In parallel the second stage has started and in the end of December it would be finished for estimation of water consumptions.

2.2.4 Work Contents

Ground Truth Operation:

For assurance of the interpreters a wide spread GCP collecting operation took place to cover the needs of both levels of land-use mapping procedure. In this operation 12 teams of two persons plus a driver were hired and trained to collect the GCPs and take photos of four directions of determined points. Their results are included in both interpretation and the conformed Geo-Database.

A sample of the selected points is shown in the following image.

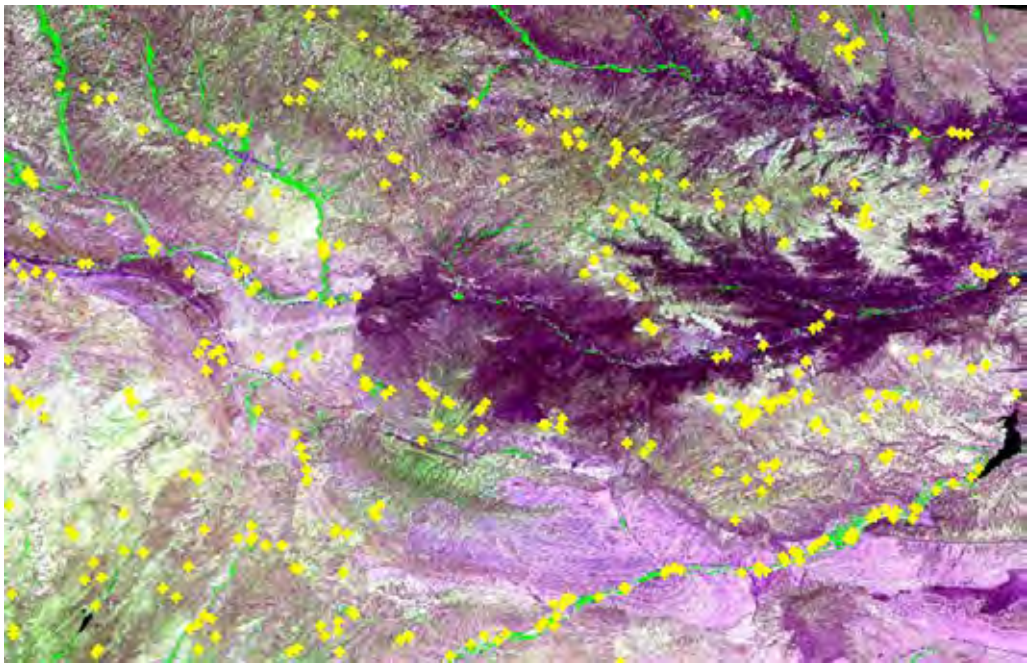


Figure 2.2.3 Sample Map of Desired Points in East- Azerbaijan Province

The field team in accordance to the QC team collects the data and sends them to the office. Office team has some excursion to the filed for getting more confidence on the job. The filed check team collects the data on the plots that were provided them for getting into the right point in the field. Sample of these plots is shown in the next picture.

Figure 2.2.4 Sample of Field Book

Explanation of the contents:

Yellow color shows potato farm, green color shows alfalfa farm by irrigation cultivation, dark green color shows pastures on hill, white color shows fallow wheat by dry-farming, this farm is almost located in vast valley, all farms join together.

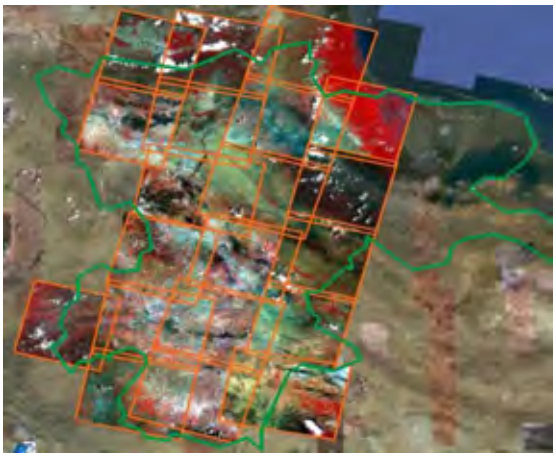
It should be mentioned that the second cultivation of this farm(for next year) will be wheat or potatoes or alfalfa.

Image Interpreting Operation:

The image interpreting team is consists of 20 engineers, they are all concentrated in satellite image processing, remote sensing and GIS database.

The sources data that used in Landuse generation are as follows.

- Basic Satellite Image: SPOT5 images in two seasons
- Asistant Satellite Image: IRS-P6-AWIFFS, ASTER
- Other Data: 1:25000 scale topographic map, Field Survey GCP, Google Earth Image.



SPOT Images

IRS-P6-AWIFFS Image

ASTER Images Index

Figure 2.2.5 Basic Satellite Image (SPOT) and Other Reference Image (IRS and ASTER)

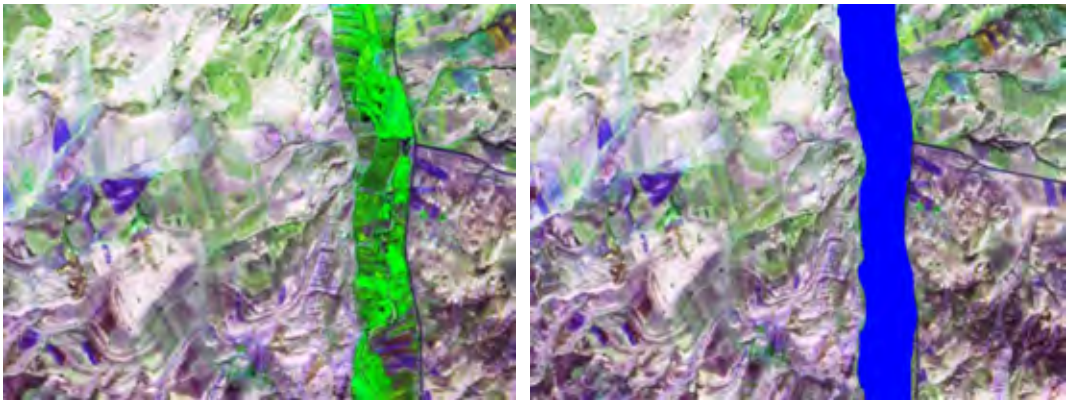


Figure 2.2.6 Example of Interpretation of Irrigation Area

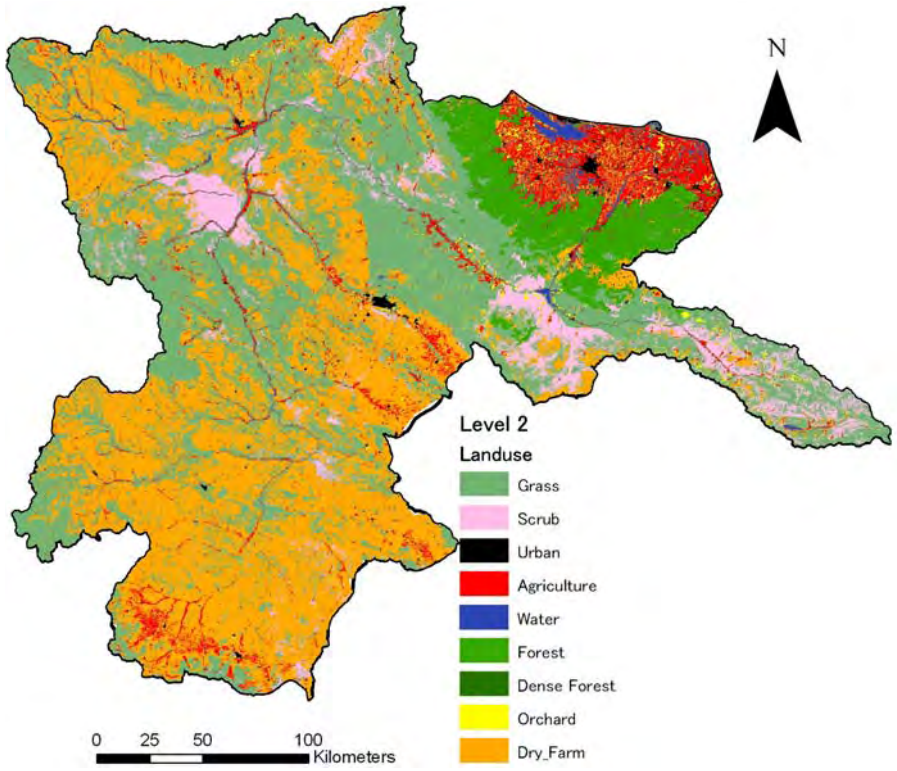


Figure 2.2.7 Sample of the Extracted USGS Level 2 Land-Use Map