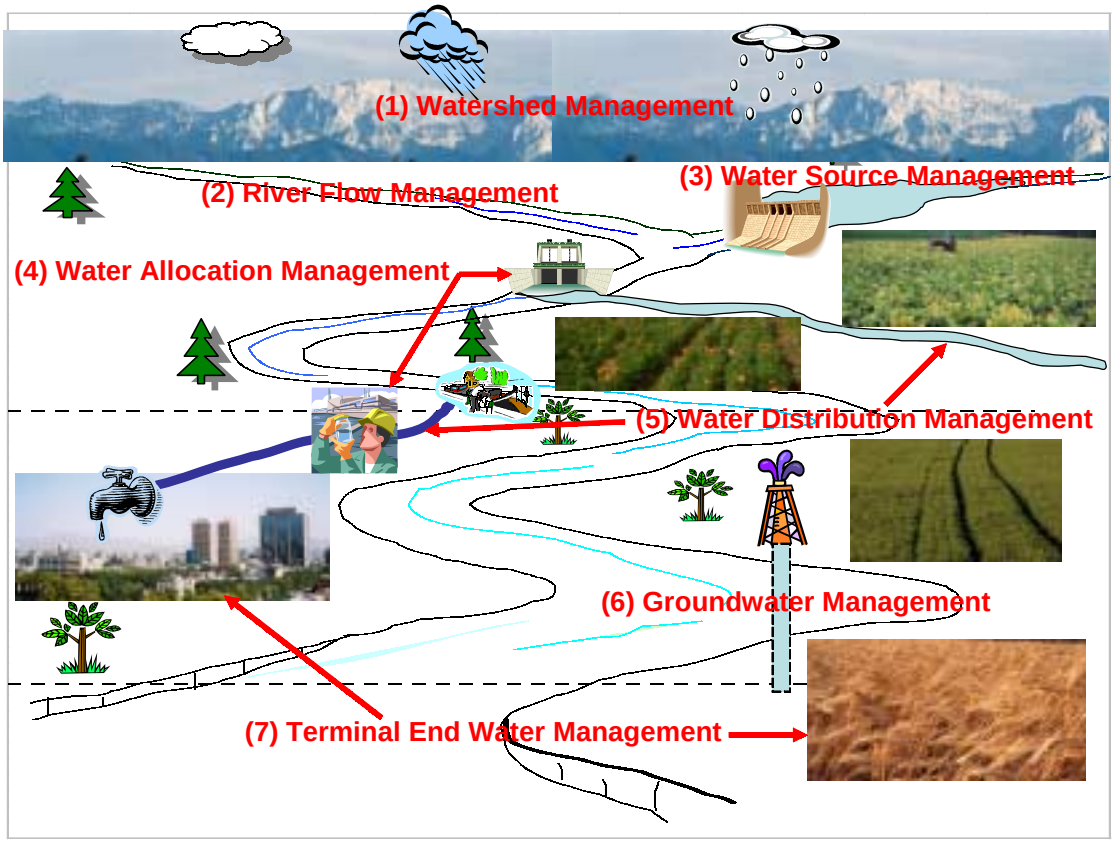
- Feasibility study of Almout water diversion project should be carried out together with the study for Qazvin central irrigation project because both projects are closely related each other.
- Inventory survey for the existing shallow and deep production wells to identify their pumping function, extracted amount of groundwater, necessity of rehabilitation, etc together with implementation of rehabilitation program and construction new production wells.

The location of the water sources and water utilization projects is shown in Figure 18.

7. Improvement of Water Management



Potential resources of both surface water and groundwater are limited in the Study Area and the use of available water resources has been stretched to the limits. Almout river may be the last source of surface water remained unused within the territory of water allocation of the capital area of Tehran. Groundwater has tended to decrease showing annual imbalance of more than 700 MCM toward the final drying up unless proper measures are taken immediately. In order to expect the sustainable development of the area within the available resources, such resources are to be managed and operated properly and effectively. Important issues of management and operation includes 1) establishment of operation rule of water source facilities to allocate necessary volume of water among water users within the minimum risk of water deficit, 2) combination use of surface water

and groundwater to allocate water effectively and rationally, 3) establishment of water allocation rule for reasonable and equitable water use among users and 4) improvement and maintenance of water use manners and facilities to minimize losses of water. Necessary activities of water management may be categorized into seven definite items as outlined below;

(1) Watershed Management

The Taleghan and Almout river basins are not covered with forest forming natural grazing and shrub land and have suffered from land sliding and soil erosion. The river flow contains considerable amount of sediment-load, which causes a large problem for the water management in the reservoir and water diversion. Natural grazing are being gradually lost by increasing number of sheep. It is necessary to carry out the watershed conservation program to foster the water resources.

(2) River Flow Management

As the surface water in the western capital area is limited and very valuable for the urban, industrial and agricultural uses, its monitoring and evaluation system should be strengthened and the potential and available water, which varies year by year depending on the water use, should be evaluated properly and accurately every year.

(3) Water sources Management

Since the Karaj and Taleghan dams are planned originally to release more water for irrigation than urban water supply, rule of reservoir operation should be altered so as to release much water to the water supply in order to expect effective use of stored water to a maximum. The reservoir operation rule should be improved based on the reservoir operation study, and the result of reservoir operation study carried out by JICA Team tentatively may provide useful information as shown in Figure 19, 20 and 21.

As for the Almout water diversion, the water operation study should be carried out on the premise that Almout water can be utilized effectively in combination with groundwater in Qazvin plain.

(4) Water Allocation Management

The allocation of surface water will change every year in accordance with requirements from various water users and availability of water at the water sources and will be defined with discussion among T.R.W.B., water managing companies and representative of water user groups. Therefore it is very important to program the reasonable and equitable water allocation taking into account the priority of water use and proper schedule.

It is also very important to carry out the water allocation for the domestic, industrial and agricultural uses in combination of the surface water and groundwater.

In a dry year, a part of surface water as scheduled to be used for the winter crops may be reduced to

supply the domestic and industrial water that has a priority and a large amount of groundwater may be used to supplement the surface water as the tentative means.

(5) Groundwater Management

As the groundwater table has lowered and its yield has decreased at many deep and shallow wells due to the excessive extraction of groundwater, it is unavoidable to control or restrict the groundwater use at production wells based on the monitoring and evaluation results of groundwater.

Though many monitoring wells of about 600 units are installed covering the western capital area, the wells of more than 400 units are not functioning due to deterioration of wells and pumps. The monitoring and evaluation works based on the monitoring result of groundwater have not been well managed by agencies in charge of managing monitoring wells and broken pumps.

It is necessary accordingly to implement the rehabilitation of production and monitoring wells and also to improve the monitoring activity, management of monitoring data and evaluation method of the collected data.

(6) Irrigation Water Management

In accordance with the information provided by the irrigation companies and the Karaj and Qazvin Water Board, the present irrigation efficiency is as low as 30 to 40%, as the results of considerable volume of water losses taking place in the irrigation system.

It is necessary to improve the water management in the irrigation canal system and at the facilities of on-farm level including the rehabilitation of canal and on-farm works.

(7) Domestic Water Management

Water losses along the pipeline network in the water supply system and by unsuitable water use of beneficiaries are estimated to amount to 30 to 35% of the total domestic water demand in many urban areas. It is necessary to improve the water management to minimize the water losses by rehabilitation of pipeline and education to beneficiaries.

Per capita water demand including water losses at cities in the western capital area is shown in Figure 24.

8. Almout Water Diversion Project

In order to satisfy the urban water demand of Tehran City in future, the Taleghan water of 310 MCM per annum is necessary to be conveyed to Tehran. As Taleghan water has been used for Qazvin irrigation since 1970s and was programmed originally to be used for the expansion of irrigation area in Qazvin plain in future, the Almout Water Diversion Project becomes necessary to compensate for the Taleghan water and to supply irrigation water to Qazvin plain. It is now recognized that this

project indispensable to guarantee the urban and industrial water supply and to stabilize the socio-economy in the capital area. JICA Team has carried out the pre-feasibility study for the project focusing on technical, economical and environmental aspects.

Several alternative plans of diversion dams in connection with its location and diversion tunnels in relation to its alignment are studied and the best suitable plan was selected taking into account the following conditions;

- Diversion dam-site is selected at a location where as much water as possible can be diverted from Almout river and from where water can be conveyed to Qazvin plain under gravity,
- Alignment of diversion tunnel is so selected to minimize its length with its inlet and outlet at a suitable topographical and geological conditions, and
- Alignment of diversion tunnel crosses the Taleghan river at a suitable elevation to be designed as a culvert but not siphon or aqueduct.

Proposed Site of Dam at Dozdaksar

The site of diversion dam is selected finally at a location near the Dozdaksar village from where about 250 MCM per annum of Almout water can be diverted under gravity. Outline of the project is summarized as follows;

(1) Hydrological Aspects

Source of Water	Catchment Area (km^2)	Average Annual Runoff (MCM)	Available Diversion Water (MCM
Almout	475	250	210
Andah Tributary	112	60	40
Total	587	310	250

Surplus water of 60 MCM equivalent to about 20% of the annual runoff is released downstream for river maintenance, irrigation and environmental purposed in the downstream area. In this connection, location of the Andah tributary is shown in Figure 25.

(2) Project Facility and Cost

Project facility and cost are summarized as below:

- Almout Diversion Dam — Concrete weir H=10m, L=56m
- Almout Water Pipeline — Steel pipe, L=6.0km, Q=22.5m^3/sec
- Almout Tunnel — D=4.0m, L=33.8km
- Project Cost — US$123.6 million

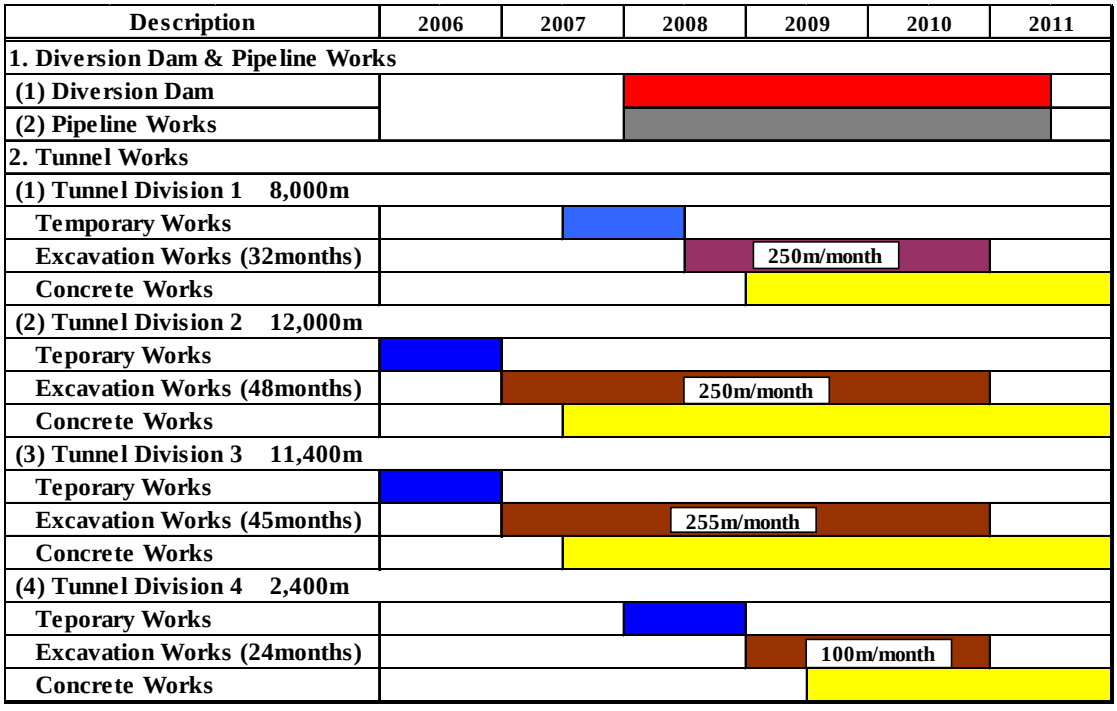
- Water Cost US$0.05/$m^3$

In this water diversion plan, construction of reservoir dam is not recommendable because of the poor topographic and geologic conditions at the dam-site, land sliding and soil erosion problem in the reservoir area, resettlement of villages, farm land, etc in the reservoir area, difficulty to get sufficient reservoir capacity due to steep river slope of 1 to 60, deep alluvial deposit with the depth of more than 30m, etc.

It is proposed accordingly to construct the diversion dam, which could divert the annual water of 250 MCM out of the average annual runoff of 310 MCM under gravity flow through the diversion tunnel with the discharge capacity of 22.5 cu.m/sec.

Almout diversion tunnel of 33.8 km long will be constructed divided into four construction divisions of which the longest tunnel length is 12km. Alternative plans of water diversion are given in Figure 25 while the general plan of Almout water diversion for the plan C-1, selected as the most suitable plan, is shown in Figure 26.

Construction Plan of Dam and Tunnel



9. EIA of the Almout Basin

EIA study by the project has been carried out based on the survey for natural, ecological and socio-economical conditions in the Almout river basin. There is no particular environmental impact to be induced by the project because the Almout water is diverted by diversion dam without causing any resettlement problem and conveyed through a tunnel passing underneath the high mountain area.

Both banks of Almout river are formed with such topography and geology that allow land-sliding and soil erosion easily. Construction of storage dam is, therefore, not recommendable because fluctuation of reservoir water level would accelerate such erosion and land-slide resulting in large accumulation of sediment in the reservoir area. As the Almout river at the proposed site of diversion dam is formed with river-bed slope of as steep as 1.5% to 2.0% bringing about a large volume of sediment transport, river training works to protect the river bank and river bed from scouring energy of flood and sediment removal facility are to be provided.

Particular and valuable plant species exist in the plateau area but not in the area along the river including the site of the proposed diversion dam. Accordingly, the project will not impact on flora diversity in the basin. No valuable fish species is reported in the river and wild animals live mostly in high mountainous area receiving no influence from the implementation of the project.


Rural Community


Water Use for Agriculture

Many villages and considerable extension of farmland exist at places along the river with inhabitant engaging mostly in irrigated paddy cultivation. It is, therefore, very difficult to construct a storage dam without avoiding resettlement problems and is very important for the project to release water from the proposed diversion dam to downstream area for irrigation as well as for river maintenance purpose, and to improve existing traditional irrigation facilities. Since the Almout river basin is considered to be the donor basin to transfer the water to Qazvin plain, it will be necessary within the basin to carry out the rural development consisting of the road, irrigation water supply, etc as the

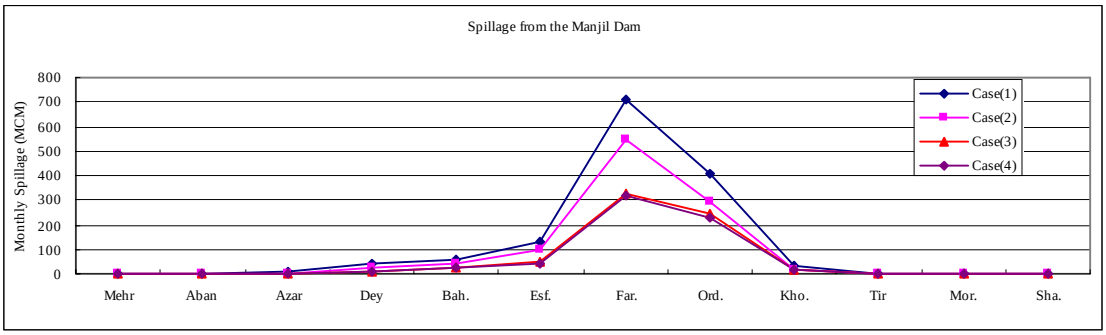
mitigation works from the socio-economic and environmental points of view. Environmental and ecological conditions in the Almout river basin are shown in Figure-27 and 28.

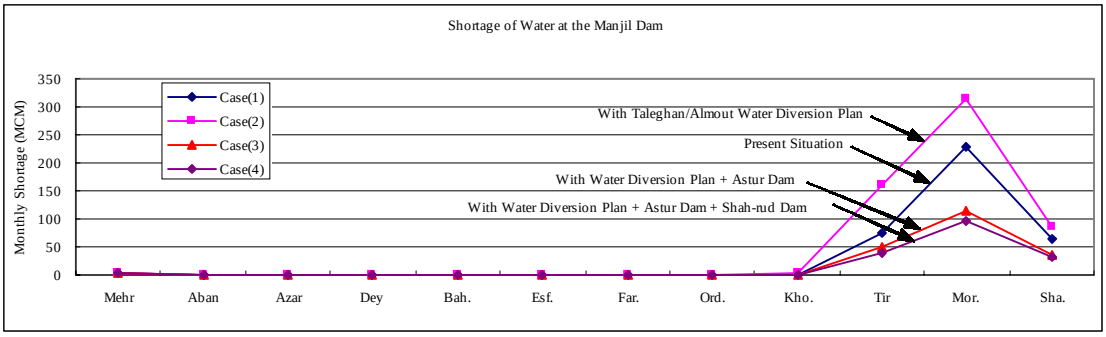
As for possible impacts of the proposed Taleghan and Almout water diversion on the operation of Manjil dam, relatively serious impact is resulted from the water operation study and, in turn, influence on the supply of water in the service area of the Manjil dam will be unavoidable. Simply speaking, about 560 MCM of reduction of annual inflow into the Manjil reservoir due to proposed water diversion will result reduction of the spillage from the reservoir by 370 MCM and increase of water shortage by 200 MCM, indicating that the direct influence of the proposed water diversion plans is 200 MCM, of which 130 MCM are caused by Taleghan water diversion and 70 MCM by Almout water diversion. Followings are resulted from water balance studies:

- Of the average annual inflow of 4,540 MCM, 3,546 MCM or 78% is conveyed from the Qezel Ozan river while remaining 994 MCM or 22% is from the Shah-rud river. Effective capacity of the reservoir was 1,672 MCM at the initial stage of operation in the early 1970s, however, massive accumulation of sediment since then mainly from the watershed of Qezel Ozan has reduced about 539 MCM of the effective capacity to 1,133 MCM at present.
- In the Sefid-rud river basin, ten (10) storage dams/reservoirs are under construction or under study. Of the above storage dams proposed or under construction in the basin, the Astur dam now under study is the most important because that it is proposed to strengthen the function of the Manjil dam by means of providing additional capacity to regulate flood runoff of the river during the months of Far. (April) and Ord. (May) that are mostly spilled out from the dam unused due to insufficient storage capacity of the dam.
- According to available data, about 3,644 MCM of water has been demanded from the Manjil dam, including 2,668 MCM for irrigation, 200 MCM for fish raising, 174 MCM for domestic consumption, 20 MCM for Industrial use and 582 MCM for environmental purpose.
- Computation made with the above demand of water shows frequent shortages of water even under the present situation of the reservoir without proposed Taleghan and Almout water diversion plans. Even with the initial condition of the reservoir having an effective storage capacity of 1,672 MCM, occasional shortage of water is resulted with an average annual value of 97 MCM. Comparison study presents the influence of a massive deposit of sediment in the reservoir, indicating increase of 270 MCM of spillage and also increase of 270 MCM of water shortage.
- Influence on the supply of water in the service area of the Manjil dam will be unavoidable. Simply speaking, about 560 MCM of reduction of annual inflow into the Manjil reservoir due to proposed water diversion will result reduction of the spillage from the reservoir by 370

MCM and increase of water shortage by 200 MCM, indicating that the direct influence of the proposed water diversion plans is 200 MCM.

- Construction of the Astur dam would contribute to reduce shortage of water from 567 MCM for the case with the proposed Taleghan and Almout water diversion plans to 202 MCM. Occasional shortage of water will still remain even after construction of the Astur dam, however, situation will be improved greatly indicating much smaller amount of shortage, 202 MCM, as compared with the existing condition of 371 MCM.
- Construction of the Shah-rud dam on the Shah-rud river near Loshan in addition to the construction of Astur dam will also bring some improvement on operation of the Manjil dam, however, effect may be rather small to meet the cost for the implementation of the project.





10. Qazvin Irrigation Development

Qazvin plain has a large agricultural area of 350,000ha and a potential to fulfill the important role to supply various agricultural products to the Tehran capital area which will hold a large population of 17 million in 2021.

As the agricultural areas in Karaj and Hashtgerd regions are unavoidable to decline year by year because of urbanization, the agriculture in Qazvin plain to support foods in the capital area will be important more and more in future.

Accordingly the conceptual plan of irrigation development by using the Taleghan and Almout water

is set up as follows.

(1) Irrigation Service Area

The existing and proposed irrigation service area is estimated as shown in the following table based on the available Taleghan and Almout water as well as groundwater.

Summary of Existing and Proposed Irrigation Area

Unit: ha

Division	Irrigable Area (ha)	Existing Net Irrigation		Proposed Net Irrigation		Increment Area (ha)	Water Source
		Area (ha)	Intensity (%)	Area (ha)	Intensity (%)		
1. Existing North Area							
North High Area	38,600	24,200	63	28,900	75	4,700	Taleghan
North Low Area	38,100	24,000	63	28,500	75	4,500	Almout
Sub-total	76,700	48,200	53	57,400	75	9,200	
2. Takestan Area	9,000	6,000	67	6,700	75	1,700	Taleghan
3. Central Area	60,900	27.000	44	45,500	75	17,500	Almout
Total	**146,600**	**81,200**	**55**	**109,600**	**75**	**28,400**	

- The higher area in the north irrigation area is located at the elevation of more than 1,250m and irrigated with Taleghan water, while the lower area at the elevation of less than 1,250m and irrigated with Almout water.
- The irrigation intensity for the existing area is 55% on an average, which increases to 75% for the proposed area in future. Increasing irrigation area reaches 28,400ha. Salinity soil also spread in the central plain, however, the plan aims to irrigate the area where is actually irrigated by insufficient groundwater. In order to distribute water equally elsewhere in the area, constant rate of irrigation, 75%, is applied for all areas. All figures presented in the above table are of the conceptual planning level, requiring more detailed study.

(2) Available Irrigation Water

Available irrigation water for the present and proposed irrigation area is summarized as follows;

Available Irrigation Water

Area	Net Irrigation Area (ha)	Water Demand (MCM)	Available Irrigation Water (MCM)			
			Taleghan Water	Almout Water	Ground-water	Total
1. Present Conditions						
(1) North Irrigation Area						
Higher Area	24,200	266	80	-	190	270
Lower Area	24,000	264	60	-	210	270
Sub-total	**48,200**	**530**	**140**	**-**	**400**	**540**
(2) Takestan Area	6,000	66	0	-	70	70
(3) Central Area	27,000	297	0	-	340	340
Total	**81,200**	**893**	**140**	**0**	**810**	**950**
2. Proposed Conditions						
(1) North Irrigation Area						
Higher Area	28,900	318	130	-	190	320
Lower Area	28,500	314	-	90	230	320
Sub-total	**57,400**	**632**	**130**	**90**	**420**	**640**
(2) Takestan Area	6,700	74	10	-	70	80
(3) Central Area	45,500	501	-	120	380	500
Total	**109,600**	**1,207**	**140**	**210**	**870**	**1,220**
Recharging Water	**-**	**-**	**-**	**40**	**-**	**40**

- Out of 140 MCM of Taleghan water at present utilized in the northern irrigation system, 80MCM are distributed to the higher land and 60MCM to the lower land. In future, Taleghan water of 130 MCM is used for the higher land and 10 MCM for Takistan area through the existing north irrigation canal system. Accordingly the irrigation intensity in the higher land increases to 75% from the present intensity of 63%.
- The lower area in the north irrigation area which is irrigated by the Taleghan water at present is to be served by the Almout water of 90 MCM in future because the area is located at the elevation below 1,250 m and can be irrigated by gravity flow of the Almout water. Irrigation intensity will be improved from 63% to 75%.
- Takestan area being located at the end of the existing north irrigation canal is presently irrigated by only groundwater and its groundwater table is lowering year by year. Accordingly Taleghan water of 10 MCM is to be supplied to the area in future to stabilize groundwater extraction.
- Central area is presently irrigated by only groundwater and has faced chronic water shortage problem. Accordingly the Almout water of 120 MCM is to be allocated to the irrigation water in the area, improving irrigation intensity from 44% at present to 75% in future.
- Groundwater extraction volume of 830MCM at present in the whole service area will slightly increase to 870MCM in future by increasing irrigation return flow and recharging water to groundwater under the Almout water diversion.

(3) Rehabilitation of Existing North Canal System

The existing north irrigation canal system has been operated since 1970s and detoriorated. Accordingly the following rehabilitation works will be required for the canal system to operate the canal water properly and without losses.

Quantity of Rehabilitation Works

Rehabilitation facilities	Quantity	Rehabilitation items
Rehabilitation of concrete structures	588 places	Reinforcement with concrete
Repair of gate		
- Repair/replacement of gate body	133 places	Repair, replacement
- Replacement of arch gate	250	Type from 50 lit to 1,000 lit
- Replacement of other gates	200	
- Replacement of gate frame	200	

Source: Inventory survey (2000)

(4) Preliminary Design of Central Canal

The central canal to convey the Almout water of 250MCM and covers the lower area of the north irrigation area and the central irrigation area is newly constructed. The outline of the central canal based on the preliminary design result is as follows;

- The water level of Almout water diversion tunnel is set up at 1,250m.
- The central canal will start at the regulating reservoir to control the Almout water, which is located at the downstream of No.2 Lateral canal and near the railway.
- The canal alignment is placed so as to cover the central area as large as possible by gravity flow system and the canal slope of 1 to 5,000.
- Discharge capacity of canal is 22.5m^3/sec
- 10 secondary canals are provided to cover the service area
- Main and Secondary canal is designed with concrete living.
- The main canal reaches finally to Buin area with a length of about 125km.
- Recharging ponds for groundwater are provided along the canal alignment to collect the drainage water from the end of lateral canals in the higher land area and receive the surplus water from the Almout water diversion

Summary of Qazvin Irrigation Canal System

Item	Existing North Area		Proposed Central Canal	
1. Irrigable Area (ha)	North, Higher	38,600	North, Lower	38,100
	Takestan	9,000	Central	60,900
	Total	**47,600**	**Total**	**99,000**
2. Net Irrigation Area (ha)	North, Higher	28,900	North, Lower	28,500
	Takestan	6,700	Central	45,500
	Total	**35,600**	**Total**	**74,000**
3. Irrigation Intensity (%)		75		75
4. Available Irrigation Water (MCM)				
Talegan water		140		-
Almout water		-		210
Groundwater		260		610
Total		**400**		**820**
5. Recharging Water		-		40
6. Irrigation Canal System				
Main Canal	$Q=30m^3/sec$, L = 94km		$Q=22.5m^3/sec$, L=125km	
Secondary Canal	12 units, L = 220km		10 units, L=150km	
7. Production Wells		800units		1,600units

The general plan of the above irrigation project is shown in Figure-29.

(5) Project Cost

The project cost for irrigation canal system is estimated at US$41.5 million. Total project cost including the Almout water diversion project is US$165.1 million (123.6 million + 41.5 million).

(6) Project Benefit

Project benefit to be generated from increased agricultural products owing to expansion of irrigation system is estimated at Rls 81 billion (about US$10 million) on the financial basis and Rls 147 billion (about 18.4 million) on the economic basis.

(7) Economic Evaluation

NPV calculated on the basis of the project cost and benefit is Rls 147 billion together with the B/C ratio of 1.3, showing the Economic Internal Rate of Return (EIRR) of as high as 14.5%. The investment cost per ha is estimated at US$5,900.

(8) Financial Evaluation

Farm income analysis estimates the incremental benefits arising from farming activities as a result of project implementation. Net farm income of Rls 4.8 million per farm household at present will increase to Rls 6.8 million under the future with project condition.

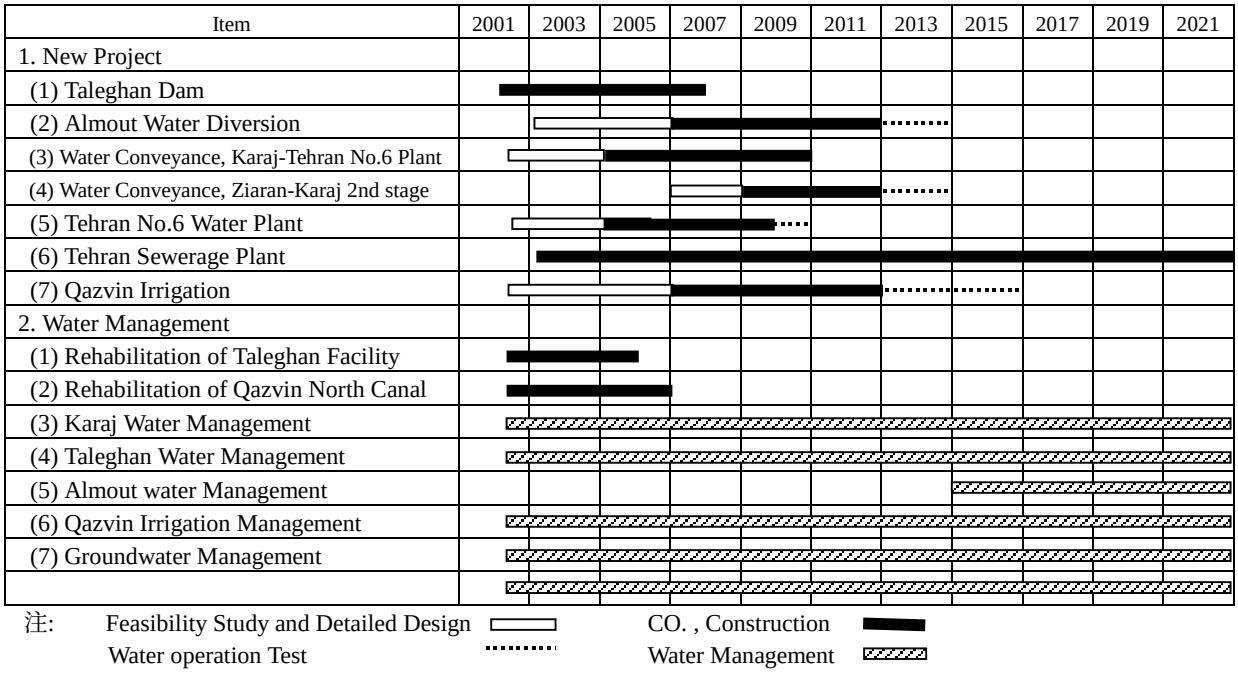
11. Conceptual Plan for Groundwater Recharge

The water management to recharge the surplus water to groundwater has been carried out at the existing recharging ponds along the north irrigation canal in Qazvin plain. In accordance with the information obtained from Qazvin irrigation company, this recharging result gives a large effort to stabilize the groundwater table and yield.

Since the groundwater aquifers along the Khah-rud and Kordan rivers have large storage capacities to recharge the surplus surface water, the groundwater recharging project by means of constructing recharging dams and recharging dikes will be effective and to be accelerated in future in order to increase the availability of groundwater. The conceptual plan of groundwater recharging project is shown in Figure-30.

12. Implementation Schedule of Water Resources Development and Management Program

As mentioned in the above, it is necessary to implement the various water resources development and water management projects to achieve the water allocation plans proposed in the Master Plan and to satisfy the increasing future water demand in the western capital area. The implementation schedule for the development and management is proposed as follows;



13. Conclusion and Recommendation

13.1 General Description

At present in 2001, 4,675 MCM per annum of water, 1,390 MCM from surface sources and 3,285 MCM from groundwater, are consumed in the western capital area of Tehran with 1,595 MCM supplied for urban use and 3,080 MCM for agriculture. This order of water supply and use will be extended to 5,630 MCM in 2021 inclusive of 1,965 MCM of surface water, 359 MCM of re-use water and 3,315 MCM of groundwater for 2,320 MCM of urban use and 3,310 MCM for agriculture, supported by the governmental policy of population absorption in the capital area. Potential resources of both surface water and groundwater are limited in the area and the use of available water resources has been stretched to the limits. Of the potential surface water resources of 2,460 MCM, present use accounts for 1,390 MCM (57%) and the usable water in future will be, at most, 1,965 MCM or 80% of the potential. On the other hand, groundwater resources, which provide 3,285 MCM per annum of water at present, have tended to decrease showing annual imbalance of more than 700 MCM toward the final drying up unless proper measures are taken immediately. In order to expect the sustainable development of the area within the available resources, such resources are to be managed and operated properly and effectively.

Water supply in Tehran City depends on stored water in Karaj dam and Latian dam connected with Lar dam and groundwater. Supply from surface sources has, however, leveled off since 1993 due to hydrological limitation and in turn extraction of groundwater has been increasing rapidly indicating obvious decline of groundwater tables at many locations. Surface water sources remain undeveloped within the territory of the area are Taleghan river and Almout river, and aiming at conversion of use of Taleghan water from agriculture in Qazvin plain to water supply in the capital area, the government has started construction of the Taleghan storage dam at immediate downstream of the existing Taleghan diversion dam and also construction of water pipeline to connect the outlet of the Taleghan tunnel and Karaj river has just completed in 2001. Both Taleghan and Almout rivers belong to Qazvin province and therefore development of Almout water to compensate for such a conversion of water use is indispensable. Irrigated agriculture in Qazvin plain is also to be expanded in order to expect smooth implementation of the water conversion plan, and is absolutely necessary for wide and equitable distribution of social benefit arising from the implementation of the water diversion project. Fortunately, implementation of the Almout water diversion project is judged feasible and viable from both engineering and economic points of view.

Moreover, to cope with increasing water demand towards the target year of 2021 opportunely, related works such as rehabilitation of existing water diversion facilities, construction of Karaj to Tehran water diversion facility, phase 2 work of water pipeline between Ziaran and Karaj are to be studied and implemented timely. Integrated water management program, development of surface

water resources and groundwater management are to be properly implemented as described in the following paragraphs.

In the area, water supply works for both urban water supply and irrigation and sewerage are conducted by semi-governmental companies and they are well managed including activities for tariff collection. In order to cope with increasing demand of water accompanied by the growth of population, development and management of water resources will become more essential. However, such an effort inevitably has a limit, and necessary measures to restraint demand of water, such as control of population growth in the capital area, is to be surveyed when longer view after 2021 is taken into consideration.

13.2 Integrated Water Management Program

Total available water for domestic, industrial and agricultural uses in the Study Area is estimated at about 5,600 MCM in 2021, consisting of the surface water of 2,300 MCM and groundwater of 3,300 MCM. This volume of available water is not thoroughly sufficient to satisfy the future water demand when the per capita value of available water, 320 cubic meter only, is taken into consideration, because this value is considerably smaller as compared with the world average. Accordingly, the integrated water management program to use and allocate the developed water properly and effectively among various water demands becomes inevitably necessary and is to be implemented urgently. In this concern, it is recommendable to pay the particular attention for the following water management in the western capital area.

- Reservoir operation and reservoir water use.
- Combination water use for surface water and groundwater
- Evaluation and management of groundwater resources
- Water allocation rule with reasonable and equitable use
- Water use on the service area level to minimize the water losses

13.3 Surface Water Sources Development

Potential surface water in the Study Area is evaluated at 2,460 MCM, of which 1,965 MCM could be developed and available to cover the proposed water demand toward 2021 in the area. However, the following study and implementation for the water sources development are to be carried out properly and on schedule.

(1) As for the Karaj surface water, the new Karaj water conveyance project to convey the Karaj water to the proposed No.6 water treatment plant through a tunnel under gravity or a pipeline with pumping station has to be urgently studied and implemented. Otherwise the proposed allocation of Taleghan water to be conveyed through the existing Taleghan tunnel, water

pipeline from Ziaran to Bileghan and existing pipeline to connect Bileghan and No.1 and 2 treatment plants will not be achieved to satisfy the future water supply in Tehran City. This project keeps the first priority among the proposed water resources development projects.

(2) As for the Taleghan surface water, it is important to complete the Taleghan dam project just on schedule. It is also urgently necessary to survey, study and implement the rehabilitation of the existing Taleghan tunnel, because that this tunnel has been operated for more than 25 years and has become superannuated, and will be used for another several ten years or even 100 years after completion of the Taleghan storage dam of which construction work has just started now. After the completion of the Taleghan dam, rehabilitation work of Taleghan tunnel is impossible because water will pass in the tunnel throughout a year to supply the urban water demand in Tehran City.

(3) As for the Almout surface water, it is very important and urgently necessary to implement the Almout Water Diversion Project to divert the Almout water to Qazvin irrigation because the Taleghan water, which has been used for Qazvin irrigation since 1970s, will be converted to Tehran urban water supply and its deficiency has to be compensated by the Almout water.

Fortunately the Almout Water Diversion Project has the high viability in accordance with the technical, economical and environmental studies made by JICA on the pre-feasibility level. It is recommendable however to carry out urgently the further study for the water diversion tunnel with a long distance of 33.8km which is the most difficult construction works involved in the project.

13.4 Groundwater Management

Groundwater being used for the domestic and industrial water supply and irrigated agriculture in the western capital area is evaluated at 3,300 MCM, showing much larger volume as compared with available surface water of 1,965 MCM in the area. However the available groundwater of 3,300 MCM is judged to be the maximum limit taking into account the available recharging water in the area such as rainfall, surplus surface water in rivers, return flow from irrigation and domestic and industrial water supply, etc.

It is recommendable to study and implement the following groundwater management in order to carry out the effective and sustainable use of groundwater.

(1) Establishment of monitoring and evaluation system including the rehabilitation of monitoring wells and the provision of new organization to evaluate and control the groundwater properly and accurately.

(2) Study and implementation of groundwater recharge program by recharging dam and dike in the Khah-rud river basin in Qazvin plain and the Kordan river basin in Hashtgerd region.

13.5 Promotion of Information Disclosure

Official presentation of the Draft Final Report of the Study was held as a seminar on 20th August, 2001 in Tehran. About 150 officials and engineers were attended to the seminar at the head of Japanese ambassador to Iran, Iranian parliament members and the vice-minister of the Ministry of Energy. Uninterruptedly on 21st, workshop was held on the themes "Modern Technology of Tunnel Construction", "Groundwater Survey, Analysis and Management" and "General Concept of Water Management", where 50 engineers were attended. Both the seminar and workshop achieved a great success.

For development and management of regional resources such as water, measures to exceed stereotyped solution are required. Mutual understandings and reliance on the necessity of development and management of resources are essential between inhabitants of donor basins and persons who are to benefit in order to achieve the most effective solution. Precise awareness is the base of mutual understandings and reliance, and the best shortcut to achieve a success is to promote constitution of common consent through deep discussions among persons concerned. Disclosure of necessary information to support such discussions is therefore necessary, and the seminar and workshop conducted at the occasion of the presentation of the Draft Final Report would be a good example for information disclosure.

Attached Figures

List of Figures

Fig.1

Figure 1 Study Area Boundary