(iv) The farm income in the Bayındır district is relatively low, though the farm size is larger. This is mainly due to the fact that low profitable olive trees occupy the farmlands to a large extent.

2.1.10 Environment

(1) General

Prior to the start of this environmental study, the JICA Preparatory Study Team conducted the environmental screening and scoping in January 1994. According to that result, it was recommended that the following four environmental items would need to be assessed in the Study:

- water quality,
- ecosystem including endangered plant and animal species,
- soil erosion, and
- cultural and historical assets

In addition to the above items, the sociological aspect is discussed in this report, because some sociological change would be caused by the implementation of the Project.

(2) Water Quality

(a) Surface Water Quality

In accordance with Water Pollution Control Regulation issued in Official Gazette No.19919 in September 1988, the standard and the classification of the quality of inland surface water were established by the Govenment as shown in Annex-L.

During the field survey in the Phase-I Study, the Study Team collected water samples at 6 locations of the identified dam sites, i.e. Beydağ, Aktaş, Burgaz, Ergenli, Uladı, and Yenişehir, and requested the DSİ-II laboratory to analyze the water quality. The result of water quality analysis made by DSİ-II is shown in Table 2.1.9. Based on the above-mentioned Turkish standard and the U.S.A. Salinity Laboratory Diagram, the water qualities at these six dam sites are assessed to be of Class I, and there would be no problem for its use for irrigation and drinking purposes.

In the Küçük Menderes river basin, water quality data has been collected by DSİ-II at two locations, Selçuk from 1992 through 1994 and the proposed Beydağ dam site in 1994. The results of analysis of this data are shown in Table 2.1.10. According to the above-mentioned Turkish standard, the water quality at the Beydağ dam site can be categorized as Class I, and this water can be used for irrigation and drinking purposes, while the water quality at Selçuk can be categorized as Class III or IV showing high values of biological oxygen demand (BOD) and low contents of dissolved oxygen (DO). In addition, the EC tests on the water samples collected at Selçuk show a medium-high salinity hazard according to the U.S.A. Salinity Laboratory Diagram. From these data, the river water at Selçuk may be judged to be

not suitable for both irrigation and drinking uses, because there may be some water pollution sources along the Küçük Menderes river.

(b) Groundwater Quality

The quality of groundwater is usually checked by DSİ-II at the time of well construction in the river basin, applying the Wilcox and U.S.A. Salinity Laboratory Diagram. The results of the analyses made so far are shown in Table 2.1.11. Most of the water samples showed that the water can be used for both irrigation and drinking purposes, except the water samples collected at Rancarköy and Merkez II located in the west part of the Küçük Menderes river basin, which showed a medium-high salinity hazard according to the U.S.A. Salinity Laboratory Diagram.

In June 1995, DSİ has also started water quality tests to check boron contents at 66 existing wells in the Küçük Menderes river basin, since crop damage was reported in the Gediz river basin, which is located immediately north of the Küçük Menderes river basin, due to the high content of boron in the groundwater. The result of water quality tests so far made at the said 66 wells shows the permissible hazard even to sensitive crops (Annex L).

(c) Water Pollution Sources

According to the information from the Ministry of Environment (MOE), the sources of water pollution are mainly waste water from factories and domestic waste water. According to the Industry Waste Inventory conducted by the State Institute of Statistics (SIS), only 25% of sample factories have facilities for waste water treatment in the Küçük Menderes river basin. According to the information from the Aegean Region Chamber of Industry (EBSO), the number and location of factories in the river basin are as shown below.

	Kiraz	Beydağ	Ödemiş	Bayındır	Tire	Torbalı	Selçuk
Urban Area	2	2	17	7	16	21	5
Rural Area	0	0	9	1	2	27	1
Total	2	2	26	8	18	48	6

According to the above table, around 40% of the factories exist in the rural area of the river basin. On the other hand, most domestic waste water flows into the rivers without any treatment.

There is no data concerning water pollution by agro-chemicals and chemical fertilizer from existing agricultural lands in the river basin. However, judging from the fact that a large quantity of agro-chemicals and chemical fertilizer is applied by farmers as mentioned in Paragraph 2.1.5-(4), this is considered to be one of the water pollution sources.

(3) Ecosystem

(a) Forest

According to the land use study conducted by the Study Team, 57,100 ha, or 16%, of the Küçük Menderes river basin is covered with forest. The majority of the forest in the river

basin is occupied by pine trees and larch masses. Juniper and wide leaf trees are observed in a limited area due to summer droughts characterized by the Mediterranean climate. The Ministry of Forestry (MOF) has been implementing afforestation projects in the river basin since 1959. By the year 2000, around 14,400 ha, which will be mainly covered with pine trees, will be afforested in the river basin in order to conserve wildlife and prevent the erosion (Annex L).

(b) Flora and Fauna

According to the information from MOE, 1,654 species of 620 types of 129 families have been identified as the flora in İzmir province. Of those of 1,654 species, 114 species or 6.9% are endemic species. This rate is low compared to the national average rate of 33%. Most of the endemic species are mainly observed on Mt. Bozdağ and Mt. Nif, which are the first and second highest mountains in İzmir province. In total, 11 endemic species are observed in the whole province as shown in Table 2.1.12.

Based on the check list for fauna prepared by the Department of Biology, Middle-East Technical University, endangered or vulnerable species, which possibly exist in the river basin, are also shown in Table 2.1.12 and summarized below:

Items	Mammals	Birds	Fish	Reptiles	Amphibians
Endangered	1	4	3	0	0
Vulnerable	4	2	1	0	0

Source : Middle-East Technical University

(c) Wetland

According to the Irrigation Master Plan prepared by IBRD (1991), the Eleman wetland which is located at the mouth of the Küçük Menderes river, is considered to be an important bird habitat in terms of bird species diversity and migration. The area covers about 1,500 ha including two lakes, Lake Gebekirse and Lake Çatal. The former is a brackish water lake with a surface area of 75 ha and a maximum depth of 5 m. The water of this lake is a mixed one of sea water and groundwater. The latter is a fresh water lake with a surface area of 74 ha and a maximum depth of 4 m, which is mainly fed by groundwater.

According to interviews of inhabitants of Zeytinköy village located near the Eleman wetland, the land is submerged every winter by floods from the the Küçük Menderes river. This land, except the western 100 ha where the land is inundated by groundwater throughout the year, is dried in summer and used as agricultural land by local people. The sea water, which intrudes in the Küçük Menderes river up to a point of 4 km from the river mouth in summer, does not flow into the said wetland except Lake Gebekirse. This wetland is important not only for birdlife but also for fishery, particularly in the said two lakes. In total, 12 fish species, consisting of four fresh water species and eight salt water species, have been confirmed in these lakes.

Of the 1,500 ha of the wetland, 1,050 ha are designated as a bird sanctuary and 450 ha are planned to be designated by MOF. However, the opening of a new drainage canal, roads and illegal hunting have caused damage to the wildlife and natural vegetation in the area.

(4) Soil Erosion

(a) Soil Erosion Hazard

The classification of soil erosion hazards in the river basin was made taking into account the topographic condition, slope classification, and vegetation covers. The classification results are as follows:

Erosion Hazard Class	Definition	Area (ha)	Proportion (%)
Class I	No risk	102,200	29
Class II	Low risk	40,800	12
Class III	Moderate risk	110,300	32
Class IV	High risk	92,700	26
Built-up Area		5,000	1
Total		351,000	100

Of the total area of 351,000 ha, around 243,800 ha or 70% is in danger of erosion. In addition, 92,700 ha, or 26%, presents a high risk of erosion mainly due to steep slopes without any forest cover. Most of the moderate risk area is covered with tree crops, forest or grass covers, while most of the low and no risk areas are occupied by agricultural lands.

(b) Overgrazing

As mentioned in Paragraph 2.1.5-(5), around 172,000 sheep and 36,000 goats are bred in the seven districts of the river basin. The rangeland potential is estimated at around 105,600 ha, consisting of 23,400 ha of pasture and grass lands and 82,200 ha of bush land, based on the result of the land use study. Therefore, the density of rangeland potential per head is 0.51 ha, which is categorized as an overgrazing status according to the Turkish classification, because the land per head is less than 1.0 ha. According to the agricultural officer interviewed in each district, most of the pasture lands are used by all members of one or more villages without any proper management. The productivity of pasture lands is, therefore, not enough to breed a large number of livestock. As a result, soil erosion is accelerated by overgrazing and poor management of pasture lands.

(5) Cultural and Historical Assets

According to the information from the General Directorate for Preservation of the Cultural and National Heritage, the following cultural and historical assets are located in the respective districts in the Küçük Menderes river basin.

	Kiraz	Beydağ	Ödemiş	Bayındır	Tire	Torbalı	Selçuk
1. Ancient City	1	1	2	-	-	1	1
2. Ancient Village	2	-	2	3	5	2	1
3. Ancient Area	2	-	5	2	5	7	6
4. Ancient Castle	4	1	2	1	6	3	2
5. Protected Area	-	-	-	-	-	-	2
Total	9	2	11	6	16	13	12

In total, six ancient cities, i.e. Efes, Meteropolis, Hypaipa, Dioshieron-Pyrgion, and Keles, exist in the river basin. Of these, Efes, which is located in the west of Selçuk district, is one of the most famous ancient cities in Turkey. Most historical and cultural assets exist in hilly areas or at higher elevations than the alluvial plain in the river basin.

(6) Others

(a) Protected Area

According to the information from MOF, the following protected areas exist in the river basin.

Name	Purpose	Area (ha)
1. Pamucak	Forest Recreational Area	20
2. Eleman marsh	Protected Area for Birds (Registered)	1,050
	Protected Area for Birds (Plan)	500
3. Gölcük lake	Forest Recreational Area	20
4. Mermeroluk	Forest Recreational Area	10
5. Sarıyar	Forest Recreational Area	20

In total, 1,620 ha are registered or planned to be registered as protected areas for the purpose of recreation or preservation of birdlife. National parks and national reserves are not located in the river basin.

(b) Mineral Resources

According to the information from the General Directorate of Mineral Research and Exploration (MTA), 12 mines have exploited, of which eight working mines and four non-working mines exist in the river basin as shown below.

	Location	Kind of Mine	Condition
1.	Akçaşehir	Coal	Working
2.	Bayındır	Zinc	Not working
3.	Kaymakaçı	Titanium	Working
4.	Halıköy	Mercury/Antimony	Working
5.	Ödemiş	Titanium/Gold	Not working
6.	Gökçen	Titanium	Not working
7.	Tire - Karateke	Marble	Working
8.	Boğaziçi	Marble	Working
9.	Bayındır	Titanium	Non working
10.	Çırpı	Marble	Working
11.	Kuşçuburny	Iron	Working
12.	Torbalı	Marble	Working

Thermal springs are often situated on active fault lines and characterized by high temperature springs of deep origin. In the river basin, one active fault line, which runs in the north mountain area, has a high potential for thermal springs. According to the information from MTA, there is a thermal spring at the Ergenli dam site in the river basin.

(c) Public Health

According to the Master Plan prepared by IBRD (1991), the following four diseases are reported as water born diseases related to water resource development in Turkey.

Name of Water Borne Disease	Distribution
Malaria	Lowlands of Southeast Anatolia
Schistosomiasis (bilharzia)	Rivers of Southeast Anatolia
Lymphatic filariasis (elephantiasis)	Whole Turkey
Japanese encephalitis	Mountains and lowlands of South East of Turkey

According to the Provincial Office of the Ministry of Health, the above diseases are not reported in the river basin.

(d) Sociological Aspects

Based on the ties of the blood relationship, the traditional group has been organized in the rural area of the Küçük Menderes river basin. The traditional group had shared the labor force for their agricultural activities such as land preparation, planting and harvesting. In addition, the members of the group had shared various political, social, cultural and economical activities. Since 1980s, however, the relationship among the traditional group member has changed because of the introduction of agricultural machinery, development of farmers' organizations, and introduction of agricultural credit. As a result, the groups were re-organized under the government support system, and the role of the traditional share farming system has become less important due to the introduction of farm machinery.

The leadership of the rural area is still affected by various social values such as social maturity, people wisdom, agricultural techniques, blood relationship and education level. Muhtar and village board which is composed of seven members are responsible for the village activity at present. The Muhtar and the board members are elected every five years on the basis of the above social values. In addition to the above members, the old men in mosques and teachers are also important opinion leaders in village activity.

(e) Role of Women

Major tasks of women in the rural area are house keeping, agricultural and livestock works. Among them, their most regular works are domestic ones including cooking, cleaning, child care and fodder. In addition, the women conduct agricultural works including hoeing, weeding and hand harvesting, etc. The men perform high technical and mechanized work in agriculture, because the men have the many opportunities for the farmers' training. The men sometimes work as casual laborors in the urban area during the free season of their agricultural activities in order to get salary by cash. Generally, the women have small power in terms of

household decision-making due to their low contribution to the economical activity compared to the men.

2.1.11 Present Conditions of Similar Projects

(1) General

In order to know the present irrigation conditions in similar irrigation projects, which will be referred to in preparation of the plan for the O&M and water management for the Project, a field survey was carried out in the following four existing irrigation projects in the Gediz river basin, as the similar projects:

(i) Menemen Irrigation Project
(ii) Manisa Irrigation Project
(iii) Adala Irrigation Project
(iv) Alaşehir Irrigation Project

In addition to the above field survey, another field survey was conducted to know the present conditions and activities of the water users' associations (WUAs). For this survey, the following four WUAs were selected also in the Gediz river basin:

(i) Menemen Left Side WUA in the Menemen Irrigation Project
(ii) Mesir WUA in the Manisa Irrigation Project
(iii) Gediz WUA in the Manisa Irrigation Project
(iv) Salihli Left Side WUA in the Adala Irrigation Project

The survey results are detailed in Annex I and summarized below.

(2) Outline of Projects in the Gediz River Basin

The Gediz river basin is located immediately north of the Küçük Menderes river basin. The irrigation development in the basin started in 1940s and 107,000 ha has been provided with irrigation water and drainage systems consisting of the following facilities as a whole:

(i) Storage dams
  - Buldan : 35.2 MCM of net storage capacity
  - Avşar: 78.6 MCM of net storage capacity
  - Demirköprü: 813.2 MCM of net storage capacity
  - Marmara: 291.9 MCM of net storage capacity

(ii) Diversion weirs: 3 Nos.
(iii) Irrigation canals:
  - Main canals 1,450 km
  - Canalettes: 2,030 km

(iv) Drainage canals: 1,260 km

The main crops cultivated in the irrigated area are cotton (58%) followed by grape (23%), fruits (6%), vegetables (4%), maize (3%), etc. The cropping intensity is estimated at

about 115%. The average yields of crops are rather high as compared with the averages of the country showing 2.5 ~ 4.0 tons/ha of cotton, 3.5 ~ 5.0 tons/ha of grape, 5.0 ~ 10 .0 tons/ha of fruits, 20 ~ 30 tons/ha of vegetables and 3.3 ~ 4.5 tons/ha of maize.

(3) Organization of the Project Office

The above-mentioned irrigation area is divided into the following six irrigation projects. The O&M of these projects are being conducted by the respective District O&M Offices as shown in Figure 2.1.8.

(i)	Menemen Irrigation Project:	23,000 ha
(ii)	Manisa Irrigation Project:	23,000 ha
(iii)	Saruhanlı Irrigation Project:	14,000 ha
(iv)	Turgutlu Irrigation Project:	15,000 ha
(v)	Adala Irrigation Project:	18,000 ha
(vi)	Alaşehir Irrigation Project:	14,000 ha

The District O&M Office is headed by a Chief Engineer and is responsible for the O&M of the project facilities operated by DSİ in the district concerned. The Menemen District O&M Office is responsible to the Director of No.21 District Office, while the other five District O&M Offices are directly responsible to the Director of the Manisa District Office.

(4) Operation and Maintenance of Project Facilities

Due to the chronic water constraints in the Gediz river basin, four dams have been constructed on the Gediz river and its tributaries for irrigation purposes. Even after the construction of these storage dams, irrigation water can be supplied from these dams only for summer crops cultivation generally from May to October, and winter crops are irrigated by groundwater mainly from the wells owned by farmers themselves or some creeks. In a drought year, however, the water supply is only made in the period from July to October giving a priority to perennial crops such as grape and citrus trees. Even in such a difficult situation in the basin, the available water in the river basin is equally distributed to all the projects and there have never been any conflicts among them.

Rotational irrigation is generally practiced on both a secondary and tertiary basis, starting from the downstream parts. Each command area can get water for 3.5 days after one week of off-irrigation period in the peak irrigation time. The irrigation methods widely applied in the basin are border irrigation for the cultivation of wheat and maize, and furrow irrigation for cotton, orchards and vegetables. Sprinkler irrigation is also applied for the cultivation of potatoes and drip irrigation for grapes in a limited area of the basin.

The maintenance works mainly consist of silt removal, weed control and repair of structures for the irrigation canals and drains. Silt removal is mainly done by means of heavy equipment. In some spots which are not accessible by the equipment, the silt is removed manually. For weed control, a chemical treatment is widely applied in addition to the mechanical removal, depending on the type of canal.

At present 72 O&M equipment consisting of 12 excavators, 5 graders, 1 dossier, 17 tractors, 2 loaders, 9 trucks, and 26 vehicles are kept by the said six project offices (District O&M Offices). Most of this equipment is well maintained and under workable condition.

For the estimation of the O&M cost, the irrigation and drainage facilities of each project are inspected by the DSİ Regional Directorate at the end of the irrigation season and an annual inspection report is prepared. This report is sent to the Operation and Maintenance Department of the DSİ Headquarters for evaluation. The budget for the O&M activities of next year is estimated after evaluation of the inspection report of this year. Then the budget is prepared by the said Operation and Maintenance Department of the DSİ Headquarters. According to the field survey, the total O&M budget allocated to the surveyed four project offices amounts to TL 86 billion which is equivalent to TL 1.10 million per hectare.

(5) Collection of Water Charge

The water charge covers the actual cost required for the operation and maintenance in the previous year and the investment cost of irrigation project. The rate of water charge is assessed by DSİ and discussed by an inter-ministerial commission formed by the representatives of the Ministry of Finance, the Ministry of Agriculture and Rural Affairs (MARA) and the Ministry of Public Works and Settlement, and approved by the Government. The different rates of water charge are set based on the land types and crops respectively. According to the inquiry to the project offices, the performance of the water charge collection has not been encouraging, showing 10 ~43% of the dues. This poor recovery is mainly due to inadequate penalty for non payment.

2.1.12 Constraints for Agricultural Development

The geographical position of the Küçük Menderes river basin has the advantages of favorable climate and land resources for crop growth as well as easy access to large markets. In spite of these advantages, however, agricultural production has stagnated at a certain level because of following major constraints:

(a) Physical Constraints

(i) Unstable and scarce precipitation:

About 80% of the concentrated in the period from November to April, and allows the cultiv ation of rainfed winter crops. However, precipitation in this season has been decreasing and has become unstable in recent years, and even winter crops need supplemental irrigation.

(ii) Limited resources of surface water:

Summer crops are unable to grow without irrigation, but surface water is scarce in summer. Then, irrigation by groundwater is intensively applied, which results in a higher irrigation cost.

(iii) Lowering of groundwater table:

The recent scarcity of precipitation reduces the recharge of groundwater. Even under this condition, however, groundwater is increasingly used for irrigation, particularly for summer crops, which has resulted in the acceleration of groundwater table lowering.

(b) Socio-economic Constraints

(i) Small land-holding and fragmentation of land:

Small land-holding is one of the main causes limiting farmers' income. Farm lands are also fragmented into small scattered parcels, which are inconvenient for efficient farming practices. The traditional custom of land heritage is one of the main reasons for the small-holding and fragmentation.

(ii) Educational level of farmers:

The majority of farmers are graduates of primary schools or have not completed primary education. Those farmers generally have a passive attitude in obtaining new technologies and knowledge.

(iii) Out-migration of younger generations:

Younger generations have a tendency to migrate to urban areas. This phenomenon brings about a decrease in a active labor force to operate farms.

(c) Agricultural Constraints

(i) Less coordination between DSİ and other agencies

For irrigation and agricultural research and the extension and dissemination of the research results, the activities of DSİ, GDRS, GDOS and GDAR have overlapped and they have similar responsibilities in some aspects. In order to achieve successful irrigated farming and attain the common goal of improving agricultural production, therefore, adequate coordination and cooperation among these agencies will become necessary.

(ii) Improper farming practices:

Continuous cropping of cotton and vegetables, which are cultivated in a large area at present without rotation, is observed in the Küçük Menderes river basin. This condition adversely affects soil fertility. In addition, cotton and vegetables require higher application of agro-chemicals and fertilizers. This causes a heavy load on the environment.

(iii) Limited meadows and pastures:

Meadows and pastures are at present used at a rate of about 0.51 ha per head of sheep and goat on average. This size is not enough to graze them even after additional feeding with crop residues and fodder crops in the summer cropping season.

(iv) High cost of concentrated feed for livestock:

Livestock production highly depends on concentrated feed. In recent years, the price increase of concentrated feed reduces the profitability of livestock breeding.

(v) Lower prices than reasonable ones for agricultural products

The marketing channels of potatoes, vegetables and fruits are complicated and many middlemen and dealers are involved at every stage in the marketing channels. As a result, this marketing channel compels the farmers and consumers to bear the costs required for marketing. Therefore, there exists much price difference between the farmgate and retail, resulting in low farmgate prices .

(vi) Limited marketing information on farm products

Due to limited marketing information for farmers, it is difficult for them to select profitable crops for next year. It is therefore necessary to involve all the farmers in the cooperatives, particularly in the agricultural village development cooperatives, so that the farmers will get the correct information on marketing of products.

(d) Constraints in Irrigation Practices

(i) Under-development of on-farm facilities and land consolidation:

Under-development of on-farm facilities and land consolidation is common to all the projects in Turkey and resulted in an inefficient and unequitable water supply to the fields.

(ii) Less progress in the establishment of water users groups:

Some decades have passed since the completion of part or all of the Project facilities, but the progress of establishment of water users groups (WUGs) is not encouraging.

(iii) Low response of farmers to water charge collection

The performance of water charge collection has not been satisfactory, showing only 10 to 40% of the dues, particularly for the surface water irrigation projects. This low collection rate is mainly due to the fact that a fine of 10% for non-

payment of the water charge is very low when inflation levels are high, and it is consequently in the farmers' own financial interest to default on their payment.

(iv) Weakness of O&M wing of project offices

Every project office has an O&M section or units, but these are not fully functioning, because these are not fully provided with properly trained staff and well-defined responsibilities, or adequate funds and equipment to carry out their designated works.

(v) Less activities for project monitoring and evaluation

All the project offices are responsible for collecting and analyzing data on the effectiveness of water management, operations and effectiveness of WUAs in securing compliance of their members to their directives, maintenance quality and cost, and agricultural progress. However, these activities are not properly done in these offices because of the limited number of well-trained staff and limited availability of funds and equipment.

2.2 Land and Water Resources Development Plan in the Basin

2.2.1 Project Concept

(1) Basic Concept for Agricultural Development

The relative importance of the agricultural sector in the Turkish economy is declining, but it still represents about 16% of GDP, about 24% of exports earnings and about 42% of employment. Moreover, agricultural development in the rural area would decelerate or decrease the rural-to-urban migration. Recognizing these economic and socio-economic effects of agricultural development, the Government placed an emphasis on it in the country's Sixth Five-Year Development Plan (1990 - 1994), which was also applied in the transition period of 1995. The following targets were set forth for the agricultural sector under the Sixth Plan:

(i) To promote modernized agricultural techniques;

(ii) To enhance agricultural production and productivity through improvement of soil productivity, introduction of high quality crop seeds, disease and pest control, and irrigation development;

(iii) To diversify industrial crops and to develop production bases for export crops; and

(iv) To maintain a balance between agricultural development and the environment.

While, in the Seventh Five-Year Development Plan (1996 - 2000), which was issued in July 1995, the targets for the agricultural sector were set forth as follows:

(i) To ensure a sufficient and balanced nutrition for the increasing population,

(ii) To increase production and exports, especially in the products which the country has a comparative advantage, and

(iii) To increase and stabilize the income of the producers.

In line with the above-mentioned targets, the basic concepts for the agricultural development in the Küçük Menderes river basin needs to be studied particularly for: (i) land resources development; (ii) water resources development; (iii) agricultural development; and (iv) irrigation development.

(2) Land Resources Development

According to the evaluation of land resources potential mentioned in Section 2.2.2, about 103,100 ha, consisting of 27,500 ha of Class I, 27,700 ha of Class II, and 47,900 ha of Class III, can be considered as the irrigable area, and the priority of land development should basically be given to the Class I, followed by Class II and Class III. In the selection of the development area, however, it is understood that this classification should not be a decisive factor for the development. Other important factors to be considered would be technical

soundness, economic viability, social environment, regional balance of farm income as well as the soil conservation and natural preservation in the development area.

(3) Water Resources Development

The main irrigation water source in the Küçük Menderes river basin has been groundwater for a long time. According to the hydrogeological study made by the Study Team, the calculated groundwater recharge is in the order of 160 million m^3 (MCM)/year. On the other hand, according to the Küçük Menderes Plain Hydrogeological Investigation Report prepared by DSİ in 1973, a volume of 63.5 MCM/year of groundwater was pumped by about 1,700 wells in 1973. Since then, well construction has been accelerated and the number of wells has reached about 6,500, from which about 250 MCM of groundwater are deemed to be pumped annually. Moreover, since precipitation has decreased since 1986, the pumped discharge has exceeded the recharge to aquifer. As a result, the groundwater level has been dropping remarkably since 1986. If this situation continues in the future, the groundwater equilibrium will be destroyed and wells in the area cannot be used any more.

Under the above-mentioned present conditions, groundwater development for irrigation cannot be expected any more but rather should be controlled to the appropriate level. For further irrigation development in the basin, therefore, the water source should be secured by other means. The following three development alternatives are conceivable:

(i) Diversion of water from other basins to the Küçük Menderes river basin.

(ii) Promotion of recharge to the aquifer through the construction of underground storage dams or artificial recharging methods.

(iii) Development of surface water resources through the construction of storage dams on the Küçük Menderes river or its tributaries.

Among the above alternatives, Alternative-(i) cannot be implemented, because the vicinal river basins such as Gediz and Büyük Menderes cannot afford to provide water to other basins. Alternative-(ii) is not so attractive, because there exist already two natural underground storage dams near Tire and Torbalı as mentioned in Paragraph 2.1.3-(5), and new artificial dams would not work effectively, and also because the artificial recharging methods are also not so effective as mentioned in Annex C. For these reasons, the irrigation development in the Küçük Menderes river basin should depend on Alternative-(iii).

(4) Agricultural Development

In the Küçük Menderes river basin, which is blessed with a Aegean climate and a location close to the third biggest city of İzmir, high-valued crops are widely cultivated, and farmers in the basin intend to develop more. For further development of agriculture in the basin, however, the shortage of water resources would be a limiting factor, and even after realization of water resources development through the construction of storage dams, it is still necessary to improve the present agricultural practices in the following manner.

(a) Cropping Pattern:

(i) The proposed crops will be selected considering the climatic condition, growth duration, marketability, profitability, labor requirement, crop rotation, farmers preference, and environmental balance.

(ii) As for marketability, crops will be classified into locally demanded, domestically demanded, and export-oriented crops. Locally demanded crops will be calculated on the basis of local population and per capita consumption, and domestically demanded and export-oriented crops will be assessed based on the present trend.

(iii) Profitability will be examined according to crop budgets estimated on a preliminary basis. Since the efficient irrigation method of using sprinkler and drip systems, which are costly facilities, is contemplated to be introduced to the river basin, profitable agriculture is a main concern.

(b) Farming Practices

Organic farming with inputs of crop residues and livestock manure will be promoted for the following reasons:

(i) Livestock manure is available, because the agriculture combined with livestock breeding is widely practiced in the basin in order to stabilize the farm economy.

(ii) Application of organic matters will increase the water holding capacity of the soil, which will result in irrigation water saving.

(iii) Application of organic matters in place of chemical fertilizers will result in a decrease of negative effects on the environment.

(c) Extension Activities

After the introduction of modernized irrigation farming to the river basin, new farming technology including the application of fertilizers and agro-chemicals and water management should be introduced to the basin, and this farming technology should be ready for acceptance by the farmers. In this context, it is necessary to establish the extension method acceptable to the farmers.

(d) Marketing and Agro-processing

To raise farm income in the river basin, it is necessary not only to enhance the agricultural productivity through the introduction of intensive agriculture but also to promote the farmers' participation in the market system and to improve agro-processing and post-harvesting systems. These promotions and improvements will also induce the creation of employment opportunities and re-attract young people to rural areas because of the activation of the rural economy.

(5) Irrigation Development

As mentioned previously, the Küçük Menderes river basin holds sufficient land resources, but their development for agricultural purposes is limited due to the scarcity of both surface water and groundwater sources. In order to develop the land resources to the maximum extent, therefore, the introduction of an efficient irrigation system and practice is of great importance. In this context, the basic concepts for the irrigation development plan in the river basin are:

(i) To introduce a modernized irrigation method for water saving as far as technically and economically justifiable,

(ii) To develop surface water resources by constructing storage dams on the Küçük Menderes river and its tributaries, taking into account the optimum allotment between the surface water and groundwater and also considering the influence of the impounded water in the reservoirs to the groundwater condition,

(iii) To identify appropriate groundwater yields which will allow a sustainable groundwater use in the future, in consideration of the surface water development plan.

(6) Municipal Water Supply

Rapid urbanization will worsen water shortage in urban areas, particularly in Bayındır, Ödemiş and Tire in the Küçük Menderes river basin. Due to this unfavorable situation, water supply to these three cities will be taken into account in the water resources development plan. Considering the locations of these cities, water supply will be made from the Ergenli dam for Bayındır, the Aktaş dam for Ödemiş, and the Akyurt and the Eğridere dam for Tire. On the other hand, any water supply for drinking and livestock grazing purposes in other rural areas will not need to be considered in the development plan, because it is understood that the number of dwellers and livestock will be maintained almost at the present level in the future.

2.2.2 Potential of Land Resources

According to the result of the evaluation of irrigation suitability in the Küçük Menderes river basin as mentioned in Paragraph 2.1.3-(6), about 108,000 ha can be considered suitable for agricultural development. For the following reasons, however, the potential lands to be considered under the present Study are evaluated.

(i) The potential area will be selected among the existing agricultural lands as far as possible, and forests and grasslands will be excluded from the potential area from the viewpoints of soil conservation and natural preservation.

(ii) According to national regulations, existing protected areas will be excluded from the potential area. In addition, protected areas or industrial areas planned by the government authorities will be excluded from the potential area.

As a result, the potential area considered under the Study is 103,100 ha as shown below.

Suitability	Area (ha)	Proportion
Potential Area		
- Class I (highly suitable)	27,500	8
- Class II (moderately suitable)	27,700	8
- Class III (marginally suitable)	47,900	14
Sub-total	103,100	30
Excluded Area from Class I to III	4,900	1
Class IV (not suitable)	238,000	68
Built-up Area	5,000	1
Total	351,000	100

2.2.3 Water Resource Potential

(1) Groundwater Potential

(a) Water Economy of the Groundwater Basin

The water economy of the whole groundwater basin is analyzed in this section. Through this analysis, the quantity of water recharged into the groundwater aquifer was also be clarified. For the convenience of water economy analysis, the basin was divided into 4 sub-blocks based on the topographic and geological conditions, as shown in Figure 2.2.1.

Sub-block	Character	Area (km^2)
Kiraz Block	Upstream of the proposed Beydağ dam site	515 km^2
Ödemiş-Bayındır-Tire-Torbalı Plain Block	Major groundwater basin of the Küçük Menderes River Basin	950 km^2
Ödemiş-Bayındır-Tire-Torbalı Mountainous Block	Runoff watershed to the major groundwater basin	1,575 km^2
Tire-Belevi Block	Additional ground water basin	215 km^2
		3,255 km^2

The volume of water recharged into the groundwater basin from the mountainous watershed and over the groundwater basin through the flat plain area was estimated from recorded data on precipitation, surface runoff, evapotranspiration (ETo), etc. The analysis covered 20 years, from 1974 to 1993, tracing changes in soil moisture by applying the precipitation data of the Ödemiş station and runoff data of the Aktaş river, or the calculated excess water volume excluding effective rainfall. Water shares obtained through the analysis are as shown below.

Items	From Mountainous Watershed (Annual average) (mm)	(%)	From Flat Plain Area (Annual average) (mm)	(%)
Precipitation	590.0	100.0	590.0	100.0
Surface runoff	206.0	34.9	127.0	21.5
Evapotranspiration	312.0	52.9	368.0	62.4
Recharge*	72.0	12.2	95.0	16.1

*: Including supplemental water to soil moisture in the surface soil layer

The water economy of the whole groundwater basin (3,255 km² excluding the Selçuk area) was estimated from the above result of estimation of recharge as shown in Figure 2.2.2. According to the water budget, a volume of 130 MCM has been recharged annually into the Ödemiş-Bayındır-Tire-Torbalı groundwater basin, which is the major groundwater basin in the Küçük Menderes river basin.

Pumping yield has far exceeded water recharge in the major basin, due to not only scarce recharge resulting from recent severe droughts, but also the increasing number of pumps within the river basin. So far, the water deficit has been covered by retention storage water from the groundwater aquifer. This has caused a drop of the groundwater level observed so far. According to the water budget, an average annual water deficit of 75 MCM has continued since 1985.

(b) Numerical Simulation of Groundwater in the Groundwater Basin

The Aqui-Three-Dimensional Finite Element Method was applied for the unsteady groundwater simulation analysis. The simulation was performed with around 200 elements modeling the whole groundwater basin, using hydrological data, hydrogeological data, and other data for input and output of the basin. Firstly, each parameter, such as hydrogeological figure was identified by comparison between the simulated groundwater levels and the figures observed at several selected points, through trial and error. The results of the groundwater simulation are given in Annex C. As a conclusion to the simulation, the global water economy of the major basin was confirmed to be adequate.

(c) Maximum Groundwater Yield for Sustainable Use

It is estimated that groundwater has recently been pumped up from the major basin at a rate of around 250 MCM/year, far exceeding the annual water recharge volume. If such over-pumping continues, either groundwater will be exhausted soon or pumping will be compelled to stop due to rising O&M expenditures for deeper pumping. Therefore, urgent execution of quantitative control of the pumping is required.

The maximum controlled pumping yield must balance with the water recharging volume. While an annual average recharge volume of 130 MCM was estimated through the water economy study, a larger volume is expected from now on, because the period of such a study included the most severe droughts since 1985. Considering these circumstances, a controlled pumping yield of 160 MCM/year was applied, as it was confirmed to be adequate through a simulation.

(2) Surface Water Potential

In estimating the water potential at the dam sites identified on the Küçük Menderes river itself and on its tributaries, the observation records of the existing stream gauging stations in the Küçük Menderes river basin or neighboring basins were used. The locations and characteristics of the subject stations which are operated by either DSİ or EIEI are given in Annex-A. As may be seen from the Annex, the observation periods of the stream gauging stations at or near the dam sites vary, and the data available for some stations are either short or discontinuous. Both the completion of the missing data for the relevant stations and the extension of the flow values for all the stations to the longest period have been carried out by applying the most appropriate correlation techniques available. The long-term and continuous flow series obtained have been transformed to the dam sites by area correlation. Besides, other hydrological techniques of estimation have been tried, and it has been concluded that the above values are convenient.

The average annual flow values of the dam sites estimated together with their extension periods are given in the following table (Annex A).

Name of the Dam	Catchment Area (km^2)	Period of Estimation	Average Annual Flow, MCM
Uladı	66.0	1965 - 1993	16.48
Ergenli	98.0	1965 - 1993	24.47
Burgaz	91.2	1965 - 1993	22.81
Aktaş	58.7	1965 - 1993	12.80
Ödemiş	64.6	1965 - 1993	24.71
Birgi	12.6	1965 - 1993	5.68
Bucak	18.0	1965 - 1993	8.18
Beydağ	444.0	1964 - 1994	76.12
Pirinçci	51.3	1965 - 1993	19.11
Sarılar	30.9	1965 - 1993	11.45
Eğridere	21.8	1965 - 1993	8.12
Akyurt	24.2	1965 - 1993	6.10

2.2.4 Land and Water Resources Development Plan

(1) Storage Dam Plan

(a) Review of Previous Studies

(i) Master Plan Prepared by DSİ in 1982

The Master Plan Study on the Küçük Menderes River Basin was conducted by DSİ in the period from 1980 to 1982, which covers the findings and recommendations reached in the study period. In the study, the development of the water and agricultural potential in the basin had been investigated at a master plan level. The proposal made in this study has mainly concentrated on the solution of the problems caused by floods, and also irrigation projects had been proposed so as to make better use of the water potential in the river basin.

The facilities proposed in the above study consist of three flood control dams, energy dissipating chutes and intercepting canals on the six tributaries, dikes and four storage dams. The proposed flood control dams are the Kiraz dam on the Keles river, the Uladı

dam on the Uladı river, the Ödemiş dam on the Rahmanlar river, while the energy dissipating chutes were proposed on the Ulçay river, the Sırımlıdere river, the Eğridere river, the Zeytinlik river, the Tasavra river and the Pirinçci river. The proposed storage dams were the Beydağ dam on the Küçük Menderes river, the Ergenli dam on the Ergenli river, the Aktaş dam on the Aktaş river, and the Burgaz dam on the Falaka river, all of which are for irrigation purposes. The main features of the above-mentioned flood control dams and storage dams are tabulated below (Figure 2.2.3).

Items	Kiraz	Uladı	Ödemiş	Beydağ	Ergenli	Aktaş	Burgaz
Purpose	flood	flood	flood	irrigation	irrigation	irrigation	irrigation
Catchment area (km^2)	61.9	65.1	64.6	436.8	97.2	58.7	91.2
Dam type	earthfill	earthfill	earthfill	earthfill	earthfill	earthfill	earthfill
Dam height (m)	25.8	19.7	25.1	64.0	77.5	93.6	102.2
Dam length (m)	533.8	145.0	840.0	890.0	805.0	615.0	415.0
Dam volume (MCM)	0.30	0.09	0.26	8.82	6.85	3.83	7.02
N. R. C. (MCM)	0.46*	0.82*	0.95*	400.00	61.78	49.27	68.86
Net Irrigation Area (ha)	-	-	-	10,000	2,000	1,500	1,975

(Note) N. R. C. : Net reservoir capacity.
* : Gross reservoir capacity

The storage dams mentioned above were designed based on the following engineering data.

Items	Kiraz	Uladı	Ödemiş	Beydağ	Ergenli	Aktaş	Burgaz
Run-off coefficient	-	-	-	0.35	0.57	0.62	0.56
Ratio of effective storage capacity to annual stream flow	-	-	-	2.30	1.60	1.98	1.97
Specific flood ($m^3/sec/km^2$)	6.22	4.79	7.13	2.92	2.26	2.66	3.83
Specific sediment discharge ($m^3/km^2/year$))	84.1	300	83.6	315	250	250	250

In addition to the above, DSİ identified six sites, i.e., Birgi, Bucak, Akyurt, Eğridere, Sarılar and Pirinçci, in the master plan study as the storage dam development sites, but finally abandoned them because of their limited economic viability.

(ii) Feasibility Study on the Beydağ and Aktaş Irrigation Development Plans

The master plans for the Beydağ and Aktaş Irrigation Development Projects mentioned above were reviewed and modified by DSİ in 1986 and 1994 respectively, based on the results of the re-assessment of water resources potential including both surface and groundwater, further detailed hydrological analysis and geological investigations at the dam sites, and re-assessment of water requirements based on the modification of the irrigation method as shown below.

Engineering data

Items	Beydağ	Aktaş
Run-off coefficient	0.35	0.38
Ratio of effective storage capacity to		1.10
Specific flood (m^3/sec/km^2)	2.87	2.66
Specific sediment discharge (m^3/y/km^2)	300	200

Salient features of the dam plans

Items	Beydağ	Aktaş
Storage dam		
- Dam type	earthfill	earthfill
- Dam height (m)	87.0	78.0
- Dam length (m)	783.5	271.0
- Dam volume (MCM)	5.6	1.6
Reservoir		
- Gross reservoir capacity (MCM)	248.3	17.3
- Dead reservoir capacity(MCM)	6.7	0.6
- Net reservoir capacity (MCM)	241.6	16.7
Irrigation area		
- Gross irrigation area (ha)	13,055	1,380
- Net irrigation area (ha)	11,044	1,168

(b) Examination of the Storage Dam Plans

Based on the data and information provided by DSİ and the results of the field survey carried out by the Study Team, the above mentioned storage dam plans, except the Kiraz dam, which is topographically not attractive, have been examined mainly based on the hydrological and topographical conditions, and the results of the examination are mentioned in Annex G and summarized below.

Items	Uladı	Ödemiş	Beydağ	Ergenli	Aktaş	Burgaz
Catchment area (km^2)	66.0	64.6	444.0	97.2	58.7	91.2
Dam type	earthfill	earthfill	earthfill	earthfill	earthfill	earthfill
Dam height (m)	83.0	25.0	95.0	93.0	80.5	115.0
Dam length (m)	505.0	840.0	788.5	805.0	271.0	415.0
Dam volume (MCM)	5.70	0.26	9.00	6.85	1.60	7.02
N. R. C. (MCM)	41.70	- 0.02	241.3	61.78	16.72	68.90
Net Irrigation Area (ha)	2,150	0	10,200	3,150	850	3,300

Name of Dam	Birgi	Bucak	Akyurt	Eğridere	Sarılar	Pirinçci
Catchment area (km^2)	12.6	18.0	24.2	21.8	30.9	51.3
Dam type *	earthfill	earthfill	acing typ	earthfill	earthfill	earthfill
Dam height (m)	70.0	74.0	41.0	70.0	119.5	70.5
Dam length (m)	280.0	1,080	1,250	410	1,150	725.5
Dam volume (MCM)	2.10	5.60	1.38	2.44	17.80	3.44
N. R. C. (MCM)	0.42	9.20	8.48	2.16	30.01	5.23
Net Irrigation Area (ha)	20	330	300	80	1,000	180

(Note) : The net irrigation area was estimated for the cropping intensity of 140%.
*: Selection of dam type is detailed in Paragraph (3) hereof.

The above-examined dam plans except the Ödemiş, Birgi and Eğridere dam plans, which have less storage capacities and are definitely less economical, have been further examined from an economic viewpoint as shown in Table 2.2.1. According to the results

shown in this table, five dam plans: Uladı, Beydağ, Ergenli, Aktaş and Burgaz dam plans, would be economically justifiable.

After knowing the economic viability of the dam plans, the following preliminary economic evaluations have been made for the irrigation projects which will use irrigation water to be released from the above five storage dams.

Name of Project	Irrigation Area	Cost			Annual Net Benefit	EIRR-1	EIRR-2
		Construction	Replacement	Annual O&M			
	(ha)	(TL billion)	(TL billion)	(TL billion)	(TL billion)	(%)	(%)
Uladı	2,150	2,077.8	315.1	9.5	210.5	6.6	7.6
Beydağ	10,200	5,542.9	1,494.9	45.0	1,189.5	13.6	14.8
Ergenli	3,150	2,651.0	461.6	13.9	304.1	7.5	8.5
Aktaş	850	667.9	124.6	3.8	103.5	10.3	11.6
Burgaz	3,300	2,754.8	483.6	14.6	319.3	7.6	8.5

(Note): EIRR - 1 : In the case of surface water development only.
EIRR - 2 : In the case of conjunctive use of surface water and groundwater

According to the above table, the Beydağ Project shows the highest economic internal rate of return (EIRR), followed by the Aktaş, Ergenli Project or Burgaz Projects and lastly by the Uladı Project in case that the irrigation is made only by surface water developed through dam construction. The economic viability of these five projects has been assessed based on the criteria applied in the Irrigation Master Plan prepared by the World Bank (IBRD) in 1991, which defined that a project with EIRR of more than 8.0% would be economically feasible. As a result, it may be concluded that the Beydağ and Aktaş Projects are feasible, showing an EIRR of 13.6% and 10.3%, respectively. For the irrigation development plan to be formulated under the present master plan study, however, it is intended to use both surface water and groundwater based on the concept of the conjunctive use of these waters. Following this concept, EIRR was re-calculated for each project after adding the irrigation area to be irrigated by conjunctively using the surface water and groundwater, and the calculated results are shown also in the above table as EIRR-2. The results indicate that the four projects, except the Uladı Project, are economically justifiable under the present economic condition in Turkey.

Following the above study results, the four project areas of Beydağ, Aktaş, Ergenli and Burgaz will be considered in this master plan study and a further detailed study will be made below.

(2) Irrigation Development Area

(a) Water Demands

There are other water demands besides irrigation water supply in the river basin. The drinking water supply is to be considered in this master plan. In the river basin, drinking water has been mainly supplied by public facilities in urban areas and by private wells in rural areas, and there is no severe shortage of water at present. However, drinking water must be in short supply in the near future, as the population and unit water demand will increase. It should be considered to supply drinking water to the major towns of Ödemiş and Bayındır in the river basin, which can be covered by the proposed dam reservoirs. The design water demand was targeted for 2020 excluding the present drinking water supply volume.

Water supply for livestock was not considered, because at present water for livestock is being supplied sufficiently from existing wells and the number of livestock is not expected to increase much in future.

(b) Groundwater Development and Irrigation Area

If volumetric control of groundwater use is achieved in the groundwater basin, a groundwater volume of 160 MCM would be available annually in the whole groundwater basin area of around 90,000 ha. Such available groundwater volume can be shared by each project area according to the ratio of the project area itself to the whole basin area. The areas which will continue to be irrigated by groundwater in the river basin were decided based on the unit irrigation water requirement and such available groundwater volume. The groundwater irrigation areas of the respective project areas are as follows:

Project Name	Available Ground-water * (MCM)	Irrigation Water Re-quirement (mm)	Irrigation Area (ha) Net Area	(Gross Area)
Beydağ	32.5	617.8	5,200	(6,150)
Aktaş	2.7	606.1	450	(530)
Brugaz	10.2	638.8	1,600	(1,890)
Ergenli	9.6	638.8	1,500	(1,770)

Note *: Available groundwater volume is estimated based on the ratio of the total project area including groundwater irrigation area, to the whole basin area.

(c) Surface Water Development and Irrigation Area

The area to be irrigated by surface water developed by each proposed dam was obtained through a reservoir operation study, applying the unit water requirement explained in Paragraph 2.2.6-(3). The irrigation area thus obtained are as shown below.

Project Name	Effective Reservoir Capacity (MCM)	Irrigation Water Re-quirement (mm)	Study Term	Irrigation Area Net (Gross) (ha)	Drinking Water Supply *
Beydağ	241.615	617.8	1961 ~ 1993	10,200 (12,050)	-
Aktaş	16.722	606.1	1965 ~ 1993	850 (1,000)	2.4MCM plus 10%
Brugaz	68.86	638.8	1965 ~ 1993	3,300 (3,900)	-
Ergenli	61.78	638.8	1965 ~ 1993	3,150 (3,720)	0.55MCM plus 10%

*: Quantity of drinking water supply includes conveyance losses of 10% of net demand.

(d) Definition of the Study Area

Positive effects of the proposed 4 dams mentioned above are schematically illustrated in Figure 2.2.4. The direct beneficiary areas will include: (i) the areas to be irrigated by surface water from the proposed dam reservoir, and (ii) the areas of existing cooperatives and private farmlands which will continue to be irrigated by groundwater within each dam command area. The direct beneficiary areas are shown below, and the total of these areas is defined as the Study Area.

(Unit:ha)

Project Name	Irrigation by Surface-water		Irrigation by Groundwater		Total Area	
	Net	Gross	Net	Gross	Net	Gross
Beydağ	10,200	(12,050)	5,200	(6,150)	15,400	(18,200)
Aktaş	850	(1,000)	450	(530)	1,300	(1,530)
Burgaz	3,300	(3,900)	1,600	(1,890)	4,900	(5,790)
Ergenli	3,150	(3,720)	1,500	(1,770)	4,650	(5,490)
Total	17,500	(20,670)	8,750	(10,340)	26,250	(31,010)

2.2.5 Agricultural Development Plan

(1) Farm Household and Agricultural Labor Force

According to the farm household survey, the average farm size and the family size as well as the labor force per household in the Study Area are estimated as shown below:

Items	Beydağ	Aktaş	Burgaz	Ergenli
Average Farm Size (ha/household)	2.46	2.50	6.19	6.10
Average Family Size (persons/household)	6.9	5.2	5.3	5.0
Average Labor Force (adult men/household)	3.35	3.24	3.33	3.32

Note: Labor force is converted to adult men equivalent from family members, applying the ratio of 50% for male and female 7 - 14 years old, 100% for male 15 - 49 years old, 75% for female 15 - 49 years old, 75% for male 50 - 64 years old and 50% for female 50 - 64 years old.

On the basis of the population census in 1985 and 1990, the population growth rate and the future population in the Study Area are estimated as shown in the following table:

	Beydağ	Aktaş	Burgaz	Ergenli	Rural*	Urban**
Annual Population Growth Rate	0.52%	0.73%	0.03%	-0.05%	0.5%	1.00%
Population Increase in 2000	5.3%	7.5%	0.3%	-0.05%	5.1%	10.5%
Population Increase in 2010	10.9%	15.7%	0.6%	-1.0%	10.5%	22.0%
Population Increase in 2020	16.8%	24.4%	0.9%	-1.5%	16.1%	34.8%

Note; *: Total population of all the villages in the river basin,
**: Total population of district centers in the river basin

The above estimation indicates that the present farm size, particularly in the Beydağ and Aktaş project areas, will gradually become smaller due to the increase of population and the traditional inheritance system. The farm income will decrease as the farm size becomes smaller in the future, unless farmers cultivate higher profitable crops than the present ones.

Most farmers hire seasonal labors for planting and harvesting cotton, tobacco and vegetables at present. This labor force comes from the river basin and the eastern regions of the country. The labor force will increase as the population increases in future. If the future employment condition remains as it is, many workers will migrate out of the river basin. However, the labor demand is expected to increase after the completion of the Project, because an intensive farming of higher profitable crops would be introduced through the Project. Therefore, it is assumed that the labor demand newly created by the Project will be satisfied by the increased labor force. The labor shortage in the river basin will be made up by workers from the eastern regions of the county in the future.

(2) Future Land Use

The present agriculture in the river basin largely depends on groundwater irrigation, though insufficiently. The groundwater table has been decreasing due to intensive use for irrigation. Under such a groundwater condition, the irrigated lands under the present condition should not be the same as in the "future without project" condition, because it is assumed that the groundwater extraction for irrigation purpose will be controlled to 64% of the current level in order to maintain the optimum discharge balanced with the rechargeable amount. Accordingly, the existing irrigated area will be decreased under the "future without project" condition, even if irrigation water is still insufficient like in the present condition and instead, the rainfed area and fallow land would be increased in the "future without project" condition.

The presently cropped area in the Study Area is estimated on the basis of the statistical data and the results of the field survey. The cropped area under the "future without project" condition is estimated taking into account the above-mentioned groundwater situation, as shown below:

(Unit:ha)

		Present Condition		"Without Project" Condition	
Area	Total	Irrigated	Rainfed	Irrigated	Rainfed
Beydağ	15,400	9,200	6,200	5,890	9,510
Aktaş	1,300	480	820	310	990
Burgaz	4,900	1,810	3,090	1,160	3,740
Ergenli	4,650	1,720	2,930	1,100	3,550
Total	26,250	13,210	13,040	8,460	17,790

As for the case of "future with project" condition, the farmlands included in the respective project area will be irrigated conjunctively by the surface water developed through the construction of the proposed dams and the groundwater controlled to 64%. These areas are estimated as shown in the following table:

(Unit:ha)

	Total Area		Irrigated by Surface water		Irrigated by Groundwater	
Area	Net	Gross	Net	Gross	Net	Gross
Beydağ	15,400	(18,200)	10,200	(12,050)	5,200	(6,150)
Aktaş	1,300	(1,530)	850	(1,000)	450	(530)
Burgaz	4,900	(5,790)	3,300	(3,900)	1,600	(1,890)
Ergenli	4,650	(5,490)	3,150	(3,720)	1,500	(1,770)
Total	26,250	(31,010)	17,500	(20,670)	8,750	(10,340)

(3) Proposed Cropping Pattern

On the basis of the present cropping pattern prevailing in the river basin, mentioned in Paragraph 2.1.5-(3), the present cropping pattern and cropped area in the Study Area are presumed as shown in Figure 2.2.5. Referring to these cropping patterns and further taking into account the following principles, the proposed crops are selected.

(i) Crops to be considered in the proposed cropping pattern are mainly selected from the crops presently planted in the Study Area, since these crops are suited to the climatic and soil conditions of the Study Area and the local farmers are familiar with their cultivation.

(ii) The maximum cultivation area of each crop is set at less than 30% of the total cultivation area to prevent unexpected physical damage and economic risks.

(iii) The crops which highly respond to irrigation and have a high marketability will be selected for irrigated farming as practicable as possible.

(iv) Crop rotation is introduced for annual crops in order to maintain soil fertility and to prevent soil-borne diseases and pests.

Tobacco and figs are excluded from the proposed cropping pattern, though these crops are cultivated at present in the Study Area, because a low effect on the production value is expected by application of irrigation. Olive trees in the Beydağ and Aktaş areas are also excluded from the proposed cropping pattern due to the same reason as mentioned above. Meanwhile, some of these trees are kept in the proposed cropping pattern for the Burgaz, Ergenli and Uladı areas, because these trees are grown with high intensity in these area and it is not practical to delete all of them from the proposed cropping pattern. As a result, the following crops are selected in the proposed cropping pattern.

Cereals:	Slightly decreasing, but maintaining the present supply for local demand.
Cotton:	Maintaining the present cropped area as the main cash crop.
Potatoes:	Slightly increasing or maintaining the present cropped area due to high profitability.
Watermelons:	Maintaining the present cropped area as the suitable crop for irrigation.
Fruit bearing vegetables:	Expanding the area as the main crops due to their high profitability.
Leafy and stem edible vegetables:	Expanding the area as the second crops in order to increase the cropping intensity.
Leguminous vegetables:	Expanding the area as the second crops in order to increase the cropping intensity and to make up a good crop rotation with other crops.
Fodder:	Slightly increasing the area from the present condition, to cover the demand of local livestock and to form a good crop rotation with other crops.

After selecting the crops to be introduced to the Study Area, a preliminary alternative study is made in order to determine the appropriate cropping intensity from the viewpoints of economic viability and practicability. For this alternative study, three cropping patterns with different intensities of 120%, 140% and 160% are prepared and first examined for their economic viability in terms of EIRR taking the Beydağ Project area as a sample area. The result shows that the cropping patterns with cropping intensities of 140% and 160% would be more economical than that of with an intensity of 120%, showing the same EIRR of 11.3% as shown below.

Cropping Intensity	Irrigation Area	EIRR
120%	10,800 ha	9.7%
140%	10,400 ha	11.3%
160%	10,000 ha	11.3%

For both cropping patterns with cropping intensities of 140% and 160%, therefore, a further examination was made to check their practicability, and it is concluded that the cropping intensity of 140% would be more practicable than that of 160%, considering the present level of farmers' technic and the sustainability of soil fertility. The cropping pattern thus determined is shown in Figure 2.2.6. In this cropping pattern, the cultivation of the annual crops is planned to be rotated every 3 years. Based on this cropping pattern, the cropped areas for the respective crops are calculated as shown in Table 2.2.2.

The following table summarizes the cropping intensities for the "present", "future without the project" and "future with project" conditions for the respective projects:

	Beydağ Project	Aktaş Project	Burgaz Project	Ergenli Project
Present	103%	103%	101%	102%
Future without Project	75%	74%	87%	87%
Future with Project*	140%	140%	130%	130%

(Note) *: The cropping intensities for the Burgaz and the Ergenli Projects are slightly modified considering a higher cropping intensity of tree crops than the Beydağ and the Aktaş Projects.

(4) Proposed Farming Practices

Since all the crops selected for the projects are being cultivated in the Study Area, the farmers have already obtained the basic knowledge of farming practices for these crops through the technical extension services provided by MARA. However, further improvement of the present farming practices would become necessary in order to introduce effective sprinkler and drip irrigation systems proposed under these projects, and to attain the anticipated yield and quality of the products at a reasonable production cost. In this view, the following are emphasized for further improvement of farming practices;

(i) Proper application of farm inputs:

At present, chemical fertilizers and agro-chemicals are excessively applied in the Study Area because of the strong desire of farmers for higher production. In addition to this, it is expected that the requirement of chemical fertilizers and agro-chemicals will increase due to the expansion of vegetable cultivation in the proposed cropping pattern. An excessive dosage of chemical fertilizers and agro-chemicals will require higher production costs and cause negative effects on the environment. To prevent this situation, the proper dosage would be applied to the crops. The application of organic manure and crop residues is also recommended in order to reduce the dosage of chemical fertilizers.

(ii) Efficient operation of farm machinery:

Farm machinery and equipment are widely used for land preparation, weeding, fertilization, crop protection, and transportation in the Study Area. The machinery

owned by individual farmers and their capacity usually exceed their farm size. This results in a costlier operation than actually required. Since the requirement of farm machinery operation will increase under the "future with project" condition, it is necessary to organize farmers into groups such as village development cooperatives, so that the machinery will be used by the groups in a more efficient way.

(iii) Extension of new irrigation methods

The farmers in the Study Area are not familiar with the new irrigation methods for water saving by means of sprinkler and drip irrigation systems. For the smooth implementation of the projects, it is essential that the farmers understand the effect of the new irrigation methods and also need to obtain operational techniques, particularly concerning water-efficient cultivation. In this regard, the establishment of demonstration plots is effective to show and verify the effect of the sprinkler and drip irrigation systems as well as to train the farmers.

(5) Anticipated Crop Yield and Crop Production

After implementation of the Project, the unit yield of crops will increase and be stabilized through the effective supply of irrigation water and the introduction of improved farming practices including the proper application of farm inputs. The anticipated yield is estimated on the basis of the statistical data and the results of the farm household survey, as shown below. The unit yield will gradually increase to reach the anticipated yield 5 years after starting operation.

(Unit: ton/ha)

Crops	Present	Target
Wheat	2.8*-1	5.5
Cotton	2.5	3.5
Potato	28.0	33.0
Watermelon	30.0	35.0
Other Fruit Bearing Vegetables	32.0*-2	45.0
Edible Leafy and Stem Vegetables	25.0*-3	27.0
Green Legumes	7.5	15.0
Olive	1.8	3.5
Other Fresh Fruits (Grape)	11.8*-4	15.0

Note: *-1; Weighted average of wheat, barley oats and rye.
*-2; Weighted average of tomato, pepper and cucumber.
*-3; Weighted average of cabbage, leek cauliflower and lettuce.
*-4; Weighted average of peach, apple, pear and mandarins

The annual crop production at the full development stage is estimated based on the anticipated yield mentioned above and the cropped area as shown in Table 2.2.2, and summarized below.

(Unit: ton)

Crops	Present Condition					Future with Project Condition				
	Beydağ	Aktaş	Burgaz	Ergenli	Total	Beydağ	Aktaş	Burgaz	Ergenli	Total
Cereals	2,720	1,320	2,770	2,580	9,390	4,240	1,070	4,020	3,850	13,180
Cotton	10,650	950	3,650	3,500	18,750	16,170	1,370	4,310	4,060	25,910
Tobacco	890	100	80	70	1,140	-	-	-	-	-
Potatoes	79,800	1,400	1,400	1,400	84,000	101,640	6,440	8,250	7,590	123,920
2nd Potatoes	28,200	2,000	-	-	30,200	43,120	5,460	0	0	48,580
Other field crops	1,540	-	480	430	2,450	-	-	-	-	-
Fodders	6,480	-	2,280	2,280	11,040	13,860	1,170	3,420	3,420	21,870
Watermelon	52,200	4,800	10,200	9,900	77,100	53,900	6,830	17,150	16,450	94,330
Summer vegetables	49,600	2,240	8,000	7,360	67,200	138,600	5,850	32,850	31,500	208,800
2nd vegetables	14,000	1,750	3,750	3,500	23,000	83,160	5,270	30,240	29,160	147,830
Green legumes	-	-	-	-	-	23,100	1,950	5,850	5,550	36,450
Olives	670	70	1,940	1,840	4,520	-	-	2,070	1,960	4,030
Figs	2,270	-	110	110	2,490	-	-	-	-	-
Other Fruits	3,780	-	3,420	3,300	10,500	23,100	1,950	9,600	9,000	43,650

(6) Livestock Production

Animal husbandry is one of the main economic activities in the Study Area, The number of cattle has slightly increased while those of sheep and goats have hardly increased in recent years. This is mainly due to the low farmgate prices of livestock products and the high cost of commercial feed. Most farmers are, accordingly, reluctant to engage in livestock production. Only a limited number of large livestock breeders are engaged in commercial livestock farming through productivity improvement by alternating the domestic breeds with the improved ones.

Most of the farm households in the Study Area, keep a small number of livestock for their home consumption, supplemental daily income by selling the marketable surplus and farm manure in a traditional way. They are expected to continue breeding livestock in their households. According to the recent trend, the rearing number of cattle will slightly increase in the future. Therefore, the fodder crops are slightly increased in the proposed cropping patterns, mainly for the cattle breeding (Annex E).

(7) Marketing of Products

After the implementation of the Project, crop production will increase in the Study Area. The marketing aspect of the crops is expected as shown in the following table;

Crops	Present Production	Future Production	Market
Cereals and Fodder	9,400 tons for cereals and 11,000 tons for fodder	13,200 tons for cereals and 21,900 tons for fodder	Mainly local consumption, fodder substituting for commercial feeds
Cotton	18,800 tons	25,900 tons	Selling to ginneries operated by agricultural sales cooperatives or privates in and around the Project area
Potatoes	114,200 tons	123,900 tons	Partly for local consumption and mainly for domestic markets in large cities
Olive	4,500 tons	4,000 tons	A small part for local consumption and mostly for oil extraction factory (domestic and export market)
Watermelon, vegetables, green legumes, grapes, fruits	177,800 tons	531,100 tons	A small part for local consumption, mostly for domestic and export markets in the form of fresh or processed products

Regarding vegetables and fruits, the domestic market is expanding, particularly in the western coast region where economic activities are developing. Regarding the export market, mainly for Europe and the Gulf areas, the country's exports had grown at rate of about 3% per annum during the period of 1987 to 1992, and are still increasing. This situation is influencing the trend of production. The production of vegetables and fruits in the mid 1990s was estimated at about 5 million tons in the Aegean region and 18 million tons in the whole country. The production shows an annual increase rate of 2% to 3%, and is expected to reach more than 7 million tons in the Aegean region and 30 million tons in the whole county in future. Considering regional and national production in future, the size of the market for vegetables and fruits is large enough to commerce produce from the Study Area.

(8) Project Benefit

The gross production value is estimated on the basis of the financial price level in mid 1995. The total production value of the four project areas will increase from TL3,116 billion under the present condition to TL5,986 billion under the "future with project" condition, as shown in Table 2.2.3 and summarized below.

(Unit: TL Billion)

Condition	Beydağ	Aktaş	Burgaz	Ergenli	Total
Present Condition	2,157	142	417	400	3,116
With Project Condition	3,846	298	944	898	5,986
Increment (Increase Rate)	1,689 (78%)	156 (110%)	527 (126%)	498 (125%)	2,870 (92%)

2.2.6 Irrigation Development Plan

(1) Delineation of the Irrigation Area

(a) Beydağ Irrigation Area

The Beydağ dam will command an agricultural area extending from the eastern edge of the alluvial plain to Ödemiş town. The area will be bordered on the north and south by the main canals which will be aligned on both sides of the Küçük Menderes river. The water level of the canals should be so designed as to have a sufficient head for water conveyance when the lowest water level of the Beydağ reservoir is at EL.182.55 m. The western part will be bordered by an existing tributary, which will be so selected as to have an equivalent command area irrigable by storage water of the proposed Beydağ reservoir (Figure 2.2.7).

(b) Aktaş Irrigation Area

The command area of the Aktaş dam will be a cultivation field located in the western part of Ödemiş town, extending from the gorge of the Aktaş river to the Küçük Menderes river. The area will be bordered on the north by the main canal, of which the water level was planned to be around EL.150 m where water flows down through the proposed diversion canal from the lowest water level of the Aktaş reservoir at EL.328.0 m. The western and eastern parts will be bordered by an existing tributary, which will be so selected as to have an equivalent command area irrigable by storage water of the proposed Aktaş reservoir.

(c) Burgaz Irrigation Area

The command area of the Burgaz dam will be a cultivation field located in the eastern part of Bayındır town, extending from the gorge of the Degirmen river to the Küçük Menderes river. The area will be adjacent to the command area of the Ergenli dam on the west and bounded on the north by the main canal, of which water level was set at around EL.100 m to have a sufficient head for water conveyance when the lowest water level of the Burgaz reservoir is at EL.115.87 m. On the south and west, it will be bordered by the Küçük Menderes river and Degirmen river respectively.

(d) Ergenli Irrigation Area

The command area of the Ergenli dam will be a cultivation field located in the south-eastern part of Bayındır town, extending on the right bank of the Mica river from its gorge to the Küçük Menderes river. On the east, the command area will be adjacent to the command area of the Burgaz dam. It will be bordered on the north by the main canal, of which the water level was set at around EL.100 m to have a sufficient head for water conveyance when the lowest water level of the Burgaz reservoir is at EL.134.5 m. The Küçük Menderes river will form the southern boundary of the area.

(2) Irrigation Method

Modernized irrigation methods, such as sprinkler irrigation and drip irrigation, should be widely introduced under this development plan, in order to save irrigation water effectively.

The sprinkler method would be applied for cultivation of cotton, fruit and vegetables, while an adjusted sprinkler or drip method would be used for leaf vegetable cultivation.

The present surface irrigation method will be applied continuously for winter crops and olive. The modernized irrigation methods shall be introduced with the first priority for steep areas and high permeable areas. The possibility of introduction of the sprinkler and drip irrigation methods were confirmed through the irrigation experiment conducted during the field survey period.

(3) Irrigation Water Requirements

(a) Estimation of Reference Evapotranspiration (ETo)

Three methods, Pan Evaporation, Blaney-Criddle and Modified Penman can be used for estimating ETo in the Study, considering the availability of necessary meteorological data in and around the river basin. Comparing the results given by each method, the Blaney-Criddle method was selected for estimation of ETo in the Study, because the method gave the mean value among the three, and its application has been authorized in Turkey for a long time.

Annual ETo was calculated at 1,326.4 mm based on the meteorological data of the Ödemiş station which is the best among the stations concerned. The Turkish application of the Blaney-Criddle method was adopted for the calculation of the above ETo value.

(b) Crop Coefficient

The water requirements for each crop could be estimated by multiplying ETo by the crop coefficient (K_c) of the respective crops. As to K_c, the values authorized in Turkey were utilized in the Study.

(c) Effective Rainfall

Effective rainfall for cultivation of crops was calculated monthly, referring to the relation between monthly rainfall and monthly effective rainfall formulated through a long experience, as shown below. Such a relation curve was utilized in the Study.

(Unit: mm)

Monthly rainfall	0.0	25.0	50.0	75.0	100.0	125.0	150.0	175.0	-
Monthly Eff.Rainfall	0.0	25.0	46.0	67.0	84.0	96.0	102.0	104.0	104.0

(d) Present Irrigation Water Requirements

Considering the irrigation conditions mentioned above, the present irrigation water requirements were calculated in accordance with the present cropping pattern. The present annual average of crop water requirements was calculated at 560.4 mm, as summarized below:

(Unit: mm)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep	Oct	Nov	Dec
Present Water Requirement	0.2	0.9	6.7	36.6	114.1	124.9	118.2	99.2	45.9	11.3	2.1	0.3

Note: An irrigation efficiency of 0.6 is applied for all crops. Irrigation water for olive is assumed to account for 40% of the total calculated value, taking into consideration the present situation.

(c) Estimated Irrigation Water Requirements

(i) Beydağ and Aktaş dam areas

The irrigation water requirements in the proposed plan for the Beydağ dam and Aktaş dam located in the Ödemiş region were calculated according to the proposed cropping pattern, which was prepared referring to the present soil and land use conditions. The annual average irrigation requirements were calculated to be 617.8 mm for the Beydağ dam area and 606.1 mm for the Aktaş dam area, and their monthly apportionments are as follows (Table 2.2.4):

(Unit: mm)

Irrigation Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Beydağ dam	0.2	0.3	2.1	10.9	67.8	113.6	122.4	163.6	97.8	34.0	4.9	0.3	617.8
Aktaş dam	0.3	0.4	4.1	17.1	61.2	97.6	117.1	164.5	99.7	37.0	6.7	0.5	606.1

Note: An overall irrigation efficiency of 0.78 is applied taking a weighted average of 0.58 for surface irrigation, 0.78 for sprinkler irrigation and 0.98 for drip irrigation.

(ii) Ergenli and Burgaz dam areas

The irrigation water requirements in the proposed plan for the Ergenli dam and Burgaz dam were calculated according to the proposed cropping pattern which was prepared referring to the present soil and land use conditions. The annual average irrigation requirements were calculated to be 638.8 mm for both cases, and their monthly apportionments are as follows (Table 2.2.4):

(Unit: mm)

Irrigation Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ergenli dam and Burgaz dam	0.2	0.4	3.9	15.9	65.0	117.8	140.4	168.5	95.5	28.8	2.2	0.3	638.8

Note: An overall irrigation efficiency of 0.78 is applied taking a weighted average of 0.58 for surface irrigation, 0.78 for sprinkler irrigation and 0.98 for drip irrigation.

(4) Irrigation Facilities

The proposed irrigation system will broadly consist of main canals , distributaries and on-farm facilities. The main canal will generally be of pipeline. Closed conduits will be used for construction of distributaries branching off from the main canal. At the head of each tertiary canal, a booster pumping station will be built in order to provide necessary pressure for sprinkler and drip irrigation. The booster pump will be installed on a bypass conduit so that water can flow by gravity when surface irrigation is applied. The sprinkler and drip irrigation equipment should be of the removable type, because it should be removed when not needed.

General features of the irrigation system in each project area are summarized as follows:

(i) Beydağ Dam Area

The irrigation system will be composed of 2 main canals, as shown in Figure 2.2.4. The right main canal will be 30.5 km long and have a discharge capacity of 5.92 m^3/sec at its head, while the left main canal will have a length of 28.5 km and a discharge capacity of 3.63 m^3/sec.

(ii) Aktaş Dam Area

Irrigation water will be diverted from the dam site and conveyed to an irrigation system through a diversion canal. The irrigation system will be composed of 2 main canals, as shown in Figure 2.2.4. The left main canal will have a length of 3.0 km and a discharge capacity of 0.54 m^3/sec at its head, while the right main canal will have a length of 4.0 km and a discharge capacity of 0.25 m^3/sec.

(iii) Burgaz Dam Area

The irrigation system will consist of 2 main canals, as shown in Figure 2.2.4. The left main canal will have a length of 8.0 km and a discharge capacity of 2.01 m^3/sec at its head, while the right main canal will have a length of 6.0 km and a discharge capacity of 1.08 m^3/sec.

(iv) Ergenli Dam Area

Irrigation water will be diverted from the dam and conveyed to the irrigation system through a diversion canal of the concrete flume type. The major facility of the irrigation system is the right main canal aligned upstream of Bayındır town as shown in Figure 2.2.4. The main canal will have a length of 10.0 km and a discharge capacity of 2.93 m^3/sec.

2.2.7 Drainage Development Plan

According to the data on groundwater tables observed by DSİ-II at 45 stations in the Küçük Menderes river basin, the groundwater tables in the river basin stay more than 10 m below the ground surface, and it is understood that there would be no sub-surface drainage problems in the river basin except the Torbalı - Selçuk area, where the groundwater tables come up to the ground surface in the rainy season. Considering these groundwater conditions, therefore, only surface drainage is taken into consideration in the Study Area. Even in the Torbalı - Selçuk area, there are few areas which will need the sub-surface drains, because there are no more swamplands except some areas around the mouth of the Küçük Menderes river owing to the drainage works done by DSİ.

The purpose of surface drainage is to remove excessive surface water. This includes runoff due to rainfall, surface runoff due to on-farm irrigation losses, and operational waste from the irrigation water supply system. However, design capacities in the proposed drainage system will be decided on the basis of excess rainfall, because it is in a different class from

others in water volume. The drainage system should consist of a main drain, which is the Küçük Menderes river, secondary drains, which are tributaries flowing into the main drain, and tertiary drains, which will be newly constructed canals flowing into the secondary drains.

2.2.8. Environment Conservation Plan

(1) Water Quality

(a) Surface Water

According to the result of the water quality analysis mentioned in Paragraph 2.1.10-(2), the river water at the identified dam sites does not have any quality problem for its use for irrigation and drinking purposes. However, the quality of surface water in the lower reaches of the Küçük Menderes river is deteriorating due to an inflow of waste water from houses, factories , and mines in the river basin. In addition, the load to the surface water caused by application of chemical fertilizer and agro-chemicals is becoming heavy in the farmlands. The following actions should therefore be taken for the conservation of water quality in the river basin:

(i) The waste water from houses, factories and mines should be treated before its release to the rivers. Since there is no plan for the conservation of water quality in the Küçük Menderes river basin, a detailed assessment of the present condition and establishment of a program for water quality conservation needs to be done by DSİ.

(ii) Following the farming practices proposed in Paragraph 2.2.5-(4), chemical fertilizers and agro-chemicals should be applied properly in both quantity and timing under the guidance of well-trained extension workers.

(iii) In the feasibility study, the possibility and magnitude of chemical fertilizer and agro-chemical impact should be assessed based on the results of comparison for their accumulations between the present and the "future with project" conditions.

(b) Groundwater

At present, the groundwater being used in most of the irrigation schemes has no serious quality problem for its use for irrigation and drinking purposes in the Küçük Menderes river basin as mentioned in Paragraph 2.1.10-(2). In order to prevent groundwater from future possible contamination caused by the application of chemical fertilizers and agro-chemicals, the same countermeasures as that for the surface water mentioned above should be taken immediately.

(2) Ecosystem

For maintenance of the present ecosystem in the Küçük Menderes river basin, the main concerns are endangered flora and fauna. In this river basin, however, most of these flora and fauna mainly exist out of the potential land taken for irrigation development as mentioned in

Section 2.2.2, and therefore no major damage of the present ecosystem is expected even after the completion of the envisioned irrigation projects, except in the Eleman wetland.

The Eleman wetland with a total area 1,500 ha is located in the lower most reaches of the Küçük Menderes river. Out of this total area, about 500 ha consisting of two lakes, wetland, and hilly areas is considered to be more important for the birdlife and fishery than the remaining 1,000 ha which has been used as agricultural land mainly in the dry season. This ecologically important area is directly receiving water from springs but not from the Küçük Menderes river. Therefore, any remarkable negative impact will not be caused on the ecosystem in this area even after project implementation, which will cause environmental changes mainly on the downstream reaches of the Küçük Menderes river due to decrease of river flow due to construction of the four dams and deterioration of water quality due to use of chemical fertilizers and agro-chemicals.

(3) Watershed Management

Based on the soil erosion hazard classification made in Paragraph 2.1.10-(4), the following guidelines are proposed for each classified land in order to conserve the watershed of the Küçük Menderes river basin.

(i) Class I : No risk

Most of the Class I area is covered by flat alluvial plains which are cultivated with horticultural and cereal crops. The main practices for soil and water conservation in the area consist of maintenance and improvement of the soil fertility by proper farm management, proper leveling, application of irrigation water, and improvement of the water logging condition. In addition, crop rotation is necessary to maintain soil fertility.

(ii) Class II : Low risk

Most of the Class II area is occupied by gentle to moderately sloping areas where tree crops are predominant. Bench terracing would be most effective for soil conservation in these areas. Well laid-out bench terraces can prevent erosion and increase water infiltration on slopes of up to 35%. The selection of the sites, which should have a sufficient soil depth for tree growth, is important to build up the bench terraces.

(iii) Class III : Moderate risk

Most of the Class III area is occupied by moderately sloping areas which are covered with forest or grass. Proper forest and grassland management is most important to prevent soil erosion in these areas. Introduction of fodder crops to the lowland area and rotation of grazing areas are necessary to reduce the pressure of overgrazing in the grasslands. In addition, an important treatment for these areas is to prepare good lands including the application of fertilizers and the mixture of nutritious grasses such as legumes and herbs. In the forest area, weeding, thinning and pruning are essential for the establishment of good growth.

(iv) Class IV : High risk

Most of the Class IV area is occupied by moderately to steeply sloping areas which are covered with bush or bare land. These areas are major sources of sediments and erosion debris reaching the lower parts. Afforestation is most useful for the reclamation of these areas. In the case of extremely poor subsoil, parent material or deep gullies, however, a tentative planting of shrubs should be adopted.

In total, 14 soil conservation projects have already been implemented or planned to be implemented by DSİ-II. In addition, around 14,400 ha are planned to be afforested in the basin by MOF by the year 2000. These projects are reasonable, because the project areas are mainly concentrated in the high risk areas from the viewpoint of soil erosion. In addition to the above projects, the improvement of farming practices or pasture management in coordination with MARA should be taken into account to prevent soil erosion even in low risk areas.

(4) Cultural and Historical Assets

According to the information from the General Directorate for Preservation of the Cultural and National Heritage, most historical and cultural assets exist in hilly areas or at higher elevations, but not in the alluvial plain in this river basin. According to the land use plan mentioned in Paragraph 2.2.5-(2), the hilly area and the higher elevation areas are excluded from the priority areas for irrigation development. Therefore, eventual negative impact to the cultural and historical assets is considered to be almost nil.

(5) Others

(a) Protected Area

Around 1,620 ha has been registered or is planned to be registered as protected areas in the river basin, and all these areas are excluded from the proposed irrigation development areas in order to preserve the ecosystem and the recreational areas as mentioned in Section 2.2.8-(2).

(b) Mineral Resource

There is one mercury mine near the Beydağ dam site. Regarding surface water pollution by the contamination of the drain running from the mine, countermeasures will be planned in the Feasibility Study on the basis of the results of water quality analysis.

The thermal spring, which is located close to Ergenli dam site and being used by villagers, will be submerged after the completion of the dam. Therefore, it is necessary to provide some countermeasure for this matter. Since it is difficult for the villagers to find other sources of thermal springs near the present one, the spring water needs to be led from the present well through a pipeline system to the location where the villagers want to construct the thermal spring facilities.

(c) Public Health

Water-borne diseases are not reported in the basin. Therefore, no negative impact would occur after the completion of the proposed irrigation development projects.

2.3 Development Cost

2.3.1 Conditions of Cost Estimate

The project cost is estimated based on the following conditions:

(i) The exchange rate used in the estimate is US$1 = TL50,000 = ¥100, which was prevailing in October 1995.

(ii) The cost for civil works is estimated referring to the costs estimated by DSİ for other projects such as Beydağ, Alaçotı, Yortanlı and Çaltıkoru Projects after converting these costs to the 1995 prices using the DSİ's conversion table.

(iii) The cost for the irrigation distribution system, such as the sprinkler and drip irrigation system, is estimated on a very preliminary basis, referring to the costs estimated in the Feasibility Study on Beydağ Irrigation Project mentioned in Part III hereof.

(iv) The cost for land acquisition in the reservoir area is estimated based on the actual unit price used for the Beydağ reservoir area after converting this price to the 1995 price using the DSİ's conversion table.

(v) The project administration cost required during the construction period is estimated at 10% of the direct construction cost.

(vi) A physical contingency of 10% of the direct construction cost is included in the project cost.

(vii) No price contingency is included in the project cost because of the vagueness of future price escalation.

2.3.2 Estimated Cost

The total project cost is estimated at TL17,570.3 billion for the four projects, comprising TL8,861.6 billion for the Beydağ Project, TL992.3 billion for the Aktaş Project, TL3,949.5 billion for the Burgaz Project, and TL3,766.9 billion for the Ergenli Project. A cost breakdown is as shown below:

Item	Beydağ Dam	Aktaş Dam	Burgaz Dam	Ergenli Dam
1 Dam Construction Cost				
1.1 Dam	2,138.5	380.2	1,668.1	1,627.7
1.2 Land Aquisition	637.0	56.2	143.5	104.2
1.3 Administration	213.9	38.0	166.8	162.8
1.4Physical Contingency	298.9	47.4	197.8	189.5
Sub-total	3,288.3	521.8	2,176.2	2,084.0
2 Irrigation & Drainage				
2.1 Irrigation & Drainage	4,550.4	384.1	1,447.9	1,374.0
2.2 Land Aquisition	61.1	5.2	19.4	18.4
2.3 Administration	455.0	38.4	144.8	137.4
2.4 Physical Contingency	506.7	42.8	161.2	153.0
Sub-total	5,573.2	470.5	1,773.3	1,682.8
Total	8,861.6	992.3	3,949.5	3,766.9

2.4 Project Evaluation

2.4.1 General

A preliminary economic evaluation is carried out for the four selected priority projects, Beydağ, Aktaş, Burgaz, and Ergenli Projects, in order to assess their economic feasibility. Economic evaluation is made on the basis of the following basic assumptions:

(i) The economic useful life of each project is 50 years.

(ii) All prices are expressed in mid 1995 constant prices.

(iii) The construction period is 4 years for all dams and surface irrigation systems, and 3 years for upgrading of existing groundwater irrigation systems to be used for the project purpose.

2.4.2 Economic Cost

The project cost to be used in the economic evaluation consists of construction cost, annual O & M cost, and replacement cost. The economic project cost is obtained by deducting the transfer payment from the financial cost and applying the standard conversion factor.

In the estimation of the economic cost, particularly for the Aktaş and the Ergenli Projects, a part of the dam construction cost needs to be allocated to the municipal water supply scheme, because these dams will be constructed for a dual purpose: irrigation of their own command areas and municipal water supply to Ödemiş town in the case of the Aktaş dam, and to Bayındır town in the case of the Ergenli dam. The cost to be allocated to the municipal water supply scheme is the construction cost of the alternative dam to be constructed for exclusive municipal water supply.

The cost of land acquisition in the reservoir area is calculated as the land value of the public assets. The loss of crop production in the proposed Beydağ reservoir is calculated as the negative benefit. A summary of the economic construction cost is as shown below (Annex-K).

(Unit:TL billion)

Items	Beydağ	Aktaş	Burgaz	Ergnli
1. Dam construction cost				
Direct construction cost	1,790.6	202.6	1,396.7	1,105.6
Land acquisition	254.8	14.3	57.4	26.5
Administration	179.1	20.2	139.7	110.6
Contingency	222.4	23.8	159.4	124.3
Sub-total	2,446.9	260.9	1,753.2	1,367.0
2. Irrigation & drainage				
Direct construction cost	3,840.9	324.2	1,222.1	1,159.8
Land acquisition	24.4	2.1	7.8	7.4
Administration	384.1	32.4	122.2	116.0
Contingency	424.9	35.9	135.2	128.3
Sub-total	4,674.4	394.6	1,487.3	1,411.4
Total	7,121.3	655.5	3,240.5	2,778.4

The annual O & M cost and replacement cost are also calculated based on the financial cost of each irrigation scheme, as shown in the following table (Annex-K).

(Unit:TL billion)

Items	Beydağ	Aktaş	Burgaz	Ergnli	Rmarks
1. O & M Cost*					
Surface water irrigation	45.0	3.8	14.6	13.9	
Groundwater irrigation	23.0	2.0	7.1	6.6	
Total	68.0	5.8	21.7	20.5	
2. Replacement Cost					
Valves	206.5	17.2	66.8	63.8	Every 25 years
On-farm equipment	1,230.1	102.5	398.0	379.9	Every 7 years
Pumps	8.9	0.7	2.9	2.7	Every 10 years
O&M equipment	49.4	4.1	16.0	15.3	Every 10 years
Total	1494.8	124.6	483.7	461.7	

Note; *: The financial cost is estimated at US$97/ha.

2.4.3 Project Benefit

The economic prices of tradable goods are estimated on the basis of the world market prices forecasted by the World Bank for the long term or past trade records of Turkey. Non-tradable goods are valued at the financial prices estimated on the current market prices and farm gate prices. Tradable goods are wheat, cotton, tobacco, olive and fertilizers. Other commodities are classified as non-tradable goods. Labor cost is assessed at 50% of the financial price.

The irrigation benefit will accrue primarily from the increased crop production owing to a stable irrigation water supply from the dam reservoirs and groundwater in the optimum volume allocated to the schemes, improvement of drainage conditions, and introduction of water saving cultivation methods. The irrigation benefit is defined as the difference in the net production value between the "future with project" and "future without project" conditions. The irrigation benefit will start to accrue immediately after the completion of the project facilities, and then, will reach full development after 5 years. The annual irrigation benefit at the full development stage is summarized in the following table.

Project	Total Area	Total Value under Present Condition	Total Value under Without Project Condition	Total Value under With Project Condition	Incremental Benefit
	(ha)	(TL billion)	(TL billion)	(TL billion)	(TL billion)
Beydağ	15,400	1,148.3	757.4	2,545.3	1,787.9
Aktaş	1,300	67.6	44,8	198.6	153.8
Burgaz	4,900	218.5	162.9	634.7	471.8
Ergenli	4,650	208.0	154.1	603.1	449.0

In the above estimate of the project benefit, particularly in the "future without project" condition, the area presently irrigated mainly with groundwater should not be totally taken into account as the irrigated area under the "future without project" condition, because the groundwater table is currently lowering due to the intensive use for irrigation purposes. It is assumed that in the "future without project" condition, the groundwater discharge for irrigation

will be controlled to 64% of the current volume, in order to balance the pumping volume with the annual recharge as mentioned in Sub-chapter 2.2. Therefore, the current irrigated area is expected to decrease and instead, the rainfed area will increase. Consequently, the total net production value under the "future without project" condition will be reduced by 25 - 34% compared to the present level.

In the economic evaluation, it is noted that in the case of Beydağ Project, about 1,300 ha of existing farmland, consisting of 800 ha of irrigated land and 500 ha of rainfed land, will be submerged by the reservoir after the construction of the Beydağ dam, and the loss of the production value in this submerged area is counted as a negative benefit in the economic evaluation. This negative benefit would amount to TL12.6 billion per annum at the present value.

2.4.4 Economic Evaluation

On the basis of the project cost and benefit estimated above, EIRR for each project is calculated, and the benefit-cost ratio (B/C) and the net present value (NPV) are also calculated using a discount rate of 5%. The results are summarized below.

	Beydağ Dam Area	Aktaş Dam Area	Burgaz Dam Area	Ergenli Dam Area
Net Area (ha)	15,400	1,300	4,900	4,650
EIRR (%)	14.8	14.1	8.5	9.5
B/C	2.09	2.05	1.40	1.49
NPV (TL Billion)	12,004	1,025	1,752	1,932

The results of the preliminary economic evaluation indicate that all four projects are economically sound with an EIRR higher than 8%. Among these four projects, the Beydağ Project shows the highest economic viability in all three indicators, followed by the Aktaş, Ergenli, and Burgaz Projects.

2.5 Development Priority and Implementation Program

2.5.1 Assessment of Development Priority of the Projects

According to the results of the study on the prospective land and water resources development plan mentioned in Sub-chapter 2.2, the following four projects, with a total net irrigation area of 26,250 ha, are identified as the promising projects for irrigation development in the Küçük Menderes river basin:

(i)	Beydağ Project	15,400 ha
(ii)	Aktaş Project	1,300 ha
(iii)	Burgaz Project	4,900 ha
(iii)	Ergenli Project	4,650 ha
	Total	26,250 ha

The construction cost of these projects would amount to about TL17,600 billion, which is extremely bigger than the DSİ-II's annual budget for project implementation, TL1,200 billion. In order to develop these projects with such a huge construction cost in a practical way, it is necessary to prepare a staged development plan from the budgetary viewpoint. For the formulation of this plan, an assessment of development priorities of the respective projects is first made based on the following criteria:.

(i) The project with the highest EIRR is given the highest ranking of "A".

(ii) The project with a largest number of beneficiaries is given the highest ranking "A".

(iii) The project in which the present annual income per household is the lowest, is given the highest ranking "A", considering the regional balance of welfare.

(iv) The project which is located nearest to İzmir is given the highest ranking "A", from the viewpoint of marketability.

(v) The project in which the existing infrastructure required for the construction work is well developed, is given the highest ranking "A".

(vi) The project of which implementation will not give any negative impact to the environment, is given the highest ranking "A".

(vii) The project for which the government development plan is most matured, is given the highest ranking "A".

(viii) The overall evaluation is made by giving the highest priority to the government policy, followed by the economic viability, the annual income per household, and the number of beneficiaries; the ranking is from I (highest) to IV (lowest).

Based on the above criteria, all the projects are assessed and the results are shown in the following table:

	Items	Beydağ	Aktaş	Burgaz	Ergenli
(i)	Economic viability	A	B	D	C
(ii)	Number of beneficiaries	B	A*	D	C*
(iii)	Annual income per household	A	B	D	C
(iv)	Marketability	B	B	A	A
(v)	Infrastructure	B	D	C	A
(vi)	Impact on the environment	A	A	A	A
(vii)	Government development plan	A	B	D	C
	Overall Assessment	I	II	IV	III

(Note) *: Including not only the farmers but also the beneficiaries of municipal water supply.

2.5.2 Project Implementation Schedule

As mentioned above, a huge construction cost will be required to complete all the four projects, and it would be difficult for the Government to arrange sufficient budget for the construction of all the projects at the same time. It is proposed, therefore, to implement the projects one by one following the above-mentioned priority order. Assuming that each project will require 7 years on an average including the survey and design periods, the total implementation period would be around 30 years.

PART - III

FEASIBILITY STUDY ON THE BEYDAĞ IRRIGATION PROJECT

3.1 Present Condition of the Project Area

3.1.1 Location and Administration

The Project Area covers about 19,600 ha in gross in the Ödemiş plain along the Küçük Menderes river, within North latitudes 38° 6' 26" to 38° 14' 28" and East longitudes of 27° 52' 30" to 28° 13' 20". The area is located about 70 km to 100 km southeast of İzmir city; the capital of İzmir province in the Aegean Region in western Turkey.

The administrative units under province (İl) are district (ilçe), sub-district (bucak), municipality (belediye), and village (köy). A municipality of district center, called Şehir, is a capital of district and categorized as urban areas in the Study. Other municipalities and villages are categorized as rural areas. The Project Area mainly extends in Ödemiş district (92% of the area), and partly Beydağ district (3%) and Tire district (5%). Only several villages are geographically located totally inside the Project Area, but many farmers in the surrounding villages and municipalities are cultivating farmlands in the Project Area. Accordingly, six municipalities including two district centers and 28 villages are administratively included in the Project Area. Of these municipalities and villages, two district centers are categorized as urban areas in the Study, and another four municipalities and 28 villages are categorized as rural areas. The list of municipalities and villages are shown below:

District (İlçe)	Sub-District (Bucak)	Municipality (Belediye)/Village (Köy)
Beydağ	-	Şehir* (District Center)
	Merkez	Alakeçili, Halıköy, Sarıkaya, Yağcılar, YukariTosunlar
Ödemiş	-	Şehir* (District Center)
	Merkez	Büyükavlucak, Demircili, Gerçekli, Gereli, Karakova, Ocaklı, Seyrekli, Yolüstü)
	Bademli	Emirli, Mescitli
	Birgi	Kışlaköy
	Kaymakçı	Kaymakçı*, Araşarlı, Çaylı*, Ertuğrulköy, Eselli, Kızılcaavlu, Kurucaova, Türkönü), Yeşilköy
	Ovakent	Ovakent*, Balabanlı, Bozcayaka, Kazanlı, Konaklı*
Tire	Gökçen	Kızılcaavlu, Yeğenli

Note; *: Municipality (Belediye), more than 2,000 population.

The Project Area occupies 35% of the total administrative areas of the three districts as shown below:

District	Beydağ	Ödemiş	Tire	Total
Number of Villages and Municipalities	6	26	2	34
Administrative Area	7,300 ha	45,500 ha	3,300 ha	56,100 ha
Project Area (Gross ha)	600 ha	18,000 ha	1,000 ha	19,600 ha
% of the Project Area in Administrative Area	8%	40%	30%	35%

3.1.2 Population and Labor Force

According to the Population Census 1990, the total population in the Project Area is 92,400 composed of 57,500 (62%) in urban areas and 34,900 (38%) in rural areas. The population growth rate during the 1985-1990 period was 1.78% per annum in urban areas, and minus 0.64% in rural areas, averaging 0.82% in the whole Project Area. This population growth rate is lower than the national average. This indicates the out-migration from the Project Area, particularly from the rural area. It is estimated that the population will increase from 96,900 in 1995 to 102,200 in 2000, assuming the same growth rate would be maintained in the future also. The main indicators of Population Census are shown in Table 3.1.1 and summarized below:

Item	Beydağ	Ödemiş	Tire	Total	Turkey
Total population (1990)	7,800	82,500	2,100	92,400	-
- District centers	5,800	51,600	-	57,400	-
- Villages and municipalities	2,000	30,900	2,100	35,000	-
Annual growth rate (1985 to 1990)	1.30%	0.83%	-1.18%	0.82%	2.17%
- District centers	2.59%	1.69%	-	1.78%	2.18%
- Villages and municipalities	-2.04%	-0.51%	-1.18%	-0.64%	-0.56%

The economicly active population in the Project Area is estimated at about 43,800, or 47% of the total population in 1990. The unemployment rate is 7.8% in the urban area and 0.7% in the rural area averaging 4.1% in the whole Project Area. Although the agricultural sector provides occupations for 81% of the economicly active population in the rural areas, only 22% of the economic active population in the urban areas are engaged in agriculture, because other occupations than the agriculture predominate, particularly in the two district centers of Beydağ and Ödemiş. Thus, about 23,200 persons are engaged in the agriculture sector in the total administrative areas of three districts, and more than half of them are deemed to be in the Project Area. The employment and occupational status in the Project Area is shown in Table 3.1.2 and summarized below:

Item	District Centers	Villages/Municipalities	Total
Population ≥ 12 Years Old	45,400	27,300	72,700
Economic Inactive Population	24,600	4,300	28,900
Economic Active Population	20,800	23,000	43,800
Unemployment	1,600 (7.8%)	200 (0.7%)	1,800 (4.1%)
Occupation: Agriculture	4,500 (21.6%)	18,700 (81.3%)	23,200 (52.9%)

3.1.3 Natural Conditions

(1) Topography

The Project Area, with a gross irrigation area of 19,600 ha, extends in the east-west direction on both banks of the upper reaches of the Küçük Menderes river. The area is bounded by mountain skirts on both north and south and by the Rahmanlar river on the west,

and gradually diminishes its width towards the East to about 1 km.

The Project Area is mainly occupied by the undulating terraces along the mountain skirts, Piedmont alluvial plains in a large part of the area, and alluvial plains along both banks of the Küçük Menderes river, all of which are being used as farmlands. The area, being dissected by small tributaries, slopes down towards the Küçük Menderes river at an average gradient of 0.4 ~ 0.6% on the right bank area, and 0.6 ~ 1.0% on the left bank area, and also slopes down westwards at an average gradient of 0.2%. There are several mounds having the heights of 50 ~ 110 m in the Project area.

(2) Geology

(a) General Geology

In the Beydağ - Ödemiş Area, the core part of Menderes Massif composes the rock basement. Those rock types are mainly such highly metamorphosed rocks as gneiss, leptite, and micaschist sometimes with marble, and partly such intrusive rocks such as granite and amphibolite. In one or two parts of the southern mountainous area, mica-quartz schist is found accompanied by mass gneiss (Figure 2.1.1).

Gneiss is usually hard and massive, and sometimes forms augen-structure, while leptite is relatively hard, medium grained and well-schistose rock. Marble is also hard and massive, but sometimes a lot of cracks develop in it. In the case of micaschist, it is generally well-weathered and soft, but its inner part is relatively hard.

On the other hand, alluvial deposits fill the graben of basement rocks in the plain area, the maximum thickness of which is more than 200m. Their composition is usually sand to silt, bearing a lot of mica-fragments. As is the tendency of the soil distribution, gravelly soil sometimes distributes along the stream line, and as apart from the stream, silty soil gradually develops. Besides, around the foot of the mountains, a large number of cobbles and boulders with sand and silt distribute widely as fan deposits. In general, soil is well-consolidated and relatively dense. Permeability seems to be relatively high because of the main composition being usually sandy silt.

The faults directing East-West and North-South are developing in the Project Area. In general, those directing East-West run along the Southern mountain foot and constitute the horst between the Büyük Menderes river basin and the Küçük Menderes river basin, while those existing northward from the above direct to the Gediz river basin.

Near Emirli köy on the left-bank side extending in the east-west direction along the above mentioned fault, a mercury ore mine exists.

(b) Geology along Canal Routes

Along the Right Main Canal, a few kilometers of uppermost stream are composed of an alternation of marble and micaschist. In the next section of 20 - 25 km, the geology on the mountain side is composed of soil for about one-third of the section, and the rest is of rock

mass of leptite, while the geology on the plain side is of soil for almost the full length. The soil in this section is generally micaceous. After this section, the first 7 - 8 km runs along the border between hard rock and sediment, and then fan deposits are distributed to the end of the canal route. The fan deposit on the upstream side is composed of gravelly, silty sand, bearing cobbles boulders gravel and micaceous silt, and that on the downstream side is silty soil (Figure 3.1.1).

Along the Left Main Canal, the geology in a few kilometers of the uppermost stream consists of fan deposits composed of sandy silt bearing cobbles and boulders. In the next section of 35 km, micaschist and gneiss are predominant along the mountain scarp and partly quartz-micaschist is found. The geology on the plain side is of soil, and that on the downstream side is of fan deposit and/or alluvium or residual soil. The fan deposit is generally of silty sand bearing gravel , and the other is of light brown sandy silt and reddish brown fine soil derived from weathered micaschist and mica-quartz schist. After those sections, mica-quartz schist and gneiss exist in the mountain side. On the plain side, gravel-bearing silty sand of fan deposit is mainly found in the upstream side, and light brown sandy silt exists on the downstream side.

(c) Construction Materials

According to the results of feasibility studies made by DSİ for the Beydağ dam, embankment materials such as impervious materials, semi-pervious materials, pervious materials and rock materials for the dam construction exist around the dam site (Annex B).

As the basements of canals, ground and excavated materials along the canal routes are usually less water tight, and therefore they may need lining in case of open canals.

Enough volume of marble is found at the quarry site located at the right bank side of the Beydağ dam, which is good for coarse aggregates and can be used for the concrete structures of the dam and canal lining after crushing. As for the fine aggregates, crushed materials of the above-mentioned marble or washed sand taken from the Küçük Menderes river or its tributaries will be used for the concrete works.

(3) Soil and Irrigation Suitability of Land

(a) Soil

DSİ-II conducted soil survey in the Project Area in 1971 and 1987 in order to clarify the irrigation suitability and drainage condition. In these surveys, however, the DSİ-II expert did not conduct the soil classification following the US soil taxonomy, because the main purposes of these surveys were to clarify the irrigation potential of the Project Area following the Land Suitability System of US Bureau of Reclamation (USBR).

According to the soil classification report prepared by the Department of Tropical Soil Science, Agricultural University, the Netherlands in 1972, the soils in the Project Area are classified into two orders, four suborders, four great groups and five subgroups, namely, Aquic Xerochrept, Typic Xerofluvent, Typic Xeropsamment, Typic Xerochrept and Lithic

Xerorthent. The characteristics of the soils are shown in Annex-D.

Considering the relationship between the results of soil survey made by DSİ-II and the data of the above soil classification, the areas of respective soils are illustrated on Figure 3.1.2 and their area extents are estimated as follows:

Soil Classification	Area (ha)	Proportion(%)
Aquic Xerochrept	1,400	7
Typic Xerofluvent	12,100	63
Typic Xeropsamment	1,500	7
Typic Xerochrept	3,000	15
Lithic Xerorthent	600	3
Village yards and Road	600	3
Riverbed	400	2
Total	19,600	100

(b) Irrigation Suitability

Based on the soil survey report prepared by DSİ-II, the irrigation suitability classification was carried out in order to assess the land resources potential for irrigation in the Project Area. This classification work was done following the USBR system which is mentioned in Paragraph 2.1.3-(6).

The soil texture, rock content, topographic condition, soil depth, drainage condition and soil fertility are taken into consideration as the specifications for the land classification prepared by DSİ-II. Based on these specifications, the areas of respective suitability classes are illustrated on Figure 3.1.3 and their area extents are estimated as below:

Suitability Class	Area (ha)	Proportion(%)
Class I	12,100	62
Class II	2,600	13
Class III	400	2
Class IV	-	-
Class V	2,900	15
Class VI	600	3
Village yards and Road	600	3
Riverbed	400	2
Total	19,600	100

Of 19,600 ha of total area classified, around 15,100 ha, or 77%, which is included in the Classes I to III, is judged to be suitable for irrigation farming, and 2,900 ha or 15%, which was included in Class III in the master plan study made in Part-II of this report, was identified to be Class V, because the detailed survey done by DSİ-II clarified that 1,400 ha are affected by residual salts brought by high groundwater table before 1985, and 1,500 ha are being affected by floods from the Küçük Menderes River. These areas would, however, be improved by the drainage improvement to be made under the Project, and will be included in the suitable classification. Class VI soils are not suitable for agriculture except grazing due to sallow soil and steep slope in the hilly area.

3.1.4 Rural Infrastructures

(1) Road and Transportation

There are four important roads running through the Project Area: National Road No.310, Provincial Road No 35-32, No.35-33 and No.35-36. National Road No.310 connects the Project Area to İzmir via Ödemiş which is the chief city in the Project Area. This road runs in the east-west direction almost along the northern boundary of the Project Area. Provincial Road No.35-32 runs southwards starting from Ödemiş and connects to Bademli via Ovakent. Provincial Road No.35-33 branches off from National Road No.310 near Kaymakçı and runs to Beydağ. Provincial Road No.35-36 runs almost along the southern boundary of the Project Area and joins Provincial Road No.35-32. All the roads mentioned above are asphalt-paved and well maintained.

In addition to the above trunk roads, there are many village roads with a total length of 320 km consisting of 210 km of asphalt-paved roads, 80 km of gravel-metalled roads and 30 km of earth roads, crisscrossing farm roads. These present road conditions in the Project Area would not require any additional road construction under the Project.

The Project Area is also connected to İzmir by the rail way extending to Ödemiş, which is operated five times a day.

(2) Domestic Water Supply

Although almost all the cities and towns in the Project Area are equipped with pipe systems for domestic water supply, people in the villages are getting water directly from groundwater wells or springs. At present, the quantity of supply is enough in all villages except two, which are planned to be provided with the pipe line system by GDRS.

(3) Community Center

At almost all the municipalities, they have city halls and meeting rooms in the mayors' offices, and they hold meeting using these facilities. As for the villages, they have various meetings and gatherings at the cooperative offices or tea houses located in the villages. Judging from these present situations, there would not be any necessity for the construction of new community centers in all the municipalities and villages in the Project Area.

3.1.5 Agriculture

(1) Land Holding and Land Tenure

There are 6 municipalities and 28 villages totally or partly included in the Project Area, of which six villages are located in the Beydağ district, 26 in the Ödemiş district, and two in the Tire district. In these villages there are about 15,800 farm households in total, of which about 60%, or 9,300 households, are cultivating their farmlands within the Project Area, because most of the villages are located across the border of the Project Area and the farmers in these villages have farmlands outside the Project Area.

The average farm size is about 1.7 ha in the Project Area, which is smaller than the average of 2.5 ha in the whole river basin. Of the total farm households, 50% are small farm households having 1.0 ha or less, and 44% are in the range of 1.0 - 5.0 ha. Larger households having more than 5.0 ha account for only 6% of the total farm households. The farm size distribution is as shown below (Annex-E).

(Unit: household)

District	> 1.0 ha	1.0 - 1.9	2.0 - 4.9	5.0 - 9.9	10.0 ha <	Total	Average size
Beydağ	833 (52%)	439 (26%)	291 (17%)	61 (4%)	19 (1%)	1,643 (100%)	1.21 ha
Ödemiş	7,012 (51%)	4,309 (31%)	1,853 (13%)	565 (4%)	85 (1%)	13,824 (100%)	1.59 ha
Tire	19 (5%)	57 (15%)	128 (35%)	135 (37%)	31 (8%)	370 (100%)	6.12 ha
Total	7,864 (50%)	4,805 (30%)	2,272 (14%)	761 (5%)	135 (1%)	15,837 (100%)	1.66 ha

Note: The figures in this table show total municiaplities and villages totally or partly included in the Project Area.
Source: Provincial Office of MARA, İzmir.

Farming type is categorized into three types of husbandry by combination of crops and livestock. About 55% of farm households are engaged in both crops and livestock husbandry, and 44% are engaged only in crops production. The farm households working only for livestock raising represent only 1% in the area as shown below (Annex-E).

(Unit: household)

District	Crops & Livestock	Crops only	Livestock only	Total
Beydağ	1,401 (85%)	95 (12%)	47 (3%)	1,643 (100%)
Ödemiş	6,982 (51%)	6,781 (48%)	61 (1%)	13,824 (100%)
Tire	165 (4%)	205 (55%)	0 (0%)	370 (100%)
Total	8,548 (55%)	7,081 (44%)	108 (1%)	15,837 (100%)

Note: The figures in this table show the total municipalities and villages totally or partly included in the Project Area.
Source: Provincial Office of MARA, İzmir.

The present land tenure situation in the Project Area shows that about 88 % of farm households are owner farmers and about 5 % are tenant farmers. Remaining 7% are share croppers who cultivate owners' lands to share products with the owners.

(Unit: household)

District	Owner Farmer	Tenant Farmer	Share Cropper	Total
Beydağ	1,564 (95%)	29 (2%)	50 (3%)	1,643(100%)
Ödemiş	11,986 (87%)	693 (5%)	1,145 (8%)	13,824(100%)
Tire	370(100%)	0 (0%)	0 (0%)	370(100%)
Total	13,920 (88%)	722 (5%)	1,195 (7%)	15,837(100%)

Note: The figures in this table show the total municipalities and villages totally or partly included in the Project Area.
Source: Provincial Office of MARA, İzmir.

(2) Land Use

The preliminary land use map in the Project Area was prepared based on the

topographic map on a scale of 1:25,000 and through aerial photo interpretation. The present land use situation shown in this preliminary map has been checked through field survey and based on the topographic map on a scale of 1:5,000. The distribution of land use pattern was further confirmed through the analysis of statistic data from MARA. As a result, six land use categories were identified in the Project Area. These land use categories are defined as follows:

Land Use Category	Definition	Remarks
Annual crops	Area cultivated with field crops and vegetables	The area includes fallow land.
Tree crop yards	Area cultivated with tree crops under irrigation or rainfed condition	-
Pasture and grasslands	Area covered with grasses for grazing livestock	-
Urban and village yards	-	Small isolated houses are not included.
Roads	All roads including the right of way	Footpaths in the field are not included.
Riverbeds	Riverbeds and seasonal streams	-

On the basis of the above definitions, the present area for each land use category is estimated as follows (Figure 3.1.4):

Land Use Category	Area (ha)	Proportion (%)
Agricultural land		
- Annual crops	15,700	79
- Tree crops	2,300	12
Pasture and grasslands	600	3
Village yards	300	2
Roads	300	2
Riverbeds	400	2
Total	19,600	100

Of the total area of 19,600 ha, some 18,000 ha, or 92%, is used for agricultural purposes, excluding livestock grazing, at present in the Project Area. Therefore, it is understood that the potential area to be included in the Project has totally been developed for agricultural purpose. Most of the annual cropping areas have been developed in the flat to gentle sloping lands of the west part of the alluvial plain and in non-dissected fans, while tree crops are grown on both banks of the Küçük Menderes river and in the gently sloping area of the Project Area. Pasture and grasslands, which occupy only about 600 ha, or 3%, of the Project Area, mainly extend over the hilly lands. Most village yards exist in the dissected fans of the Project Area.

(3) Crops and Cropping Pattern

The Project Area is mainly included in the Ödemiş district and partly in the Beydağ and Tire districts. The average cropped areas in the recent five years in the three districts are shown in Table 3.1.3. The cropped area in the Project Area is estimated on the basis of statistic data and the results of field survey and interviews. The total cropped area is estimated at 17,420 ha

in a year, comprising 15,460 ha of annual crops and 1,960 ha of perennial crops, which is correspondent to 113 % of cropping intensity against the net farmland of 15,400 ha as shown in below (Figure 3.1.5).

Crop	Area (ha)	Proportion
Cereal	970	6%
Cotton	4,260	28%
Tobacco	1,110	7%
Potato	2,850	18%
Fodder	540	4%
Other field crops	320	2%
Watermelon	1,740	11%
Summer vegetable	1,550	10%
2nd potato	1,410	9%
2nd vegetable	560	4%
Olive	370	2%
Fig	420	3%
Other fruits	320	2%
Poplar (log wood)	850	6%
Others	150	1%
Total cropped area	17,420	113%
Total net farm land	15,400	100%

Cotton is one of the important crops in the Project Area, prevailing 4,260 ha, or 28%, of the total farmland. Cotton is planted in February to March; at the end of the winter season, and picked from September to November.

Potatoes are another dominant crop in the Project Area, particularly in the Ödemiş plain. Total cropped area is 4,260 ha or 27% of the area, composed of 18% of the first crop and 9% of the second crop. The first potatoes are planted in early spring and harvested in early summer, and the second potatoes are planted at the end of summer. Some farmers plant the second potatoes immediately after the first ones because of their higher profitability, despite extension workers worry about the increase of soil diseases caused by continuous cropping.

Various vegetables are planted in 3,850 ha, or 25%, of the area. Of this vegetable area, watermelons grow in the largest area of 1,740 ha, which corresponds to 11% of the total cropped area. These are the most popular fruit-bearing vegetables, and are differentiated as "Bostan", together with melons, from other vegetables in the country. Among the other vegetables, cucumbers have a larger cropping area. Leafy and root vegetables are grown in a limited area. Green legumes are recently expanding as the second crops planted in the summer season.

Olive trees are mainly grown on the mountain slopes surrounding the Project Area and are not found in a large spot within the Project Area. The olive trees in the area are generally as old as 200 - 300 years and their productivity is low. Therefore, the olive yards are gradually decreasing. Due to low profitability, the cultivation area of fig orchards is also decreasing. Other fruit trees such as grapes, cherries and peaches are grown in the mountainous area rather than in the plain area. Irrigated poplar plantation for log production is often observed in the Project Area particularly along the Küçük Menderes river, but this area is decreasing because of a recent price decline.

(4) Crop Yields and Production

Unit yields of the main crops in the Project Area are estimated based on the statistics, field information and farmers' household survey and are shown below.

Crop	Yield (ton/ha)	Crop	Yield (ton/ha)
Wheat	3.0	Watermelon	30.0
Barley	2.5	Tomato	35.2
Cotton	2.5	Pepper	20.7
Tobacco	0.8	Cucumber*	11.8
Potato	28.0	Cabbage	40.2
2nd Potato	20.0	Olive	1.8
Maize	4.8	Fig	5.4
Alfalfa	12.0	Grape	11.8

* : Cucumbers include the varieties for pickles. The yields of the varieties for fresh fruits are estimated at more than 20 tons/ha.

Based on the cropped area and the crop yield mentioned in the above, the production of main crops in the Project Area is estimated at about 2,700 tons of wheat, 10,700 tons of cotton, 890 tons of tobacco, 108,000 tons of potatoes, 52,200 tons of watermelons, 52,000 tons of vegetables, as mentioned below.

Crops	Area (ha)	Yield (ton/ha)	Production (ton)
Cereal	970	2.8*1	2,720
Cotton	4,260	2.5	10,650
Tobacco	1,110	0.8	890
Potato	2,850	28.0	79,800
2nd Potato	1,410	20.0	28,200
Fodder	540	12.0*2	6,480
Watermelon	1,740	30.0	52,200
Summer Vegetable	1,550	22.6*3	35,030
2nd Vegetable	560	30.4*4	17,020
Other Field Crops	320	4.8*5	1,540
Olive	370	1.8	670
Fig	420	5.4	2,270
Other Fruits	320	11.8*6	3,780

Note: *1; Average yields for wheat and barley
*2; Yield of alfalfa
*3; Average yields for tomato, peppers and cucumbers
*4; Average yields for cabbages, cauliflowers and leeks
*5; Yield of maize
*6; Average yields for grapes, peaches and apples

(5) Farming Practices and Farm Inputs

The farming works are usually carried out by farm families, but most farmers hire labors for planting, inter-cultivating (weeding) and harvesting, among which cotton harvesting (picking) requires the maximum labors. Land preparation, seeding of cereals, cotton and potatoes, harvesting of cereals and potatoes, and transportation of inputs and outputs are done by tractors with attachments, while other farming works are manually done.

About 66% of tractors have a working capacity of 35 - 50 HP, and 18% of them have more than 50 HP. The tractors are owned at the rate of one per eight farm households in Ödemiş district, 18 farm households in Beydağ district and three farm households in Tire district. Therefore, the average farmland per tractor is 13 ha in Ödemiş, 26 ha in Beydağ and 11 ha in Tire. Although the tractors are also used in the neighboring farmers on custom operation basis, the capacity of tractor seems to be exceeding the requirement in the Project Area.

Farmers usually use seeds and seedlings certified by the Government. Main varieties of the major crops are listed in Table 3.1.4. The main sowing seasons for these major crops are early to middle spring, while the second crops like potatoes, some vegetables and forage crops are sown in late summer, and cereals are sown at the end of autumn.

Chemical fertilizers popularly applied in the Project Area are compound 20-20-20, compound 15-15-15, ammonium nitrate, ammonium sulfate, urea, TSP, and potassium sulfate. The standard dosage of fertilizers for major crops is tabulated in Table 3.1.4, though the dosage largely fluctuates by farmers. The average amount of fertilizer annually applied for the total cultivated area in the Ödemiş district is estimated at 540 kg/ha of fertilizer containing 21% of nitrogen , 190 kg/ha of 17% phosphate fertilizer, and 40 kg/ha of 50% potassium fertilizer, according to the data from MARA. These amounts are considerably high compared to the average of the whole river basin (310 kg, 120 kg and 20 kg respectively). This is mainly due to high consumption in the larger cropping areas of potatoes and vegetables. On the other hand, the total amount of manure available in the area seems to be insufficient compared to the standard dosage. Farmers who are able to produce or procure manure generally apply it at the rate of about 2 - 5 ton/ha in a year or once in two years.

Various kinds of agro-chemicals are applied for crop protection. Insecticides made from organic phosphate, carbonate, chloride, fungicides and herbicides are commonly used in the area. However, the quantity and timing of application are not adequate despite the repeated advice of extension workers.

The cropped area has been widely irrigated by pumping groundwater. Irrigated crops are mainly cotton, potatoes, watermelons and several vegetables. The furrow irrigation method is predominant in the area, Recently, however, due to the rise of irrigation cost resulting from the lowering of the groundwater table, irrigation is not practiced sufficiently as it should be.

Generally, farmers are liable to concentrate on growing high profitable crops and often neglect the proper crop rotation. Some farmers plant the second potatoes on the same field after harvesting the first potatoes, or other farmers grow cotton on the same field every year. Thus, in view of keeping soil fertility high and protecting plants from diseases, improper cropping patterns are often practiced in the area.

Table 3.1.5 shows the typical farming practices prevailing in the Project Area, which are recognized based on the various reports and the results of farmers' household survey and field survey.

(6) Livestock and Fishery Production

Major livestock in the Project Area are cattle and sheep, and goats are raised only in a few villages as shown below (Annex-E).

District	Cattle			Sheep			Goat		
	Heads	House-holds	Heads per house-hold	Heads	House-holds	Heads per house-hold	Heads	House-holds	Heads per house-hold
Beydağ	2,645	317	8	2,719	50	54	45	1	45
Ödemiş	24,851	4,839	5	19,701	253	78	1,662	14	119
Tire	795	135	6	1,190	15	79	100	1	100
Total	28,291	5,291	5	23,610	318	74	1,807	16	113

Source: Provincial Office of MARA, İzmir.
Remark: The figures in this table show total villages in and adjoining the Project Area.

In the Project Area, about 33 % of farm households are rearing cattle. Only 2 % of farm households are rearing sheep and goats. As for cattle, the rearing size is very small; 1-4 heads by 64% of rearing households, and 5-10 heads by 27% of rearing households. On the other hand, the rearing size of sheep is rather large; 10-50 heads by 45 % of rearing households, and 50-100 heads by 36% of rearing households. Cattle are raised near the farm to produce small scale sales of milk (including dairy products) or meats mainly for home consumption. Eighty-three percent of the rearing households raise cattle for milk production and only 3% for meats production. Sheep are kept in high mountain areas in the summer season and in the villages in the winter season.

Based on the average heads of animals raised in the past 5 years, annual livestock production in the Project Area is estimated at about 20,000 tons of milk, 1,000 tons of meats and 1,000 tons of cheese.

There is no fishery production in the Project Area because of no perennial water bodies available for fishing.

3.1.6 Irrigation and Drainage

(1) Irrigation Water Sources and Irrigation Area

The irrigation water source in the Project Area depends almost all on groundwater. The Project Area has largely two groundwater basins: around Beydağ-Kaymakçı and around Ödemiş. These basins are part of the aforesaid Ödemiş-Tire Groundwater Basin. The thickness of alluvium in the former basin is a little more than 100 m, and more than 250 m in the latter basin at maximum.

During the field survey, an inventory survey was made on existing wells in the Project Area, and clarified that the number of existing wells in the area is more than 2,000 as shown below.

Item	Number of well
Private irrigation well	
- Identified	2,095
- Unidentified	75
Cooperative irrigation well	31
Drinking water supply well	42
Destroyed well	59
Total number of wells	2,302

Based on the above survey, it is estimated that about 51 MCM of groundwater may be pumped annually from these wells mainly for irrigation purposes, of which approximately 11 MCM is supplied for the use of irrigation cooperatives, and approximately 40 MCM is for private use.

The private wells are concentratedly located around Mescitli and Yeğenli at a density of more than 30 wells/km^2, while that in the other area is usually in between 10 - 30 wells/km^2. The power source for the pump equipment is electricity for 89.5% of the total wells, and the remaining are still operated by gasoline engines. The groundwater table usually stays around 20 m to 25 m below the ground surface along Küçük Menderes River, but it becomes deeper gradually away from the river, and it reaches more than 40 m below the ground surface around Ödemiş. Until 1992 the lowing of the groundwater table was remarkable along the hill foot slope reaching up to 30 to 40 m below the ground surface, while that along Küçük Menderes River was not so big.

Based on the results of this survey, the area which has been irrigated during the summer season, though insufficiently, is estimated at 9,200 ha as shown in following table:

Category	Number of well	Net irrigation area (ha)
Private irrigation	more than 2,000	8,500 *
Cooperative		
- Kaymakçı	1	60
- Büyükavlucak	5	80(170)
- Küçükavlucak	7	10(160)
- Yolüstü	12	350
- Konaklı	6	200
Sub-total	31	700
Total	more than 2,000	9,200

Note: *; This irrigation area consists of 5,500 ha irrigated by farmers' own wells and 3000ha irrigated through buying water.

About 25 % of farmers in the Project Area have their own wells and irrigate their farmlands of 5,500 ha according to the results of the survey. In addition to these areas, the farmlands owned by the farmers who have no wells have been unsteadily irrigated with insufficient water obtained from well owners. Generally, the farmers who have not wells and get irrigation water from their relatives or buy water from neighbors, irrigate their farmlands with a smaller quantity of water as far as possible, because it is their burden to buy water. The water price varies from TL 20,000 to TL 125,000 for 1-hour irrigation through a 3" pipe, which depends upon their locations. There are particular cases that farmers buy irrigation water from remote owners located more than 2-km away because of problems in water price or personal relations.

In case of planting cotton, farmers explained that four or five times of 7-hour irrigation were given to their farmlands per 0.1 ha in a crop season. As this amount of irrigation water is equivalent to an irrigation depth of 550 mm at maximum, it seems that they irrigate their farmlands saving water to less than 70 % of the normal irrigation water requirements which were estimated at 822 mm by DSİ-II in the feasibility study of the Beydağ Dam Project. From this fact, the present total of the irrigated area is estimated at around 8,500 ha in the Project Area, although it holds some water stress in irrigation.

(2) Irrigation System

No public irrigation system other than those of irrigation cooperatives exists in the Project Area. The majority of irrigation systems in the area consist of a well and 3" delivery pipe, which are privately installed and operated. Five irrigation cooperatives exist within the Project Area as mentioned above. Several numbers of medium-sized well pumps with a capacity of 20 ~ 30 lit/sec and a related pipeline system having 150 ~ 250 mm diameter subsist in each cooperative.

Besides these existing cooperatives, two additional cooperatives of Küçükavlucak-II (40ha) and Yolüstü-II (150 ha) were planned to be established in 1995.

(3) Irrigation Method

The furrow irrigation method has been practiced in most of the Project Area, and border and basin irrigation methods have also been practiced in a very limited area, especially for tree crops.

As to the furrow irrigation practice, a ready-made 3" PVC pipe having several outlets has been widely used, which can easily be connected to an existing well. The furrow direction and length are decided so as to reach water sufficiently to the end of the furrow without wasting much water.

Five sample areas of 25 ha each were selected in the field survey to identify the actual situations of the furrow length and farm plot size. The furrow length and farm plot area were measured in the sample areas on the topographic maps with a scale of 1:5,000, and the measured results were checked in the fields. According to the result of this survey, farmers generally take direction of furrow in parallel with contour lines in a steep area, and not in parallel with contour lines in a flat area. The results of the measurement of furrow length and farm plot size are summarized as follows:

Length of Furrow of the Farmland in the Project Area (m)

Item	Sample1	Sample 2	Sample 3	Sample 4	Sample 5	Overall
Land gradient	1/186	1/260	1/200	1/116	1/173	
Average	74.83	87.00	73.13	111.10	113.14	86.56
Mode	95.00	75.00	80.00	120.00	150.00	80.00
Max.	140.00	160.00	160.00	270.00	180.00	270.00
Min.	38.00	35.00	22.00	20.00	30.00	20.00
St.deviation	26.82	27.16	31.92	64.15	47.20	46.19

Farm Plot Size in the Project Area (ha)

Item	Sample1	Sample 2	Sample 3	Sample 4	Sample 5	Overall
Average	0.72	0.84	1.05	0.95	1.02	0.91
Mode	1.04	0.24	0.25	1.50	0.48	0.48
Max.	2.09	2.08	3.30	4.03	2.86	4.03
Min.	0.12	0.21	0.10	0.08	0.16	0.08
St.deviation	0.45	0.44	0.99	0.72	0.74	0.70

(4) Drainage Condition

Excess water in a plain area and runoff from a mountainous area flows down to the Küçük Menderes river through its tributaries, which exist at intervals of 3~5 km on average. Existing roads partly act as drains, where the road surface is shaped by a concave cross section, due to insufficient capacities of the tributaries. The Küçük Menderes river, which is a major flood way of the Project Area, meanders in the lowland having various cross sections. However, no serious flood damage has been caused since 1981, because some river training works along the Küçük Menderes river have been made by DSİ and extreme floods have never occurred.

Any noticeable drainage courses are not found on-farm level. Farmers try to catch rainfall effectively for crop water consumption in farmlands. At the time of the feasibility study of the Beydağ Dam Project carried out by DSİ in 1986, 1,034 ha of farmlands needed the provision of sub-surface drains because of the high groundwater level of less than 1.0 meter below the ground surface. During the recent decade, however, the groundwater table has lowered more than 10.0 meters due to the over pumping of groundwater, and the problem of sub-surface drainage has been dissolved, though almost all shallow wells located along the Küçük Menderes river have been hindered from normal operation by such lowering of the groundwater table.

3.1.7 Agricultural Support Services and Farmers' Organizations

(1) Agricultural Extension and Farmers' Training

Agricultural extension and farmers' training in the Project Area are dealt with by the District Agricultural Offices of Ödemiş, Beydağ and Tire. The activities of extension and training are carried out mainly through the Agricultural Extension and Applied Research Project (AEARP, TYUAP) assisted by the World Bank. The numbers of extension staff in these offices are summarized below.

(Unit: persons)

Experts	Beydağ	Ödemiş	Tire	Total
Director	1	1	1	3
Agricultural engineer	3	8	5	16
Veterinarian	1	2	3	6
Agricultural technician	3	11	11	25
Veterinary technician	2	6	7	15
Other staff	6	14	8	28
Total	16	42	35	93

Source: Provincial Office of MARA, İzmir.

Several programs for extension and training are prepared and carried out every year by

the above extension staff. The provincial office provides financial and technical assistance to their activities. The main projects for extension services in the recent years are:

(i) Agricultural extension application and research project

(ii) Second crops development project (potatoes, fodder, legumes, etc.)

(iii) Orchard management project (grapes, peaches, plums, figs, etc.)

(iv) Livestock development project (promotion of vaccination and fodder production, etc.)

Under these projects, various demonstrations and training have been conducted in farmers' fields. By TYUAP, the extension workers obtain technical assistance through field experiments conducted by the Agricultural Research Institute at Menemen.

During the period from 1995 to 1999, the provincial government will finance funds for the projects on effective irrigation systems in some districts including Ödemiş, Beydağ and Tire. Under these projects, irrigation system using drip, sprinkler and mini-sprinkler methods will be examined.

In order to strengthen the system for crop protection from diseases and insects, the provincial agricultural office is conducting KSD survey (investigations, identification and evaluation of damages and diagnosis of plant diseases), field tests on the optimum application of agro-chemicals, and investigations of seedlings for certification.

Besides these, a series of extension meetings, educational courses and incentive contests are organized for farmers throughout the year, together with distribution of various kinds of pamphlets to the farmers. Technical seminars for extension workers are sometimes held in and outside the Province.

Although extension workers are making their best efforts to conduct the extension programs, there still exist some problems mainly due to the financial shortage. For instance, only three local offices for village group technicians (VGT) have been established so far, though eight offices should have been established in the Ödemiş district under the plan, and there exists a shortage of training equipment such as video-cassettes, copy machines, and agricultural machinery for demonstration.

(2) Agricultural Cooperatives

The agricultural cooperatives are classified into three types, i.e., agricultural development cooperative, credit cooperative and sales cooperative. The agricultural development cooperative is further categorized into such three types as village development cooperative, irrigation cooperative and fishery cooperative, though there is no fishery cooperative in the Project Area. The number of existing agricultural cooperatives and their member in the Project Area are as shown below (Annex-E).

Item	Beydağ		Ödemiş		Tire		Total	
	No. of cooperative	No. of member	No. of cooperative	No. of member	No. of cooperative	No. of member	No. of cooperative	No. of member
Agricultural development cooperative								
- Village development cooperative	1	289	2	1,201	0	0	3	1,490
- Irrigation cooperative	0	0	5	980	0	0	5	980
- Fishery cooperative	0	0	0	0	0	0	0	0
Agricultural credit cooperative*1	2	951	6	3,279	0	0	8	4,230
Agricultural sales cooperative*2	0	0	3	2,558	3	3,206	6	5,764

Note: *1; The business territory is not limited to the village, in which the cooperative is located.
*2; The business territory is district-wide.

The village development cooperatives are established for better marketing of farm products. In the Project Area, three villages have this type of cooperative, but their activities are limited only to the process and sale of olive and milk of a small scale. The farmers are not aware of its substantial role that will bring more benefit to farmers by selling their products by themselves. This is shown by the phenomenon that farmers usually take two ways of selling their products, particularly for vegetables and fruits. One way is to sell the products to merchants in their fields before maturing, and the other is to sell the products at weekly markets in rural towns. Therefore, most of the farmers may not be conscious of the role of cooperatives in the sale of their farm products, and do not desire to establish such cooperatives.

Five irrigation cooperatives have been established by farmers for the operation and maintenance of the DSİ/GDRS-assisted groundwater irrigation schemes in the Project Area.

Eight villages in the Project Area have agricultural credit cooperatives, which provide credits for such farm inputs as fertilizers, agro-chemicals, and planting materials to the member farmers. Member farmers are living not only in those villages, but also in nearby villages.

Each district of Ödemiş and Tire has three kinds of agricultural sales cooperatives (so-called Tariş) to deal with three respective products; cotton, olive (oil and fruits) and figs. The cooperatives perform such activities as purchasing products from growers and grading them. These cooperatives are under the authority of the agricultural sales cooperatives union.

(3) Agricultural Credit

Agricultural credit sources for farmers in the Project Area are agricultural credit cooperatives and branch offices of the Agricultural Bank (Ziraat Bankaşi). In the province, there are 97 agricultural credit cooperatives as a whole, of which eight cooperatives are located in the Project Area (4 villages per cooperative on an average). These cooperatives were originally established to provide operation funds and inputs to small to average-sized farmers. However, currently large farmers are also utilizing credit from these cooperatives. In 1994, the number of member farmers in the Project Area was about 4,300, and the yearly loan amount was about TL70,000 million. The operation funds of the cooperatives were originally financed by the Agricultural Bank. It is estimated that generally 30% of loans were paid by cash, and 70% were paid in kind such as fertilizers, agro-chemicals, crop seeds, agricultural machinery, terminal irrigation facilities, etc. The upper limit of loan per farmer is TL120 million/year at

present. If farmers want to take more loan than the limit, they must directly apply to the Agricultural Bank.

Generally the Agricultural Bank has its branch offices in districts, and local farmers can get loans through those branch offices. The Agricultural Sales Cooperative Bank (Tariş Bank) also provides loans for farming through the agricultural sales cooperatives.

(4) Farm Inputs Distribution

There are about 15 private stores in the Ödemiş district and 5 stores in the Beydağ district dealing with farm input materials. Farmers can easily get farm inputs such as seeds, fertilizers, agro-chemicals, equipment and materials from these stores. In addition, the agricultural credit cooperatives supply those materials and equipment through the credit system as mentioned above.

The provincial office of MARA delivers the certified seeds of some crops and seedlings of fruits trees based on the farmers' request every year. Particularly for the seedlings of fruit trees, the Ödemiş Fruits Culture Production Station Directorate, operated by the provincial office of MARA, produces and distributes about 100,000 saplings of vines, peaches and apricots in and outside the Project Area. In addition, there are many private sapling nurseries in the Ödemiş district.

İzmir province is the biggest manufacturing center of agricultural machinery in Turkey. There are about 50 manufacturers in the province, which produce almost all kinds of agricultural machinery. Some manufacturers are also located in Tire, Torbalı and Ödemiş, and provide easy access to farmers for the procurement of machinery.

(5) Post-harvest, Agro-processing and Storage Facilities

The market channels of agricultural products are different by the kinds of products. As will be mentioned in Section 3.1.8, most potatoes, fresh fruits and vegetables are directly dealt with by merchants at farm fields or are sold at local weekly markets, except vegetables like cucumber for pickles. At present, there are a limited numbers of public storage facilities or processing facilities for these products in the Project Area. Considering these circumstances, it is desirable to establish storage facilities and processing factories for potatoes to produce potato-chips or starch, since potatoes are excessively produced these days. There are cold storages with a total capacity of about 35,000 tons for fresh fruits in İzmir.

In case of cotton, about one-third of the products are sent to the ginning factory of the district agricultural sales cooperative, and two-thirds to private factories. The agricultural sales cooperative in Ödemiş owns storage facilities with a total capacity of about 6,000 tons. There are about 15 private small-scale ginning factories in the Beydağ area. For olive oil, two village development cooperatives and four private companies operate processing factories. Ödemiş District Agricultural Sales Cooperative deals with about half of the olive produced in the area, and has a storage capacity of 40 tons. For dried figs, the dealing share of the district agricultural sales cooperative is very low, though the capacity of their storage is about 2,000 tons. There are ten private processing factories of figs in the Project Area. Cereal crops are

sold to TMO (Grain Marketing Board) and tobacco to TEKEL (Tobacco, Tobacco Products, Salts and Alcohol Industry). For cereals, there are some small-scale flour mills and storage in the town areas. The lack of storage facilities for potatoes, fresh fruits and vegetables seems to weaken the farmers' standing in marketing.

3.1.8 Marketing and Prices

The marketing of agricultural products in the Project Area is basically in the same situation as that in the whole river basin. Cereals and fodder are mainly for home consumption. Cotton, olive and figs are handled by TARİŞ. Potatoes, fresh vegetables and fruits are sold by merchants and the markets operated by municipalities.

The prices of agricultural products and inputs are generally bound by the seasonal fluctuation of production and market demand. Furthermore, the high rate of inflation heavily affects the price formation in the markets. The price escalation rate in the period from 1994 to mid 1995 is estimated at about 180% in terms of the consumer price index. This resulted in the discrepancy of the commodity prices at different points of time. The prices of agricultural commodities in the Project Area are estimated on the basis of the 1994 prices listed by the provincial agricultural office, the consumer price index, and the past trend of prices, and are shown in Sub-chapter 3.5 together with economic prices.

3.1.9 Farm Economy

(1) Crop Budgets

Crop budgets for the main crops in the Project Area are estimated on the basis of the yield, inputs and prices as shown below (Annex-F).

Crop	Condition	Yield (ton/ha)	Price (TL/kg)	Gross value (TL 1,000/ha)	Cost (TL 1,000/ha)	Net Value (TL 1,000/ha)
Cereals*	rainfed	2.8	7,200	22,660	12,040	10,620
Cotton	irrigated	2.5	45,300	113,250	31,420	81,830
Tobacco	rainfed	0.8	181,200	144,960	73,730	71,230
Potato	irrigated	28.0	7,500	210,000	48,060	161,940
Second Potato	irrigated	20.0	6,500	130,000	40,700	89,300
Fodder	rainfed	12.0	4,500	54,000	16,320	37,680
Watermelon	irrigated	30.0	5,400	162,000	33,690	128,310
Summer vegetables	irrigated	32.0	5,000	211,200	55,450	155,750
Second vegetables	irrigated	25.0	5,400	135,000	43,700	91,300
Olive	rainfed	1.8	19,400	34,920	23,600	11,320
Fig	rainfed	5.4	5,700	30,780	25,380	5,400
Other fruits**	irrigated	11.8	12,000	141,600	59,700	81,900

Note; * : Cereals include wheat, barley, oat and rye, and are represented by wheat.
** : Other fruits include mandarins, apple, pears and peaches, and are represented by fresh grape.

According to the above table, such crops as potatoes, vegetables and fruits show high profitability, but the wide fluctuation of prices brought about risk and instability in the farm economy. The Government provides the support prices for cotton, tobacco, olive and figs through SEEs and TARİŞ, and farmers tend to select those crops as main crops in order to stabilize their farm income.

(2) Farm Household Budgets

The present farm household budget is estimated taking the average farm household having 1.7 ha of farm lands. The estimate is made based on the results of the household survey and crop budgets mentioned in the above paragraph. In the estimation, self-consumption of crop products is counted as income, and family labors are valued in the production cost. The farm household budget thus estimated is as shown in the following table (Annex-F):

(TL million)

Item	Amount
I. Gross Income	
(1) Farm Income	
Crops	245.3
Livestock	18.2
Sub-total of (1)	263.5
(2) Off-Farm Income	14.7
Total of I	278.3
II. Expenditure (TL million)	
(1) Production Cost	71.8
(2) Living Expense	
Food	82.2
Education	22.2
Others	64.5
Sub-total of (2)	168.8
Total of II	240.6
III. Net Reserve (TL million)	37.7

According to the above table, the income of the household largely depends on the crop production, of which value amounts to TL 245.3 million or 88% of the gross income. Livestock and off-farm income is a supplemental income source. The expenditure is TL 240.6 million or 86% of the gross income. Therefore, the net reserve is limited to TL 37.7 million per household, and it is considered that this amount is not sufficient to improve the living condition of the farmers.

3.1.10 Environment

(1) Water Quality

(a) Surface Water Quality

DSİ-II conducted the water quality analysis at the proposed Beydağ dam site as shown in Table 3.1.6. Based on the Turkish water quality standard and the U.S.A. Salinity Laboratory Diagram, the water qualities at the dam site are categorized in Class I, and there would be no problem for its use for irrigation and drinking purposes.

(b) Groundwater Quality

DSİ-II conducted the groundwater quality analysis at 66 existing wells in the Küçük Menderes river basin in June 1995 in order to check the degradation of groundwater quality during the drought years after 1985. Of 66 wells, 11 wells exist in the Project Area and the

result of the water quality analysis is shown in Table 3.1.7. According to this table, most of the water samples show that the water can be used for both irrigation and drinking purposes, except two water samples collected at Ödemiş and Büyük Avlucuk located in the northern part of the Project Area. These two samples show boron contents, though permissible even to sensitive crops according to the Wilcox Diagram.

(c) Water Pollution Sources

The Study Team collected water samples from the lower reaches of the drain flowing from the mercury mine at Halıköy in the Beydağ district. Analysis of heavy metals contents, i.e., lead, mercury, zinc, copper and antimony, was requested of the DSİ-II laboratory for the same water samples and the results are as shown below.

(Unit : mg/l)

	Lead	Zinc	Mercury	Copper	Antimony	pH
Sample	0.107	0.510	0.002	0.104	0.498	5.2
Turkish Standard*	0.500	3.000	0.500	5.000	-	6.0-9.0

Note; * ; Wastewater Discharge Standard

The above table shows that the contents of all the heavy metals are within the Turkish standard of water quality except pH. Moreover, the water drained from the mercury mine does not flow into the proposed Beydağ dam reservoir due to the topographic condition.

In the upstream area of Beydağ dam reservoir, the main sources of water pollution are waste water from livestock and households in the Kiraz district, which flow into the river without any treatment. Under such conditions, the eutrophication of the dam reservoir will possibly be caused by the phosphorus (P), nitrogen (N) and chemical oxygen demand (COD) contained in the waste water after the construction of the dam. This impact of eutrophication will be evaluated in the further study.

In the Project Area, chemical fertilizer and agro-chemicals are applied to agricultural lands. Based on the present amount of applied farm inputs and cropping pattern in the Project Area, the present total amounts of nitrogen (N), phosphorous (P) and agro-chemicals would be 1,400 tons, 210 tons and 70 tons respectively, which are calculated on the basis of a unit application of 90 kg/ha of nitrogen, 13 kg/ha of phosphorous and 4 kg/ha of agro-chemicals respectively. The amounts of these farm inputs presently used in the Project Area are compared to the national averages of farm inputs in 1990 estimated by MARA; 70 kg/ha of nitrogen, 35 kg/ha of phosphorous and 1.2 kg/ha of agro-chemicals respectively.

According to the analyzed data of water quality of both surface and groundwater collected in the field survey period, degradation of water quality caused by nitrogen or phosphorus was not confirmed. Therefore, it is understood that the application amount of these chemical fertilizers are still within a limitation of a natural circulation system. Moreover, damage to human health or cattle caused by agro-chemicals are not reported in the Küçük Menderes river basin.

(2) Ecosystem

(a) Flora

According to the result of the present land use survey in the Project Area mentioned in Paragraph 3.1.5-(2), only 5% of the total Project Area, or 1,000 ha of land, is undeveloped, consisting of grasslands and riverbeds. In addition to the above area, 250 ha of forest and grassland areas exist in the proposed Beydağ reservoir area. According to the information from the Dokuz Eylül University in İzmir, the possibility of existence of endangered or vulnerable species is almost nil judging from the existing information and data.

(b) Fauna

Based on the check list for fauna in the Küçük Menderes river basin prepared by the Department of Biology, Middle-East Technical University, endangered or vulnerable species of mammals, fish, birds, reptile and amphibians are checked in the Project Area including the dam reservoir area in collaboration with Dokuz Eylül University. As a result, no endangered or vulnerable species are confirmed in the Project Area.

(3) Soil Erosion

(a) Soil Erosion Hazard

DSİ-II prepared the planning report for the five watershed management projects in the catchment area of the Beydağ dam. Of 43,680 ha of the total catchment area, 75%, or 33,040 ha, is covered by the scope of five projects. According to the present land use and slope classification mentioned in the planning report, the soil erosion risk is classified as shown below (Annex-L):

Erosion Risk	Area (ha)	Proportion (%)
Low risk	16,150	48
Moderate risk	7,500	23
High risk	7,820	24
Riverbed etc.	1,180	4
Built-up Area	390	1
Total	33,040	100

Of the total area of 33,040 ha, around 7,820 ha, or 24%, presents a high risk of erosion mainly due to steep slope without any forest covers.

(b) Watershed Management Project

Of the above five watershed management projects, two projects are still being implemented and three projects are waiting for implementation. The contents of the projects are as shown in Annex-L. The estimated cost is around TL 284,000 million at the 1995 price level. All the projects will be implemented in collaboration with the Ministry of Forestry (MOF) and GDRS. According to the planning report prepared by DSİ, MOF will conduct the reforestation and improvement of existing forest area, while GDRS will conduct the construction of rural roads related to the project areas.

Compared with DSİ's plan, the reforestation area to be actually implemented will become small, because local people don't want to change the land from existing grazing area or agricultural land to forest area. MOF has a responsibility for extension activity in the forest area. However, MOF, even DSİ and GDRS, has no extension activity for the improvement of soil erosion in the slope area in the agricultural and grazing lands. On the other hand, MARA, which has responsibility for the above extension activities, is not included in the said project activities and concentrates on the extension activity in the irrigated land in a plain area where the erosion risk is low.

(4) Cultural and Historical Assets

According to the information from the General Directorate for Preservation of the Cultural and National Heritage, seven cultural and historical assets exist around the Project Area. They are Kaymakçı (ancient city), Kızılcaavlu (ancient city and ancient castle), Emiril (ancient castle), Ovakent (ancient village), Konaklı (ancient village), and Balabanlı (ancient castle). Those cultural assets exist in the built-up area of villages located in hilly areas or at higher elevations than the alluvial plain. Moreover, no cultural and historical assets are reported in the proposed Beydağ reservoir area, also according to the information from the General Directorate for Preservation of the Cultural and National Heritage.

(5) Dislocation of People

According to the DSİ-II plan, most of the dwellers in Çiftlikköy and Karaman and part of the people in Bakırköy and Yenişehir need to be resettled in other places because of construction of the Beydağ storage dam, while people in Kurudere, Karaoba and Yağlar do not need to be shifted. According to the information from DSİ-II, the present land use in the proposed reservoir area is as follows:

Present Land Use	Area (ha)	Proportion (%)
Agricultural Land		
- Annual Crop	1,010	68
- Tree Crop	230	15
Forest and Public land	250	17
Total	1,490	100

Of 1,490 ha of the area to be submerged, 1,240 ha is private land and to be acquired under the project, and the remaining 250 ha is governmental land. Of 1,240 ha, 53 ha of the dam construction site has been acquired so far. The schedule of land acquisition is not definite due to a shortage of the government budget. Therefore, the detailed survey concerning the land owners, land value and people's intentions has not been conducted by DSİ-II.

After DSİ-II finishes the cost estimate of land value, the land committee, which is composed of five officers of district government office, Ministry of Finance, district office of MARA and DSİ, will be organized in order to examine the land value and play as a mediator between land owners and DSİ before the implementation of the land acquisition. If the owner or DSİ has a complaint about the mediation by the land committee, the case can be brought to the court under the "Land Acquisition Law" revised in 1983. The land value judged in the court will be the final.

3.2 The Project

3.2.1 Objectives and Scope of the Project

The main objectives of the Project are to irrigate 15,400 ha of net area of farm land by utilizing the available surface water and groundwater in an efficient way through provision of a modernized and water saving irrigation system, to introduce advanced farming practices to the irrigated area and to establish an effective system for water management and operation and maintenance of the project facilities.

In order to realize the above-mentioned objectives of the Project, the following scope of the Project is envisioned:

(i) Construction of an irrigation system consisting of main canals, secondary canals and tertiary canals in order to distribute water from the Beydağ storage dam to the irrigation area in an efficient manner.

(ii) Construction of a drainage canal system consisting of secondary canals and tertiary canals which will directly or indirectly lead excessive rain water and loss of irrigation water to the Küçük Menderes river.

(iii) Implementation of on-farm development, including the provision of an irrigation terminal system, such as sprinkler and drip irrigation facilities, quaternary drains, farm operation roads, land leveling, and land consolidation, if required.

(iv) Introduction of improved farming practices, including the selection of profitable crops and diversified cropping system, proper and timely application of fertilizers and chemicals, and improvement of post-harvesting and marketing system.

(v) Improvement of agricultural support services such as agricultural research, agricultural extension services and agricultural credit, and improvement of farmers' organizations such as village development cooperatives, agricultural credit cooperatives and agricultural marketing cooperatives,

(vi) Establishment of an effective water management and O&M system, including the establishment of water users' associations (WUA) and water users' unions (WUU), and

(vii) Monitoring and evaluation of irrigation, agricultural, and environmental aspects.

3.2.2 Potential Development Area

According to the result of irrigation suitability classification mentioned in Paragraph 3.1.3-(3), 15,100 ha included in Class I to III is judged to be suitable for irrigation farming under the present conditions. In addition to this area, 2,900 ha classified as Class V can be included in the suitable classification after the implementation of the Project because of

following reasons:

(i) Of 2,900 ha classified as Class V, 1,400 ha is affected by residual salts brought about by the high groundwater table before 1985. Judging from the information obtained through the interview of farmers, however, those lands can be considered as irrigable land, because a proper drainage condition will be provided through the construction of drainage facilities under the Project, and as a result, the residual salt would gradually be leached out. It is also judged that the possibility of salinity problems brought about by groundwater would be almost nil in future , because the groundwater table will not rise any more from the present one due to pumping balanced with groundwater recharge for the use of irrigation purposes.

(ii) The remaining 1,500 ha is affected by floods from the Küçük Menderes river and its tributaries. However, these lands will become suitable for irrigation farming, because the possibility of inundation by flood is almost nil in these areas after the implementation of the Beydağ dam and drainage improvement under the Project.

From the above-mentioned reasons, the irrigation suitability classification under the "future with project" condition will be changed from the present one to the following (Figure 3.2.1):

Suitability Class	Area (ha)	Proportion(%)
Class I	13,400	68
Class II	4,000	20
Class III	600	3
Class IV	-	-
Class V	-	-
Class VI	600	3
Village yards and Road	600	3
Riverbed	400	2
Total	19,600	100

According to the above-mentioned classification, about 18,000 ha included in Class I to III can be considered as the land resources potential for the Project. The priority of land development should basically be given to the Class I, followed by Class II and Class III, as far as the water resources potential allows.

3.2.3 Water Availability and Possible Irrigation Area

(1) Available Water Sources

(a) Groundwater

According to the result of the study on the groundwater potential made in Paragraph 2.2.3-(1), 160 MCM of groundwater would be available annually in the whole Küçük Menderes river basin. Based on this quantity, the available groundwater quantity in the Project

Area is estimated at 32.5 MCM per annum based on the ratio of groundwater basin area in the Project Area to that in the whole river basin.

(b) Surface Water

Although there run many tributaries of the Küçük Menderes river through the Project Area, no tributary can be developed economically as a water source for irrigation in the area. There are also some springs in the area, but these are already used for other irrigation areas than the Project Area and the water quantity available to the Project is negligibly small. Therefore, the available water source for the irrigation of the Project Area is only the Küçük Menderes river. According to the result of the hydrological study made in Paragraph 2.1.3-(3), the total runoff in a year is 76.6 MCM on an average for the period of the last 22 years at the Beydağ dam site having 444 km^2 of the catchment area.

(2) Possible Irrigation Area

Based on the available water resources mentioned above and the annual average water demand of 617.8 mm, for which detailed calculation is mentioned in Paragraph 3.2.5-(4), the possible irrigation area is obtained as follows, and the detailed calculation procedure and result are mentioned in Annex H.

(Unit: ha)

Irrigation Area by Surface Water		Irrigation Area by Groundwater		Total	
Net	Gross	Net	Gross	Net	Gross
10,200	(12,050)	5,200	(6,150)	15,400	(18,200)

3.2.4 Agricultural Development Plan

(1) Basic Concept for Agricultural Development

The present agriculture in the Project Area is relatively advanced, but its potential has not been used to the maximum extent, and therefore the farmers intend to develop more in an intensive manner. For the further development of the agriculture, however, shortage of irrigation water is the most serious constraint in the Project Area. It is therefore understood that the supply of sufficient and stable irrigation water would be the prerequisite for the development of sustainable agriculture in this area. Apart from this water supply situation, it should also be understood that the present farming and supporting activities would have some room to be improved in order to attain the project feasibility and to raise the farmers' income level through the establishment of productive and advanced agriculture in the Project Area. In this regard, the agricultural development plan will be formulated based on the following concepts:

(i) to formulate the reasonable cropping pattern and proper crop rotation to maximize the crop production,

(ii) to establish the improved and practicable farming practices to realize the proposed cropping pattern and yields,

(iii) to improve extension services to cope with modern irrigation farming, and

(iv) to improve farmers' organizations within the framework of the existing institutions.

(2) Farm Household and Agricultural Labor

As mentioned in Paragraph 3.1.5-(1), the average farm size for the total 9,300 farm households in the Project Area is about 1.7 hectares, while the agricultural labor force per farm household is estimated at 2.78 of male and 2.58 of female. These labor forces are converted to the adult men equivalent manpower applying the same conversion rates as mentioned in Paragraph 2.2.5-(1), and the manpower per farm household is obtained to be 3.35 men. Since it is expected that the situation of the labor force in the Project Area will not be changed in the future, the proposed agricultural development plan will be prepared on the basis of the manpower obtained in the above.

In the Project Area, hired labor is easily available, but most of farming practices would be carried out by family manpower as much as possible in order to reduce the labor cost. Furthermore, it is desirable that most of the proposed farming practices, except at the seasonal labor peak, will be planned to be handled only by family labor power that is estimated about 67 man-days per month for an average farm household.

(3) Future Land Use

In the Project Area, the cultivation area will not be increased in the future because of a lack of newly reclaimable land, even after this irrigation project is implemented, and the irrigated land will be rather decreased under the "future without project" condition due to the excessive use of the groundwater as mentioned in Paragraph 2.2.5-(2). Then, the cropped area under the "future without project" condition is estimated at 15,400 ha, consisting of 5,890 ha of irrigated area and 9,510 ha of rainfed area. As for the "future with project" condition, the total cropped area to be irrigated is 10,200 ha by surface water from the Beydağ reservoir, and 5,200 ha by groundwater.

(4) Proposed Cropping Pattern

Referring to the present cropping pattern shown in Figure 3.1.5 and further taking into account the following principles, the cropping pattern under the "future with project" condition is studied:

(i) Crops to be considered in the proposed cropping pattern will mainly be selected from the crops presently planted in the Project Area, since these crops are suited to the climatic and soil conditions of the Project Area, and the local farmers are familiar with their cultivation.

(ii) The cropping intensity will be raised to 140%, which is allowable from the physical and economical viewpoints as mentioned in Paragraph 2.2.5-(3), though the maximum cultivation area of each crop will be limited to less than 30% of the total cultivation area, considering the unexpected physical damage of crop and economic risk.

(iii) The crops which highly respond to irrigation and have a high marketability will be selected for irrigated farming as much as possible. Especially for vegetables with a high response to irrigation and high marketability, their cropped areas will be increased rather than tobacco, olive, figs, poplars, etc.

(iv) Three-year crop rotation, which is prevailing in the area, will be followed for the cultivation of annual crops in order to maintain soil fertility and to prevent soil-borne diseases and pests.

Cotton and potatoes are the most important cash crops in the Project Area. These crops highly respond to irrigation, and most farmers give a high priority to the cultivation of these crops. The cropping share of these crops should not be decreased under the "future with project" condition, though very high cropping intensity of these crops is not appropriate in view of the crop rotation and the balance of labor force. Thus, the cropping share of these crops will be kept at almost the same level as the present one.

The cropping ratio of cereal crops in the Project Area is lower than that in other areas of the basin. This is mainly due to the lower profitability than other crops. Especially for the purpose of grain production, these crops are not recommended to be cultivated more than the present level.

Watermelons and other summer vegetables, second vegetables, leguminous vegetables and fresh fruits have a high response to irrigation and a high profitability. Accordingly, these crops are recommended to be included in the cropping pattern as much as possible, if it is adequate from the viewpoint of crop rotation and labor use.

Cropping share of the fodder crops is low in the Project Area, though some parts of cereals are used for feed purposes. Judging from the present situation of livestock production, it may be said that heads of cattle, sheep and goats will hardly increase in near future, but it is still important to improve the current livestock production. For this purpose, it is necessary to increase fodder crops. The inclusion of fodder crop in the cropping pattern is also necessary to keep better crop rotation.

In the Project Area, tobacco is cultivated at a relatively high cropping intensity, though this crop has a low response to irrigation. In addition, the production of this crop tends to be excessive and is being controlled by the Government. Therefore, this crop will not be cultivated, at least in the irrigated land in the Project Area. The tree crops such as poplars, olive and figs will also be excluded from the irrigated land because of their low response to irrigation and their low profitability.

Taking into consideration the above-mentioned principles, the proposed cropping pattern in the Project Area is prepared as shown in Figure 3.2.2.

(5) Proposed Farming Practices

(a) Scheduled and Collective Crop Production

From the viewpoint of profitable marketing, especially for vegetables, scheduled and collective crop production must be very advantageous, because this makes it easier to uniform the quality of products and to promote the scheduled and collective shipping. To realize this production manner, the organization of active agricultural cooperatives is essential.

(b) Proper Application of Farm Inputs under Modernized Irrigation

As mentioned in Paragraph 2.2.5-(4), the farmers in the Project Area have already obtained the basic knowledge of farming practices for the proposed crops. However, further improvement for the application of farm inputs will be necessary under the modernized irrigation practices.

Generally, the quantities of farm inputs such as chemical fertilizers and agro-chemicals would be increased to raise the cropping intensity following the proposed cropping pattern. Especially for raising the cultivating ratio of summer and the second vegetables, increased application of these farm inputs will be inevitable. In addition, to achieve the proposed crop yield applying modernized irrigation, the application of farm inputs should be increased generally in most of the crop cultivation. However, excessive dosage of chemical fertilizers and agro-chemicals will unnecessarily increase the production cost and cause negative effects on the environment. Therefore, proper timing and quantity of these farm inputs application are essential in the farming practices under the "future with project" condition. Table 3.2.1 shows the proposed farming practices for main crops.

In this proposed farming practice, the labor balance by month per average farm household is shown in Table 3.2.2. As shown in this table, except for the seasonal labor peak, most farming practices of an average farm household with about 1.7 ha in farm size will be able to be managed by the family labor.

The increase of manure application is preferable for healthy crop growing and soil conservation. At present, most farmers who can get manure seem to apply it to a large extent, and some farmers apply green cereals as green manure called 'Hasil'. Even under this present condition, manure application should be promoted for the conservation and improvement of soil structure and fertility. From this viewpoint, it is recommended that livestock raising be promoted, expecting an increase of barnyard manure production and also recommended that additional green grasses be included in the crop rotation for the increasing of green manure.

To realize the scheduled and collective crop production, the application unit, quality and application method of each farm input should be uniformed throughout the Project Area as much as possible through the extension works.

(c) Co-use of Farm Machinery

At present, many agricultural machines are used in the Project Area. However, most of

them are owned individually, despite the farm size of the owners being relatively small, and used ineffectively as mentioned in Paragraph 3.1.5-(5). Under the "future with project" condition, therefore, agricultural machinery should be utilized more effectively following the systematic utilization plan, and at least a part of them should be provided and managed by the agricultural cooperative as common properties.

(d) Introduction of New Irrigation Methods

Under the "future with project" condition, sprinkler, drip and surface irrigation methods will be introduced to the Project Area for the effective use of irrigation water. However, the most suitable irrigation method is not always same by crop. In order to introduce the most suitable irrigation method to the crops in the area, therefore, sufficient field trials should be conducted, and a manual for new irrigation practices should be established before introducing the new irrigation method.

(6) Anticipated Crop Yield and Crop Production

After implementation of the Project, the unit yields of crops will gradually increase and reach the anticipated yields after 5 years from the start of irrigation. The following table shows the anticipated yields and the annual crop production at the full development stage of the Project, which are estimated based on the present crop yields, existing feasibility reports prepared by DSİ for the Beydağ Dam Project and Aktaş Dam Project, the farm household survey conducted by the Study Team, and the data from the Irrigation Master Plan prepared by the World Bank in 1993 (Annex E).

Crop	Crop Area (ha)	Anticipated unit yield	Production (ton)
Cereal	770	5.5	4,240
Cotton	4,620	3.5	16,170
Potato	3,080	33.0	101,640
2nd Potato	1,540	28.0	43,120
Fodder	770	18.0	13,860
Watermelon	1,540	35.0	53,900
Summer vegetable	3,080	27.3	84,080
2nd Vegetable	3,080	35.0	107,800
Green legume	1,540	15.0	23,100
Fruits tree	1,540	15.0	23,100

(7) Livestock Production

As mentioned in Paragraph 3.1.5-(6), the main livestock in the Project Area are cattle and sheep. The total rearing heads of cattle in 1995 were about 28,000 in the villages concerned with the Project, of which about 60% (17,000 heads) were deemed to be reared in the Project Area. This number of livestock is assumed to increase by about 15% (2,600 heads) within 10 years (Annex E).

Since the present rearing size is small and marketing conditions of livestock production will not be much changed in future, the livestock production from cattle rearing will only be increased following the natural trend under the "future without project" condition. However, the rearing condition will be improved much under the "future with project" condition due to the increase of fodder crops as mentioned in Paragraph 3.2.4-(4), and will result in the increase

of livestock production.

Most sheep are raised mainly in mountainous area by a relatively small number of households, and furthermore, the recent trend of the number of sheep does not show a remarkable change. Therefore, livestock production from sheep rearing will hardly be changed even under the "future with project" condition.

(8) Strengthening of Agricultural Support Services

(a) Agricultural Extension

For the successful achievement of extension work after the implementation of the Project, the shortage of extension workers would occur, because they will have to be engaged in the following activities in addition to the ordinary works being carried out:

(i) to promote modernized and water-saving irrigation farming,

(ii) to establish a guideline for the delivery of irrigation water and crop production schedule,

(iii) to guide the Agricultural Development Cooperative Union newly proposed under the Project in optimum crop cultivation through the efficient water supply, and

(iv) to disseminate the results of irrigation techniques confirmed in the demonstration farm proposed in Paragraph 3.3.2-(3).

In order to cope with the above-mentioned situation, it is proposed to increase the extension workers by 50% from the present number, and further proposed to improve their working environment and to give them incentives for good performance.

(b) Agricultural Credit

The shortage of supply of agricultural credit is not identified in the Project Area at present, but the capacity of credit seems to be insufficient after the implementation of the Project, because most farmers will have to get credit mainly from the Agricultural Bank for the implementation of the on-farm development works, of which the total cost will amount to about TL 2,200 billion, which is equivalent to TL 237 million/household. In addition to this investment cost, the farmers may need to get another credit for the provision of the post harvest and agro-processing facilities. For crediting such a huge amount of money to the farmers in the future, the bank should have enough funds, and furthermore they have to simplify the process of appraising loan applications and ease the access of small farmers to institutional credit.

(c) Village Development Cooperatives

At present, the activities of village development cooperatives are not encouraging, mainly because their number is less and their sizes are not extensive, which limit their activities to a large extent. In order to improve this situation, therefore, it is proposed to establish more cooperatives and increase their members. It is further proposed to organize a Village Development Cooperative Union, which will consist of all village development cooperatives in

the Project Area, expecting the strengthening of their standing against dealers, wholesalers and retailers for keeping reasonable prices of the farm products and establishing a proper channel of information on markets.

The Village Development Cooperative Union will have two working sections; the farming section and the marketing section in addition to the supporting section of administration as shown in Figure 3.2.3, and the duties of the respective working sections are mentioned below.

(i) Duties of the farming section are to guide member farmers to:

- follow the scheduled farming to avoid surplus production and to lessen the peak of labor requirements,
- standardize crop varieties to get high valuation of the products at the markets,
- arrange farm laborers within the member cooperatives or inter-region, and
- arrange the cooperative use of agricultural machinery within the member cooperatives to avoid excessive investment for the procurement of these machinery.

(ii) Duties of the marketing section are to guide member farmers to:

- arrange collective shipping to raise the marketing power,
- make the proper grading and packing of agricultural products to give a favorable impression to the markets,
- arrange the effective processing and storage of agricultural products to get additional value on the products, to control the amount of fresh products, and to find the best sales timing,
- perform the profitable marketing of agricultural products at the wholesale markets, and
- collect market information to select profitable crops for the next year.

(9) Marketing of Products

Crop production will increase after the implementation of the project as shown in the following table.

Crops	Present Condition			Future with Project Condition			Incremental
	Area (ha)	Yield (ton/ha)	Production (tons)	Area (ha)	Yield (ton/ha)	Production (tons)	Production (tons)
Cereals	970	2.8	2,720	770	5.5	4,240	1,520
Cotton	4,260	2.5	10,650	4,620	3.5	16,170	5,520
Tobacco	1,110	0.8	890	-	-	-	-890
Potato	2,850	28.0	79,800	3,080	33.0	101,640	21,840
Second Potato	1,410	20.0	28,200	1,540	28.0	43,120	14,920
Other field crops	320	4.8	1,540	-	-	-	-1,540
Fodder	540	12.0	6,480	770	18.0	13,860	7,380
Watermelon	1,740	30.0	52,200	1,540	35.0	53,900	1,700
Summer vege.	1,550	32.0	49,600	3,080	45.0	138,600	89,000
Second vegetables	560	25.0	14,000	3,080	27.0	83,160	69,160
Green Legumes	-	-	-	1,540	15.0	23,100	23,100
Olives	370	1.8	670	-	-	-	-670
Figs	420	5.4	2,270	-	-	-	-2,270
Other Fruits	320	11.8	3,780	1,540	15.0	23,100	19,320

Cereals and fodder will be consumed for home consumption. Annual self-consumption of cereals will increase from the present 290 kg/household to 460 kg/household in the future. Fodder production will contribute to livestock production saving commercial feed. Production of cotton will increase by 50% in the future and be marketed through the present marketing channel of TARİŞ. Production of potatoes will reach 145,000 tons, of which about 14,000 tons will be sold to the large cities like İstanbul, Ankara and İzmir, after the deduction of self-consumption.

Production of vegetables and fruits will drastically increase from 120,000 ton at the current level, to 320,000 ton in the future. As mentioned in Paragraph 2.2.5-(7), the demand for vegetables and fruits are steadily expanding in the domestic and international markets, and increased production will be mainly sold to these markets.

(10) Crop Budgets

Crop budgets under the "future with project" condition are estimated on the basis of the yields, inputs and prices, as shown below.

Crop	Yield (ton/ha)	Price (TL/kg)	Gross value (TL 1,000/ha)	Cost (TL 1,000/ha)	Net Value (TL 1,000/ha)
Cereals*	5.5	7,200	44,400	18,730	25,670
Cotton	3.5	45,300	158,550	47,470	111,080
Potato	33.0	7,500	247,500	65,130	182,370
Second Potato	28.0	6,500	182,000	57,020	124,980
Fodder	18.0	4,500	81,000	29,130	51,870
Watermelon	35.0	5,400	189,000	46,980	142,020
Summer vegetables	45.0	5,000	225,000	81,900	143,100
Second vegetables	27.0	5,400	145,800	61,790	84,010
Green Legumes	15.0	11,600	174,000	46,580	127,420
Other fruits (fresh grape)**	15.0	12,000	180,000	49,800	130,200
Other fruits (citrus)**	25.0	9,000	225,000	66,050	158,950

Note; *: Cereals are represented by wheat, and include value of sub-products (straw).
**: Other fruits are represented by fresh grape and citrus.

Net production values per hectare will increase to 242% for cereals, 136% for cotton,