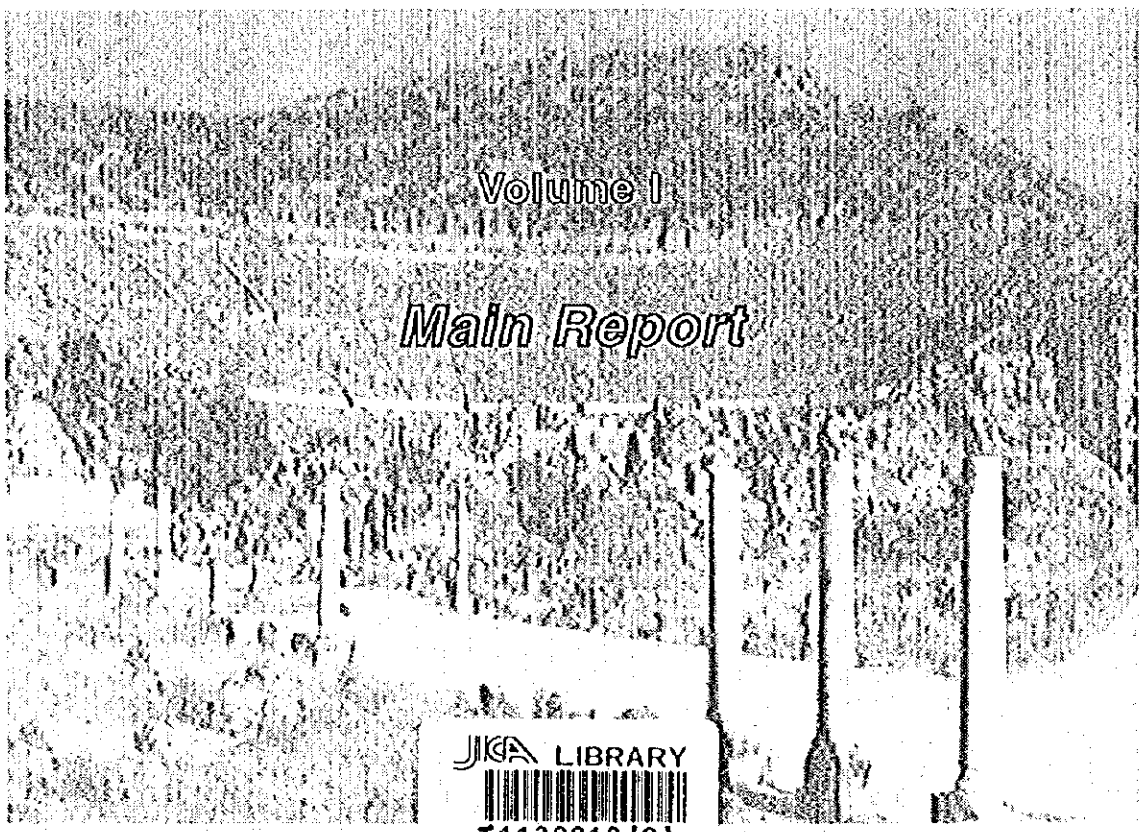
Japan International Cooperation Agency (JICA)

General Directorate of State Hydraulic Works, Government of Turkey

THE STUDY ON KÜÇÜK MENDERES RIVER BASIN IRRIGATION PROJECT IN THE REPUBLIC OF TURKEY



May 1996

NIPPON KOEI CO., LTD.

NIPPON GIKEN INC.

Japan International
Cooperation Agency
(JICA)

General Directorate of
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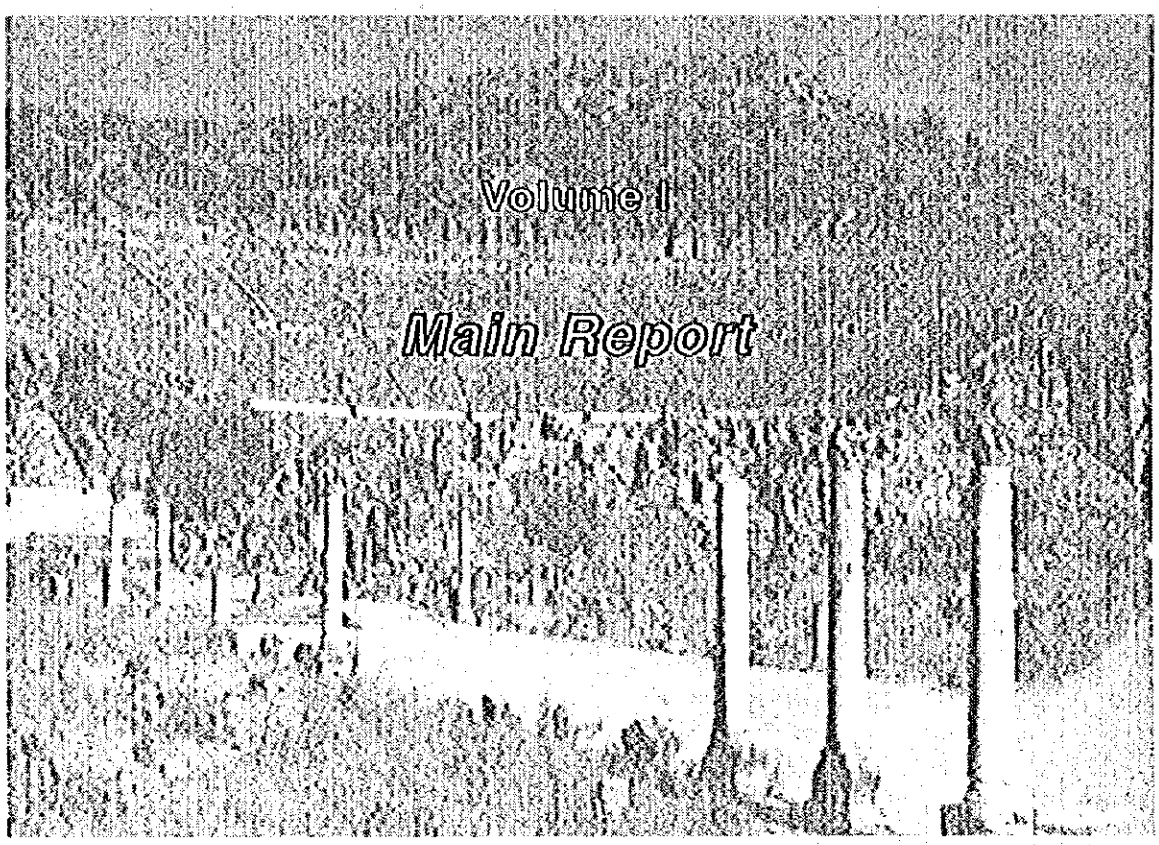

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PREFACE

In Response to a request from the Government of Turkey, the Government of Japan decided to conduct a study on Küçük Menderes River Basin Irrigation Project and entrusted the study to the Japan International Cooperation Agency (JICA).

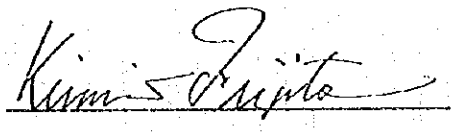
JICA sent to Turkey a study team headed by Dr. Yasuhiko Kunihiro, Nippon Koei Co., Ltd., three times between January 1995 and May 1996.

The team held discussions with the officials concerned of the Government of Turkey, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Turkey for their close cooperation extended to the team.

May 1996



Kimio FUJITA
President
Japan International Cooperation Agency

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

We have the pleasure of submitting herewith the study report on the Küçük Menderse River Basin Irrigation Project in the Republic of Turkey, in accordance with the terms of reference issued by your Agency.

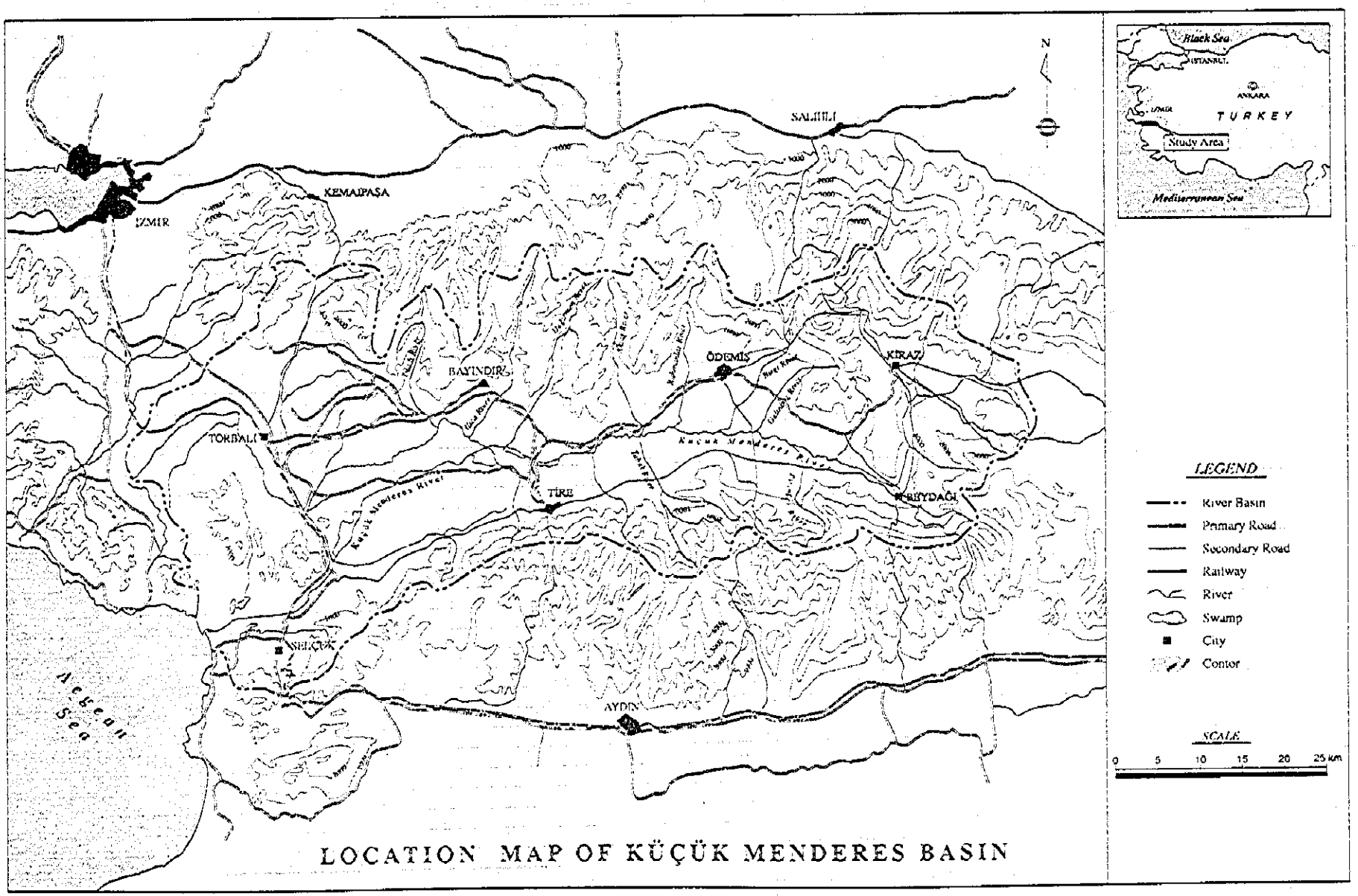
The Study was carried out for a total period of 17 months from January 1995 to May 1996. The Project was basically formulated with the principal aim of the increase of agricultural production and the improvement of farmers' living standards in the Project Area through (i) irrigation development (ii) agricultural development (iii) drainage improvement (iv) project services and (v) improvement of operation and management.

The Project is judged to be technical sound and economically feasible. After the implementation of the Project, the increase in the agricultural production would substantially contribute to the improvement of regional economy as well as the enhancement of living standard in the project area. Moreover, the Project would also contribute to the control of annual degradation of groundwater in the Project Area. We would recommend that the Project soon be implemented in line with the conclusions presented in this report.

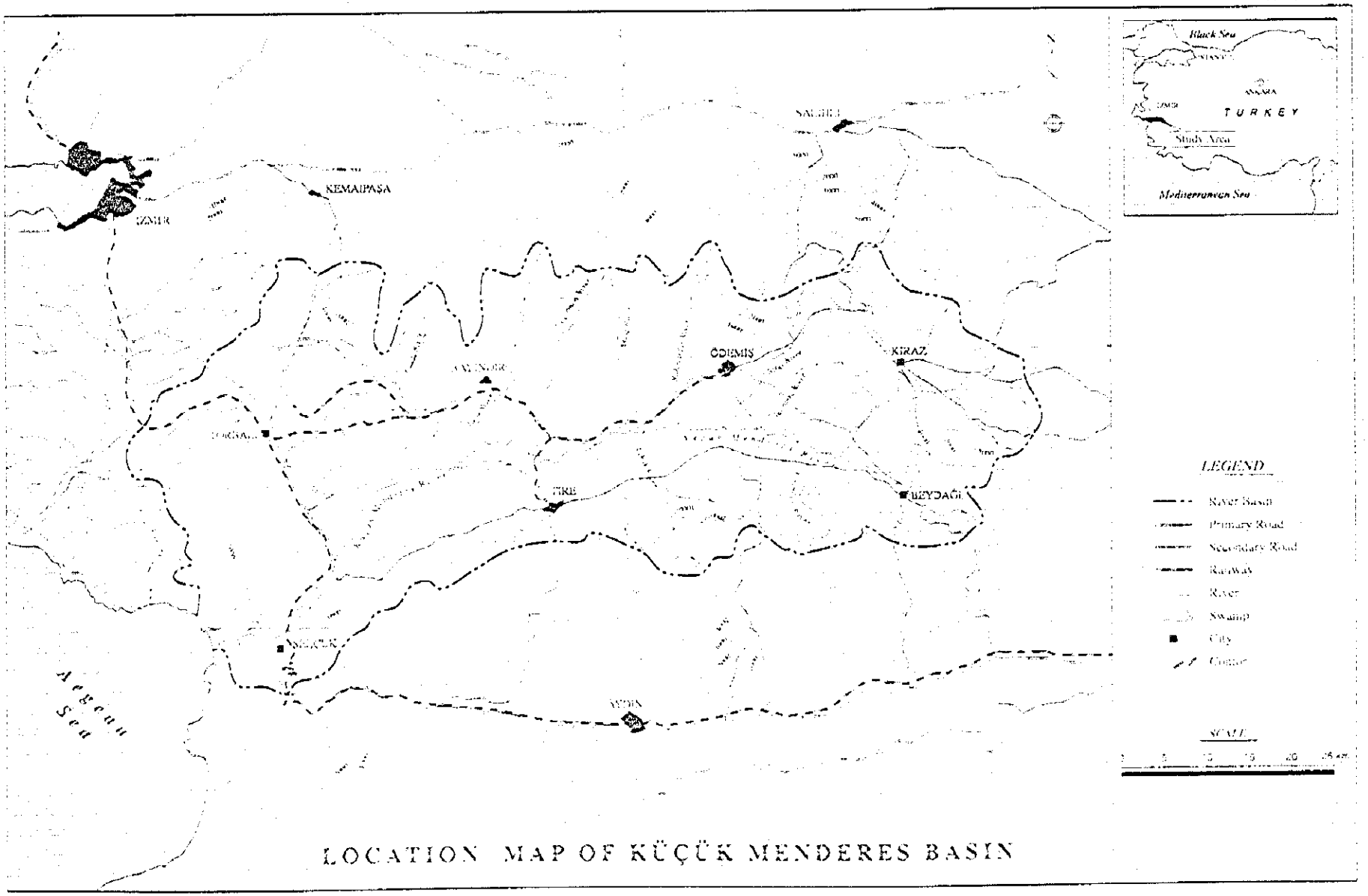
We wish to express our deep appreciation and gratitude to the personnel concerned of your Agency, your Turkey Office, the Embassy of Japan and the Authorities concerned of the Government of Turkey for the courtesies and cooperation extended to us during our field surveys and studies.

Very truly yours,

Yasuhiko Kunihiro
Leader of the Study Team
for the Küçük Menderes River Basin
Irrigation Project



LOCATION MAP OF KÜÇÜK MENDERES BASIN



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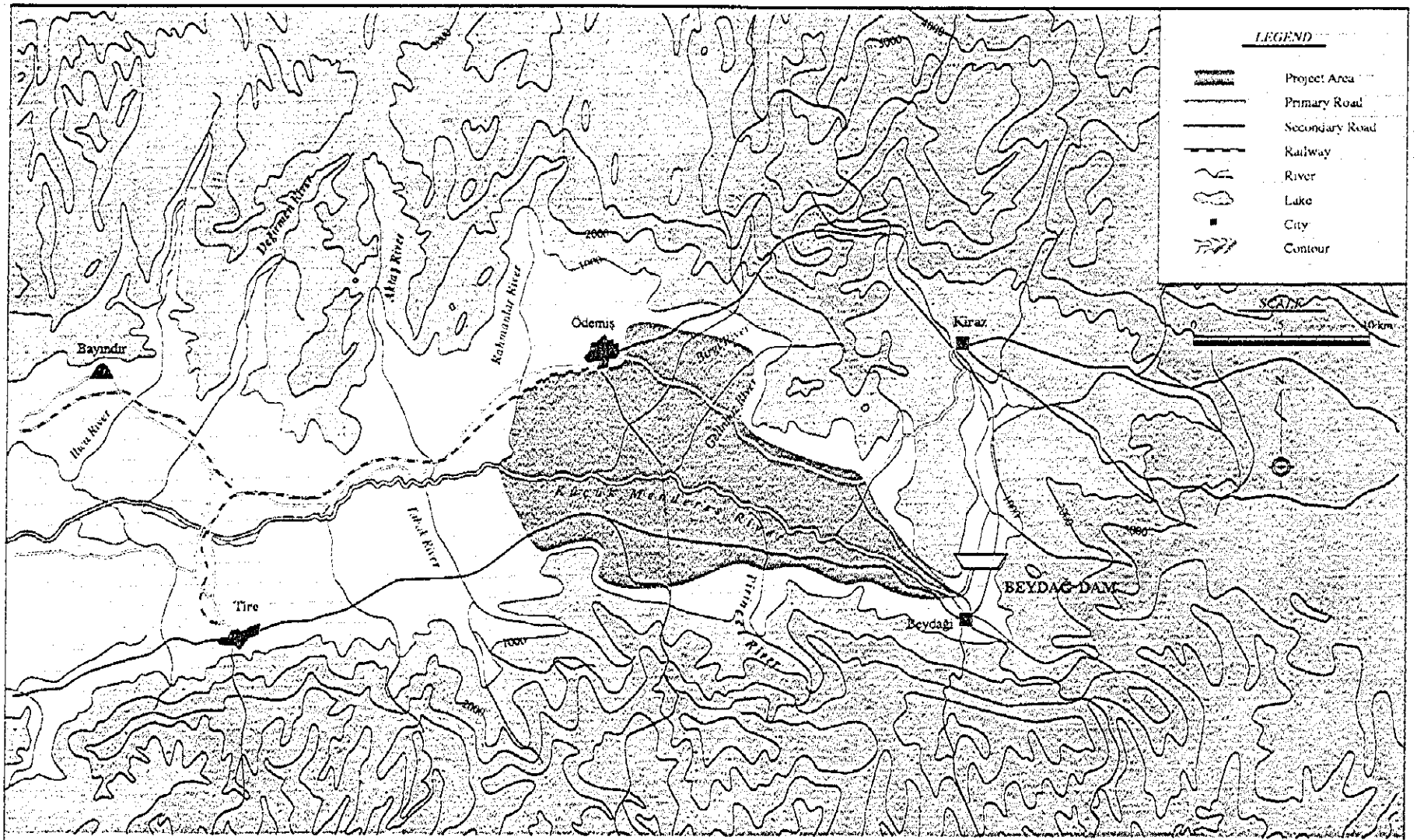
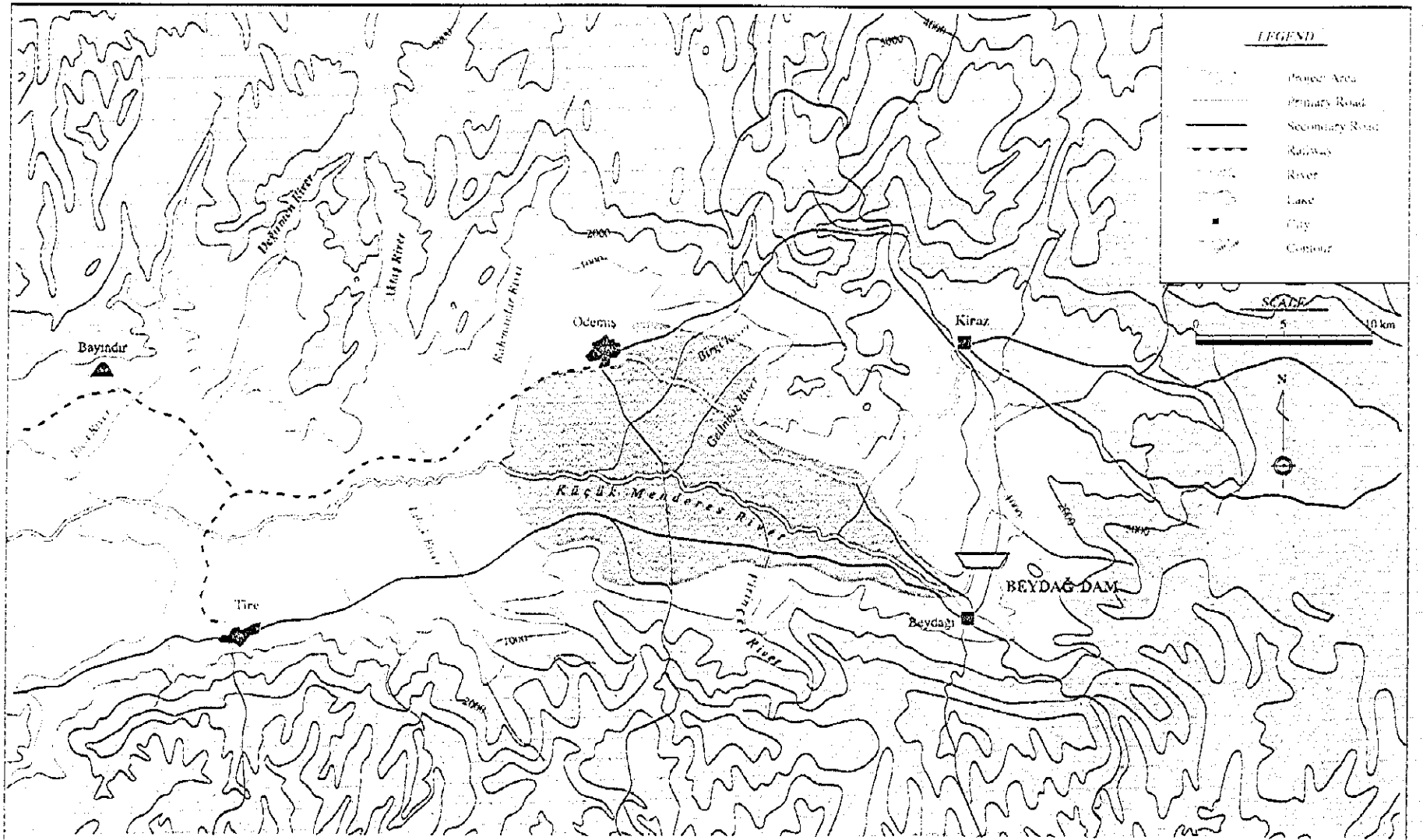


LOCATION MAP OF BEYDAĞ PROJECT AREA



LOCATION MAP OF BEYDAĞ PROJECT AREA

SUMMARY AND RECOMMENDATION

SUMMARY

PART - I GENERAL BACKGROUND OF THE PROJECT

Introduction

(01) In December 1991, the Government of Turkey (GOT) asked the Government of Japan (GOJ) for technical assistance in the preparation of the Master Plan on the Küçük Menderes river basin and the Feasibility Study for the Beydağ Irrigation Project. In response to this request, GOJ sent the Contact Mission in January 1994 and the Preparatory Study Team in April 1994. The Scope of Work (S/W) for the Study on the Küçük Menderes River Basin Irrigation Project (the Study) was agreed upon between GOT, through the General Directorate of State Hydraulic Works (DSI), and the Japan International Cooperation Agency (JICA) on April 11, 1994.

(02) This report has been prepared in accordance with the above-mentioned S/W. This report contains the results of the master plan for irrigation development in the Küçük Menderes river basin and the feasibility study on the Beydağ Irrigation Project as the priority project, putting main emphasis on the present conditions of socio-economy, agriculture, irrigation, agro-economy, and environment in and around the Study Area, the prospective land and water resources development plan, the environmental conservation program, a preliminary cost estimate of the priority project, project evaluation and the proposed development and implementation program of the priority project.

General Economic and Agricultural Background

(03) Turkey is located on two continents, Asia and Europe, and occupies an area of about 779,000 km^2, of which about 755,000 km^2 is in Asia and 24,000 km^2 in Europe.

(04) The country exhibits a climatic variation from a mild climate in the coastal regions to hot summers and cold winters with limited rainfall in the inland Anatolia regions. Most of the precipitation, which ranges from 300 mm to 700 mm on average, falls in winter and spring.

(05) Around 36% of the land, or 27.7 million ha, is classified as agricultural lands including 5.3 million ha of fallow lands. Around 9.3 million ha of land is composed of built-up areas, riverbeds, marsh areas and lakes, etc.

(06) As of 1990, the total population of Turkey was estimated to be 56.5 million. Of the total population, 23.2 million, or 41%, lived in rural areas and the remaining 33.3 million, or 59%, in urban areas. The population density was estimated at 73 persons/km^2 in 1990. The population growth rates are 0.67% per annum in rural areas and 3.59% in urban

areas. The high increase of population in urban areas is mainly attributed to the rural-to-urban migration.

(07) During the period from 1981 to 1992, the Gross Domestic Product (GDP) grew at a rate of 6.6% per annum for industry, compared to 2.7% for agriculture and 4.7% for services. Consequently, the economic position of the agriculture sector in the GDP fell from 42% in 1960 to 17% in 1992, while the shares of industry and services rose from 16% to 26% and 36% to 51% respectively in the same period.

(08) Although agriculture share has fallen in the national accounts, it is still an important sector in the natural economy. In 1992, about 41% of the population lived in rural areas where the main economic activity is agriculture, and 44% of the working population was engaged in agriculture. Moreover, many manufactured exports depend on the processing of raw agricultural materials, including cotton textiles and processed food products.

(09) The export value increased from US$ 2,910 million in 1980 to US$ 15,300 million in 1993. The imports, especially consumer goods, also grew largely from US$ 7,910 million in 1980 to US$ 29,400 million in 1993. The trade deficit, therefore, deteriorated and increased to US$ 14,083 million in 1993.

PART - II MASTER PLAN FOR THE KÜÇÜK MENDERES RIVER BASIN

Present Condition of The Küçük Menderes River Basin Area

(10) The Küçük Menderes river basin, covering 3,510 km^2, is located in the Aegean Region of western Turkey. The river basin narrowly extends almost in the east-west direction. It has a length of about 110 km and a width of 30 km on average, ranging from 15 km to 50 km. In the central part of the river basin, there extends a flat plain, most of which is being used as farmlands.

(11) The total population of the river basin was 407,000 in 1990, composed of 158,000 (39%) in urban areas and 249,000 (61%) in rural areas. The average annual growth rate from 1985 to 1990 was 1.0% in the whole river basin. The population density is 99 persons/km^2, ranging from 70 persons/km^2 in the Kiraz district to 119 persons/km^2 in the Ödemiş and Torbalı districts.

(12) Being affected by the Aegean climate, the weather in the river basin is hot and dry in the summer and warm and wet in the winter. Mean annual precipitation in the catchment area of the Küçük Menderes river is estimated at 705 mm. About 80% of rainfall has been recorded in the period from November to April. Monthly mean temperature varies from 6.9 °C in January to 27.6 °C in August. Relative humidity is high in the winter and low in the summer, ranging from 50% in July to 76% in December.

(13) The annual mean discharge of the Küçük Menderes river is 2.43 m^3/sec at the proposed Beydağ dam site with a catchment area of 444 km^2, 11.47 m^3/sec at Selçuk with a catchment area of 3,255 km^2, and 12.36 m^3/sec at the river mouth with a catchment area of 3,510 km^2.

(14) The base rocks of the Küçük Menderes river basin are composed mainly of a highly metamorphosed rock complex called Menderes Massif, which was formed mostly by the Alpidic Tectogenesis. Mesozoic limestone and Neogene conglomerate, limestone and siltstone overlie the Menderes Massif near the Aegean Coast.

(15) Hydrogeologically, the strata in the Küçük Menderes river basin may be largely divided into four formations: metamorphosed rocks, crystalline limestone, neogene sediment, and alluvium. The main aquifer in the basin is the alluvium spreading widely along the Küçük Menderes river, though the groundwater within fissures or cavities in marble or neogene sediments is never ignored. The metamorphosed rocks, marble and neogene sediments are hydrogeologically aquiclude or aquitard, and the alluvium which lies very thickly and fills in morphologically very deep underground valleys of rock basement forms a large scale aquifer in the basin.

(16) In the river basin, around 108,000 ha, or 31%, are suitable for irrigation farming. Most of the soils in mountainous or hilly areas are not suitable for agriculture except for tree crops plantation, due to shallow soil and steep slope, while most soils in flat to gently sloping areas are suitable for irrigated agriculture. Problem soils, such as salinity or sodic soil, are not found in the river basin except in the downstream areas where the wetland exists.

(17) The average farm size in the river basin is estimated at about 2.5 ha, which is much smaller than that of the national average (5.2 ha/household). About 40% of farm households are cultivating less than 1.0 ha. The average farm size tends to be larger towards the lower reaches of the Küçük Menderes river because of the geographical position along the respective reaches of the river.

(18) About 55% of farm households cultivate crops only, while about 44% of households are engaged in both crop and livestock production. The number of households engaged in livestock production only is about 1%. The current land tenure situation in the river basin shows that 84% of farm households are owner farmers and 4% are tenant farmers. The remaining 12% are cultivating both their own and rented lands. This proportion may be similar to that in the Study Area.

(19) Cotton is cultivated in the largest area accounting for 18% of the total farmland, followed by wheat (14%), watermelons (6%), tobacco (5%), and vegetables. Among the horticultural crops, watermelons are predominant (49%) followed by cucumbers (13%), tomatoes (6%) and peppers (6%). Tree crops such as olive, figs and grapes are popular and widely grown in the river basin. The present cropping intensity is estimated at about 103% in the rainfed land. The present crop yields of these crops are rather low: 2.7

tons/ha for cotton, 3.8 tons/ha for wheat, 0.8 tons/ha for tobacco, 31.0 tons/ha for watermelons, 26.2 tons/ha for potatoes, 1.8 tons/ha for olive, and 6.1 tons /ha for figs.

(20) Livestock breeding is one of the essential economic activities in the river basin. Farmers get income from both livestock production and animal power for such works as transportation, cultivation, etc. The major livestocks in the river basin are cattle, sheep, goats and poultry, totaling 112,000 heads, 172,000 heads, 36,000 heads and 776,000 heads respectively.

(21) There are two categories of irrigated area depending upon the manner of organization for irrigation practices. One is the area irrigated by using groundwater, stream flow and spring under the control of the irrigation cooperatives. Such irrigated area is estimated at 11,600 ha in total, consisting of 7,630 ha by groundwater, 2,260 ha by stream flow, and 1,710 ha by spring, respectively. The other is the area privately irrigated by using groundwater. The area in this category has been increasing because of the recent dry spell starting in 1986. The total irrigated area in this category is estimated at about 41,400 ha served by 6,500 wells. There is no irrigation system using surface water from the dam reservoir in the river basin.

(22) The General Directorate of Agricultural Research (GDAR) has overall responsibility for all agricultural research activities. Agricultural research covering the provinces in the Aegean Region is carried out by 5 research institutes under the supervision of GDAR. Agricultural extension and farmers' training in İzmir province are under the responsibility of the Provincial Office of the Ministry of Agriculture and Rural Affairs (MARA).

(23) Generally, there are three types of cooperatives concerning farmers, namely agricultural development cooperatives (which are sub-divided further into three types: village development cooperatives, irrigation cooperatives, and fishery cooperatives), agricultural credit cooperatives, and agricultural marketing cooperatives.

(24) The farm household budgets of typical farmers are estimated as shown in the following table:

Items	Kiraz	Beydağ	Odemiş	Tire	Bayındır	Torbalı	Selçuk
Farm size (ha)	2.8	3.2	3.2	11.6	9.3	6.9	6.2
Household size (person)	5.6	6.9	5.2	5.3	5.0	5.7	5.4
Gross income (mill. TL)	208.0	233.9	253.2	936.0	462.1	663.3	301.9
Expenditure (mill. TL)	178.2	231.1	221.4	565.4	341.7	446.9	272.0
Net reserve (mill. TL)	29.8	2.8	31.8	370.6	120.4	216.4	29.9

(25) Major constraints to proper agricultural development in the river basin are as mentioned below:

(a) Physical constraints: (i) unstable and scarce precipitation; (ii) limited resources of surface water; and (iii) lowering of groundwater table.

(b) Socio-economic constraints: (i) small land-holding and fragmentation of land; (ii) low educational level of farmers; and (iii) out-migration of younger generations.

(c) Agricultural constraints: (i) limited coordination between DSİ and other Agencies; (ii) improper farming practices; (iii) limited meadows and pastures; (iv) high cost of concentrated feed for livestock; and (v) lower than reasonable prices of agricultural products.

(d) Constraints in irrigation practices: (i) under-development of on-farm facilities and land consolidation; (ii) limited progress in establishment of water users groups; (iii) low response of farmers to water charge collection; (iv) weakness of O&M wing of project offices; and (v) limited activities for project monitoring and evaluation.

Land and Water Resources Development Plan in the Basin

(26) In line with the development targets set forth in the Sixth and Seventh 5-Year Development Plans, the basic concepts for agricultural development in the Küçük Menderes river basin need to be studied, particularly: (i) land resources development; (ii) water resources development; (iii) agricultural development; and (iv) irrigation development.

(27) According to the results of the evaluation for irrigation suitability in the Küçük Menderes river basin, 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 irrigation suitability can be considered as a potential area of land resources.

(28) According to the result of the numerical groundwater simulation in the river basin, the annual average recharge volume would be 160 MCM. On the other hand, the potential of the surface water in the river basin would be 390 MCM in an average year.

(29) In the Master Plan prepared by DSİ in 1982, 12 dam sites were identified on the tributaries of the Küçük Menderes river, and these dams are examined by the JICA Study Team. As a result, the following four dams were considered promising for the development of irrigation water resources in the river basin. Among these dams, the Aktaş and Ergenli dams will also supply municipal water to Ödemiş town and Bayındır town respectively.

Items	Beydağ	Aktaş	Burgaz	Ergenli
Catchment area (km^2)	444.0	58.7	91.2	97.2
Dam type	earthfill	earthfill	earthfill	earthfill
Dam height (m)	95.0	80.5	115.0	93.0
Dam length (m)	788.5	271.0	415.0	805.0
Dam volume (MCM)	9.00	1.60	7.02	6.85
N. R. C. (MCM)	241.3	16.72	68.90	61.78

(Note): N.R.C; Net reservoir capacity

(30) By using both surface water thus developed and groundwater available in the development areas, the total net irrigation area to be considered in this Master Plan study ("Study Area") is 26,250 ha as detailed in the following table:

(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)

(31) The average farm size and the family size as well as labor force per household in the Study Area are estimated as shown below. The present farm size 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.

Items	Beydağ	Aktaş	Burgaz	Ergenl
Average farm size (ha/household)	2.4	2.5	6.1	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

(32) The proposed cropping patterns were prepared by combining the proposed crops of cotton, cereals, potatoes, watermelons, fruit bearing vegetables, leafy and stem edible vegetables, leguminous vegetables and fodder. In these cropping patterns, the cultivation of annual crops was planned to be rotated every 3 years. The cropping intensity was proposed to be 140% for the Beydağ and Aktaş Project Areas and 130% for the Burgaz and Ergenli Project Areas through examination of the economic viability and the practicability in these areas.

(33) After implementation of the projects, the following crop yields and annual production are expected:

(Unit : ton)

Crops	Yield (ton/ha)	Beydağ	Aktaş	Burgaz	Ergenli
Winter cereals	5.5	4,240	1,070	4,020	3,850
Cotton	3.5	16,170	1,370	4,310	4,060
Potato	33.0	144,760	11,900	8,250	7,590
Fodder	8.0	13,860	1,170	3,420	3,420
Watermelon	35.0	53,900	6,830	17,150	16,450
Other fruit bearing vegetables	45.0	138,600	5,850	32,850	31,500
Edible leaf and stem vegetables	27.0	83,160	5,270	30240	29,160
Green legumes	15.0	23,100	1,950	5,850	5,550
Olive	3.5	-	-	2,070	1,960
Other fresh fruits	15.0	23,100	1,950	9,600	9,000

(34) The total cost of the projects has been roughly 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, all of which exclude price contingencies.

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

	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

(36) The implementation of all the projects mentioned above will require a huge amount of investment. In order to develop these projects in a practical way, a staged development plan should be adopted. For the preparation of such a plan, an assessment of the development priorities of the respective projects has been first made from the viewpoints of: (i) economic viability, (ii) number of beneficiaries, (iii) annual income per household, (iv) marketability of agricultural products, (v) accessibility, (vi) impact on the environment, and (vii) the Government's development policy. As a result, the first priority of development will be given to the Beydağ Project, followed by the Aktaş, the Ergenli Projects and lastly the Burgaz Project.

PART - III FEASIBILITY STUDY ON THE BEYDAĞ IRRIGATION PROJECT

Present Condition of the Project Area

(37) The Project Area covers about 19,600 ha in gross in three districts of Beydağ, Ödemiş and Tire within North latitudes 38° 6' 26" to 38° 14' 28" and East longitudes 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.

(38) The total population in the Project Area is 92,400 composed of 57,500 (62%) in the urban area and 34,900 (38%) in the rural area. The population growth rate during the 1985-1990 period is 1.78% per annum in the urban area and minus 0.64% in the rural area, averaging 0.82% in the whole Project Area.

(39) 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 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%.

(40) The geology along the Right Main Canal varies place to place; alternation of marble and micaschist along a few kilometers of the uppermost stream, micaceous soil and rock mass of leptite in the mountain side and micaceous sand in the plain side along the next section of 20 - 25 km, and gravelly silty sand along the remaining section. While, the geology along the Left Main Canal is composed of sandy silt along a few kilometers of the uppermost stream, and micaschist and gneiss in the mountain side, and fan deposit and/or alluvium or residual soil in the plain side along the remaining 35 km.

(41) Of the total area of 19,600 ha, around 15,100 ha, or 77%, which is included in Classes I to III, is judged to be suitable for irrigation farming. In addition to this area, 2,900 ha of land identified as Class V, which are presently affected by residual salts brought by a high groundwater table before 1985 or by floods from the Küçük Menderes river, is also included in the suitable class, because these areas would be improved by the drainage improvement to be made under the Project.

(42) 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. About 55% of farm households are engaged in both crops and livestock husbandry, and 44% are engaged only in crops production. As for the land tenure situation, about 88% of farm households are owner farmers and about 5% are tenant farmers. The remaining 7% are share croppers who cultivate owners' lands to share products with the owners.

(43) Of the total area of 19,600 ha, some 18,000 ha or 92% is used for agricultural purposes excluding livestock grazing area at present in the Project Area. The total cropped area is estimated at 17,420 ha in a year, comprising 15,470 ha of annual crops and 1,960 ha of perennial crops. The main annual crops cultivated in the area are cotton (28%), potatoes (27%), vegetables (25%), watermelons (11%) and other crops such as cereals, leafy and root vegetables and green legumes. The unit yields of the main crops are 2.8 tons/ha for cotton, 28.0 tons/ha for potatoes, 30.0 tons/ha for vegetables and 34.6 tons/ha for watermelons.

(44) The farming works are usually carried out by farm families, but most of farmers hire labors for planting, inter-cultivating and harvesting. 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. The average amount of fertilizer annually applied for the total cultivated area is estimated at 540 kg/ha of fertilizer containing 21% nitrogen, 190 kg/ha of 17% phosphate fertilizer, and 40 kg/ha of 50% potassium fertilizer. Insecticides made from organic phosphate, carbonate and chloride, fungicides and herbicides are commonly used in the area.

(45) In the Project Area, about 33% of farm households are rearing cattle. Only 2% of farm households are rearing sheep and goats. In the case of cattle, the rearing size is very small; 1-4 heads by 64% of rearing households and 5-10 heads by 27% of rearing households. While, 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.

(46) The irrigation water source in the Project Area depends almost completely on groundwater. There are five irrigation cooperatives established under the assistance of DSI/GDRS, and these cooperatives cover about 700 ha of irrigation area, of which water sources are totally groundwater provided by 31 wells. In addition to these, more than 2,000 wells have been dug by farmers themselves, and provide irrigation water to about 8,500 ha of farmlands, though insufficiently. In these areas, the furrow irrigation method has widely been applied, and border and basin irrigation methods have also been applied in a very limited area, especially for tree crops.

(47) The present farm household budget is estimated taking the average farm household having 1.7 ha of farmland. According to the estimated result, the net reserve is TL37.7 million per household, which is not sufficient to improve the living condition of the farmers.

(48) At present, there are no particular environmental problems in the Project Area except the soil erosion in the Beydağ river basin, where about 7,820 ha or 24% of the total river basin presents a high risk of erosion mainly due to a steep slope without any forest cover.

The Project

(49) The main objectives of the Project are: (i) 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; (ii) to introduce advanced farming practices to the irrigated area; and (iii) to establish an effective system of water management, and operation and maintenance of the project facilities.

(50) As mentioned in item (41) hereof, the 15,100 ha included in the Class I to III irrigation suitability classification is judged to be suitable for irrigation farming under the present condition. In addition to this area, 2,900 ha classified as Class V can be included in the grade of suitable classification after the implementation of the Project.

(51) There will be two water sources available for the irrigation development of the Beydağ Project Area: groundwater and surface water from the Küçük Menderes river. The groundwater potential will be 32.5 MCM per annum, while the available surface water will be 76.6 MCM per annum on average at the Beydağ dam site. Based on these available water sources and the calculated irrigation water requirements, the water balance study was made and the possible irrigation area was obtained to be 15,400 ha consisting of 5,200 ha to be irrigated by groundwater and 10,200 ha by surface water.

(52) The cropping pattern proposed for the "future with project" condition will consist of cotton (30%), potatoes (30%), leafy vegetables (20%), watermelons (10%), fruit bearing vegetables other than watermelons (20%), cereals (5%), green legumes (10%), fodder (5%) and fresh fruits (10%), which make 140% of the total cropping intensity.

(53) 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 annual production of the respective crops:

Crop	Crop Area (ha)	Production (ton)
Cereals	770	4,240
Cotton	4,620	16,170
Potatoes	3,080	101,640
2nd Potatoes	1,540	43,120
Fodder	770	13,860
Watermelon	1,540	53,900
Summer vegetables	3,080	84,080
2nd Vegetables	3,080	107,800
Green legumes	1,540	23,100
Fruits trees	1,540	23,100

(54) For the successful achievement of agricultural development, the following agricultural supporting services need to be improved and strengthened:

(i) Agricultural Extension Service
- to increase the extension workers by at least 50%,
- to improve the working environment of extension workers, and

- to give extension workers incentives for good performance.

(ii) Credit System
- to increase the operational funds for the Agricultural Bank,
- to simplify the process of appraising loan applications, and
- to ease the access of small farmers to institutional credit.

(iii) Village Development Cooperative
- to establish more cooperatives and increase their members, and
- to establish a Village Development Cooperative Union which will consist of all village development cooperatives in the Project Area.

Project Work

(55) In order to attain the final target of the Project, well-facilitated irrigation and drainage systems will be required. These systems will comprise the intake facility at the head of the irrigation canal system, headrace, two main canals, 16 secondary canals, 267 tertiary canals, 30 secondary drains, 270 tertiary drains and on-farm development facilities. All the facilities to be implemented under the Project are listed below.

Facilities	Right Bank Area	Left Bank Area	Total
1. Headrace			
- Canal length (km)	-	-	1.00
- Related structure (nos.)			
measuring device	1	1	2
bifurcation structure	-	-	1
2. Main canals			
- Canal length (km)	30.50	28.50	59.00
- Related structures (nos.)			
siphon	12	19	31
turnout	9	7	16
check valve	11	10	21
air valve	15	8	23
blowoff valve	14	9	23
measuring device	2	1	2
3. Secondary canals			
- Canal length (km)	44.40	28.15	72.55
- Related structures (nos.)			
siphon	44	28	72
turnout	179	88	267
check valve	41	31	72
air valve	149	83	232
blowoff valve	88	57	145
measuring device	9	16	25
4. Tertiary canals			
- Canal length (km)	226.70	120.50	347.20
- Related structures (nos.)			
turnout	2,308	1,228	3,536
check valve	456	241	697
air valve	769	413	1,182
blowoff valve	769	413	1,182
measuring device	179	97	276

(to be continued)

Facilities	Right Bank Area	Left Bank Area	Total
5. On-farm facilities (set) *	180	90	270
6. Secondary drain			
- Length to be improved (km)	8.05	8.45	16.50
- Related structure (nos.)			
cross drain	18	13	31
drop structure	89	43	132
7. Tertiary drain			
- length (km)	227.35	120.90	348.25
- Related structures (nos.)			
Junction structure	184	88	272

(Note) *: Consisting of quaternary canals (ϕ100 mm PVC pipes), drainage ditches, and sprinkler, drip and furrow sets.

(56) The time required for the implementation of the Project is estimated to be 10 years including 2 years for survey and design, 1 year for preparatory work, 5 years for construction and 4 years for project services, of which 2 years will overlap with the construction period. Provided that the financial arrangement for the Project is concluded by the end of 1996, the construction of the project work would be completed by the end of 2004 and the project services would be completed by the end of 2006.

(57) The total project cost, excluding the cost for the Beydağ dam, is estimated at US$162.1 million, comprising TL5,345 billion which is equivalent to US$106.9 million for the local currency portion and US$55.2 million for the foreign currency portion. If the cost for the Beydağ dam is included in the above-mentioned project cost, the total cost required for project implementation will be US$237.3 million, comprising TL7,799 billion which is equivalent to US$156.0 million for the local currency portion and US$81.3 million for the foreign currency portion.

Organization and Management

(58) DSİ will be the executing agency of the Project. For the successful implementation and O&M of the Project, it is proposed to establish a Project Office at the existing DSİ compound in Ödemiş. The Project Office will mainly function as a construction office during the construction period of the project works, and as an O&M office after completion of the construction. The Project Office, in coordination with the General Directorate of Rural Services (GDRS) and the Ministry of Agriculture and Rural Affairs (MARA) through the proposed Project Coordination Committee, will consist of: (i) Survey and Design Division; (ii) Construction Division; (iii) O&M Division; (iv) Agricultural Division; (v) Administration Division; (vi) Finance Division and (vii) Monitoring and Evaluation Unit. Among these divisions and unit, the Survey and Design Division, Construction Division and the Land Acquisition Section of the Administration Division will be phased out by the completion of the construction. Instead, the O&M Division will be established two year before completion of the construction, so that this division will fully function from the start of the O&M period of the Project.

(59) An essential prerequisite for successful O&M of the irrigation and drainage systems in terminal units would be to organize the Tertiary Group (TG) which will cover 60 ha on an average and be headed by a Gate Operator. About 10~30 TGs will form an

Irrigators' Group (IG) which will basically be organized for each secondary canal which will cover about 960 ha of net irrigation area on an average. The IGs included in the command area of a main canal will form a Water Users' Association (WUA). Since there will be two main canals in the Project Area, two WUAs will be established in the area. These WUAs will form a Water Users' Union (WUU) which will have the function of coordinating two WUAs for an equitable water distribution to the two main canals and maintenance work. In addition to this function, WUU will function as a contact point with the O&M Division of the Project Office for preparing the operation program of the dam reservoir and the dam intake, and assisting and advising WUAs in preparing a maintenance and repairing program.

Project Evaluation

(60) Project evaluation is made from economic and financial viewpoints. The economic evaluation is made in terms of economic internal rate of return (EIRR), net present value (NPV) and benefit-cost ratio (B/C). On the other hand, the financial evaluation is made from the view points of farm economy and the farmers' capacity for cost recovery. In addition, the indirect benefit of the project and the environmental considerations are assessed on a preliminary basis.

(61) The results of the economic evaluation of the Project shows an EIRR of 13.9%, NPV of US$ 241.5 million at the discount rate of 5% and B/C of 2.26 also at the discount rate of 5%. The sensitivity analyses are also worked out and indicate that the project viability would be rather insensitive to adverse changes. From these results of evaluation, it can be said that the Project is economically feasible.

(62) The financial viability has been evaluated and the result shows that under the "future with project" condition, the annual net reserve of the average farmer would increase from TL 37.7 million at the present level, to TL 151.3 million. Within this net reserve, the farmers in the Project Area can afford to repay 10% of the initial investment of the Project in addition to the O&M cost and replacement cost for the sprinkler and drip irrigation sets without much difficulty.

(63) After the implementation of the Project, the following indirect benefits are expected:

(i) improvement of groundwater condition,

(ii) increase of employment opportunity,

(iii) enhancement of living condition,

(vi) demonstration effect of modernized irrigation, and

(v) foreign currency earnings.

(64) According to the results of the initial environmental examination (IEE), it is suggested that an environmental impact assessment (EIA) is necessary for the items of: (i) sociological impact on the people to be dislocated from the Beydağ reservoir area; (ii)

eutrophication of the Beydağ reservoir water; and (iii) deterioration of water quality for both surface water and groundwater. The result of EIA is briefed below.

(i) Sociological impact on the people to be dislocated from the Beydağ reservoir area

Due to construction of the Beydağ dam, around 1,500 people living in the reservoir area have to be dislocated to other areas. For the preparation of plan and procedure for the land acquisition in the reservoir, the procedure taken by DSİ-II for the Tahtalı Dam Project is judged to be applicable to the case of the Beydağ reservoir, but it is noted that a public consultation meeting should be held before the implementation of land acquisition in the reservoir area, and an action plan for the support of the dislocated people and improvement of their life should be prepared on the basis of monitoring their living conditions in the new area.

(ii) Eutrophication of the Beydağ reservoir

The inflow of nutrients from the upstream area of the dam into the Küçük Menderes river would affect the water quality in the Beydağ reservoir. The possibility and the magnitude of the eutrophication is assessed following the Vollenweider Mode. As a result, the concentration of chlorophyll-a (indicator of the eutrophication) in the reservoir is estimated at 25.9 mg per one cubic meter of reservoir water in the future. According to the OECD guidelines for eutrophication in a lake or reservoir, this value corresponds to the category of "very high possibility". Therefore, countermeasures should be taken in order to mitigate the magnitude of the eutrophication of the reservoir based on the results of monitoring to be started after completion of the dam construction.

(iii) Deterioration of water quality

The deterioration of the water quality in the surface and the groundwater in the Project Area would be caused by the increased application of chemical fertilizers and agro-chemicals. The possibility and the degree of deterioration of surface water were examined for the "future with project" conditions, and the result showed that the impact would not be serious. As for the groundwater, it is difficult to assess the change of these concentrations in the water due to a lack of concerned data. But, it is suggested that careful attention should be paid to the concentration of nitrogen.

RECOMMENDATION

(01) All the priority projects of the Beydağ, Aktaş, Burgaz and Ergenli are judged to be technically sound, economically feasible and financially viable. Furthermore, the Project will bring about the various kinds of indirect benefit as mentioned in item (63) hereof. Thus, it is recommended that all the projects be implemented as early as possible following the priority sequence mentioned in item (36) of Part II.

(02) The Project should be implemented based on the realization of a need to let the farmers participate in the irrigation development, operation and maintenance, and management process. The Project would be visualized under the basic principle that WUAs to be formed in the Project will get proper information about the Project from its inception. Users should get full information on the project concept, objectives, procedures of implementation, and roles and responsibilities of parties involved in the Project and generate self service support capabilities. Therefore, the Project should be implemented on the users' demand and their capability. The WUAs along with the staff of the proposed Project Office would develop a capability, by which operation and maintenance system would be done.

(03) The groundwater simulation study made under this study suggests that the present use of groundwater should be limited to 64% in quantity to avoid further lowering of the groundwater table in the basin. Through the above-mentioned simulation study, it is understood that the availability of groundwater potential should be confirmed based on the simulation and optimization study to be made based on the further detailed hydrogeological data which needs to be collected in the project design stage.

(04) According to the results of the environmental assessment, social problems for the people to be dislocated from the Beydağ reservoir area, eutrophication of the reservoir and the deterioration of water quality may be caused by the implementation of the Project. Therefore, these matters should be closely monitored and evaluated based on the elaborated monitoring plans by the Project Office immediately after the completion of the Project, and countermeasures should be taken properly, if required.

THE STUDY
ON
KÜÇÜK MENDERES RIVER BASIN IRRIGATION PROJECT

DRAFT FINAL REPORT

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1. ABBREVIATIONS

Abbreviation	Turkish	English
AEARP	Tarımsal Yayım ve Uygulamalı Araştırma Projesi	Agricultural Extension and Applied Research Project
ASCUs	Türkiye Tarım Satış Kooperatifleri Birliği	Turkey's Unions of Agricultural Sales Cooperatives
ÇAYKUR	Çay Kurumu	Tea Industry Corporation
DMİ	Devlet Meteoroloji İşleri	State Meteorological Service
DSİ	Devlet Su İşleri	General Directorate of State Hydraulic Works
DSİ-II	Devlet Su İşleri 2.Bölge Müdürlüğü	DSI Second Regional Directorate
EBK	Et ve Balık Kurumu	Meat and Fish Organization
EBSO	Ege Bölgesi Sanayi Odası	Aegean Region Chamber of Industry
EİE	Elektrik İşleri Etüd İdaresi	Electrical Power Resources Survey and Development Administration
EFTA	Avrupa Serbest Ticaret Birliği	European Free Trade Association
FAO	Birleşmiş Milletler Gıda ve Tarım Örgütü	Food and Agriculture Organization of United Nations
GDAR	Tarımsal Araştırma Genel Müdürlüğü	General Directorate of Agricultural Research
GDOS	Örgütlenme ve Destekleme Genel Müdürlüğü	General Directorate of Organization and Support
GDRS	Köy Hizmetleri Genel Müdürlüğü	General Directorate of Rural Services
JICA		Japan International Cooperation Agency
IBRD	Dünya Bankası	International Bank for Reconstruction and Development, World Bank
MARA	Müsteşarlık Araştırma Grubu	Ministry of Agriculture and Rural Affairs
MOF	Orman Bakanlığı	Ministry of Forestry
MOE	Çevre Bakanlığı	Ministry of Environment
MTA	Maden Tetkik Arama Genel Müdürlüğü	General Directorate of Mineral Research aand Exploration
OECD		Organization for Economic Cooperation and Development
SEE		State Economic Enterprise
SIS	Devet İstatistik Enstitüsü (DİE)	State Institute of Statistics
SPO	Devlet Planlama Teşkilatı (DPT)	State Planning Organization
TCZB	Türkiye Cumhuriyeti Ziraat Bankası	Turkish Agricultural Bank
TEKEL	TEKEL	Tobacco, Tobacco Products, Salt and Alcohol Industry
TİGEM	Tarım İşletmeleri Genel Müdürlüğü	General Directorate of Agricultural Enterprises (General Directorate of State Farms)
TKK	Tarım Kredi Kooperatifleri	Agricultural Credit Cooperatives
TMO	Toprak Mahsulleri Ofisi	Grain Marketing Board (Soil Products Office)
TAFAS	Türkiye Şeker Fabrikaları Birliği	Turkish Sugar Factories Incorporated
TARİŞ	Tarım Satış Kooperatifleri	Agricultural Sales Cooperatives in the Aegean region
TZDK	Türkiye Zirai Donatım Kurumu	Turkish Agricultural Supply Corporation
YEN	Tarımsal Yayım Merkezi	Agricultural Extension Center
USBR	ABD Arazi Islahı ve Geliştirme Bürosu	United States Bureau of Reclamation
USDA	ABD Tarım Departmanı	United States Department of Agriculture
VGT	Köy Grubu Teknisyenleri	Village Group Technician
WUA	Sulayıcı Birliği	Water Users Association
WUG	Sulama Grubu	Water Users Group

2. ABBREVIATIONS OF MEASUREMENTS

Length

mm = millimeter
cm = centimetre
= 0.39 in.
m = meter = 1.09 yd
= 3.28 ft.
km = kilometre = 0.62 ml

Area

cm^2 = square centimetre
m^2 = square meter
km^2 = square kilometre
= 100 ha
ha = hectare = 0.01 km^2
= 2.5 ac

Electrical Measures

kW = kilowatt = 1,000 watt
MW = megawatt = 1,000 kW
GW = gigawatt = 1,000 MW
kV = kilovolt = 1,000 Volt

Other Measures

% = percent
° = degree
' = minute
" = second
°C = degree in Celsius
Hp, PS = horse power

Volume

lit. = litter
cm^3 = cubic centimetre
m^3 = cubic meter
= 1,000 lit.
MCM = million m^3
= $1x10^3$ m^3

Weight

g = gram
kg = kilogram
t = metric ton = 1,000 kg

Time

sec = second
min = minute = 60 seconds
hr = hour = 60 minutes
= 3,600 seconds
day = 24 hrs = 1,440 minutes
= 86,400 seconds
yr = year

Derived Measures

m^3/sec = cubic meter per second (Cumec)

Monetary

US$ = US dollar
Y = Japanese yen
TL = Turkish lira

3. EXCHANGE RATE

US$1 = TL50,000 = Y 100 (As of Mid-1995)

PART - I

GENERAL BACKGROUND OF THE PROJECT

1.1 Introduction

1.1.1 Authorities

This report has been prepared in accordance with the Scope of Work (S/W) for the Study on the Küçük Menderes River Basin Irrigation Project (the Study) agreed upon between the Government of Turkey (GOT) through the General Directorate of State Hydraulic Works (DSİ) and the Japan International Cooperation Agency (JICA) on April 11, 1994. The S/W is attached to this report as Attachment II.

This report compiles the results of the survey and study conducted by the study team of JICA (Study Team) in both Phase-I and II Study periods. It describes the General Background of the Project in Part - I, the Master Plan for the Küçük Menderes River Basin in Part - II and the Feasibility Study on the Beydağ Irrigation Project as the priority project in Part - III, putting main emphasis on the present conditions of socio-economy, agriculture, irrigation, agro-economy, environment in and around the Study Area, the prospective land and water resources development plan, the environmental conservation program, a preliminary cost estimate of the priority project, project evaluations and the proposed development and implementation program of the priority project.

1.1.2 Project Background

Since the early 1960s, major structural changes have taken place in the Turkish economy. Industrialization for import substitution has been initiated in the basic framework of the national economic development policy. This policy led to the high economic growth of 7% per annum in terms of gross domestic product (GDP) until the early 1970s. Afterwards, the worldwide recession brought crisis to the Turkish economy due to the deterioration of the trade balance. In 1980s, the economic growth gradually recovered, accompanied with a higher inflation rate. This situation still exists at present. During the period of 1981 to 1992, the GDP grew at a rate of 6.6% per annum for industry, compared to 2.7% for agriculture, and 4.7% for services. Consequently, the economic position of the agriculture sector in the GDP fell from 42% in 1960 to 17% in 1992, while the shares of industry and services rose from 16% to 26% and 36% to 51% respectively in the same period.

Although the share of agriculture has fallen in the national accounts, it is still an important sector in the national economy. In 1992, about 41% of the population lived in rural areas where the main economic activity is agriculture, and 44% of the working population was engaged in agriculture, though internal migration towards urban areas continues at a fast pace and consequently agricultural labor is decreasing. Moreover, many manufactured exports depend on the processing of raw agricultural materials, including cotton textiles and processed food products.

Under the agricultural situation mentioned above, GOT has taken various measures to develop the agriculture sector, including irrigation development, domestic price supports, input subsidies, credit, and privatization of state economic enterprises. Out of these measures, the development and management of the irrigation infrastructure are key issues to the future development of agriculture, since the limit of the country's cultivable area was reached in the 1970s at the maximum extent of 27.7 million hectares and therefore growth of agricultural GDP should be achieved by increasing productivity per hectare mainly through irrigation. This would contribute to a deceleration of the rate at which workers leave their villages in pursuit of non-agricultural jobs in urban areas.

In line with the above-mentioned agricultural development policy, GOT, putting a high priority on the Küçük Menderes river basin of 3,510 km^2, has taken up the agricultural development in this basin, where population density is high but land and water resources are limited as compared to the country's averages. Moreover, agricultural development in the basin is behind to some extent as compared with those in the nearby basins of the Gediz and Büyük Menderes where irrigated agriculture is well developed. For these reasons, intensive and effective irrigation development is of paramount importance in the Küçük Menderes river basin for the promotion of regionally balanced welfare.

The first activity taken by the Government in the Küçük Menderes river basin was the preparation for a study on water resources development and drainage improvement in 1928. Based on the result of the study, the Government started construction of the Mahmutlar diversion weir, flood canal, some drainage canals and stream rehabilitation works. The construction of these facilities had been started in 1933 and the first slice of works had almost been completed in 1951. Afterwards, some additional flood preventive measures such as dikes and shore protection works were also implemented in succession.

In 1963, DSİ prepared the "Reconnaissance Report on the Küçük Menderes River Basin", which did not propose the construction of any hydraulic structures, but recommended some measures in order to make better use of existing water and land resources in the basin. DSİ also studied and evaluated groundwater potentials in the basin and prepared "Hydrogeologic Survey Report for the Küçük Menderes Plain" in 1973.

The above-mentioned studies were made in a limited extent to develop the fertile lands mainly located within the downstream part of the basin which had been mainly covered with permanent lakes and swamps before such rehabilitation studies were made. DSİ, recognizing this fact, formulated a master plan for the whole Küçük Menderes river basin in 1982, mainly aiming at the irrigation of an area of 26,500 ha composed of four irrigation schemes through the construction of four dams at Beydağ, Aktaş, Burgaz and Ergenli in the upper reaches of the Küçük Menderes river and its tributaries. In this master plan, the first priority of development was given to the Beydağ dam project, and its feasibility study was carried out by DSİ in 1986. As the second priority project, the Aktas dam project was considered, and its feasibility study was also conducted by DSİ in 1995. The construction of the Beydağ dam started in 1994 and is now in progress.

After preparing the master plan mentioned above, more than 13 years have passed and socio-economic and agricultural conditions and the water resources conditions have changed much during this period. Particularly, since 1986, rainfall in the river basin has been decreasing, and the groundwater table has been lowering seriously due to less rainfall and over pumping of groundwater for irrigation purposes. This adverse change of water resources conditions badly affects the agricultural production which largely depends on the irrigation. Considering this situation seriously, DSİ intended to update this master plan with a main purpose of ensuring suitable land development compatible with the limited water resources by introducing an efficient irrigation method. For this revision of the master plan, GOT requested the Government of Japan (GOJ) for technical assistance in December 1991. In response to this request, GOJ sent the Contact Mission in January 1994 and the Preparatory Study Team in April 1994. The scope of work (S/W) for the Study on the Küçük Menderes River Basin Irrigation Project (the Study) was concluded between DSİ and JICA on April 11, 1994.

Based on this scope of work, the Study Team was first dispatched to the Study Area in January 1995. The Study Team completed the Phase-I Study in July 1995 and recommended to consider the Beydağ Area as the first priority area for the agricultural development in the river basin. Following this study, the Study Team conducted the field survey from August 20 to October 25, and the study at the home office from December 1 to January 19, 1996 in the frame work of the Phase-II Study.

1.1.3 Objective of the Study

The objectives of the Study are:

(a) To conduct a study on irrigation development for the Küçük Menderes River Basin Irrigation Project (the Project), and

(b) To carry out technology transfer to the Turkish counterpart personnel through on-the-job training in the course of the Study.

1.1.4 Study Area

The study covers the proposed irrigation area of 23,000 ha delineated in the field survey and study made for the whole Küçük Menderes river basin (approximately 3,510 km^2).

1.1.5 Activities of the Study Team

The Study consists of two phases: the Phase-I Study, which was made mainly for the formulation of a basic concept of the master plan by reviewing the previous studies and analyses of data and information; and the Phase-II Study, which was made for the formulation of a master plan for the Study Area and a feasibility study on the proposed irrigation area to be covered by the Beydağ dam reservoir (Beydağ Area).The Phase-I Study was carried out from January 15 to July 30, 1995, and the Phase-II Study was carried out from August 20, 1995 to January 20, 1996, as shown in Figure 1.1.1. The experts of the Study Team and their counterparts dispatched by GOT are listed in Table 1.1.1. The minutes of meetings held with DSİ during these study periods are attached hereto as Attachment IV through Attachment IX.

After submittal of the Draft Final Report prepared in the Phase-II Study period to DSİ, the Study Team was dispatched to Ankara for the period from March 10 to 17, 1996 to discuss the contents of the Draft Final Report with DSİ. The result of discussion was compiled as minutes of meeting (Attachment X).

1.2 General Economic and Agricultural Background

1.2.1 Land and Population

Turkey lies between North latitudes 35°51' and 42°06' and East longitudes 25°40' and 44°48'. The country is located on two continents, Asia and Europe, and occupies an area of about 779,000 km^2, of which about 755,000 km^2 is in Asia and 24,000 km^2 in Europe. The country is geographically divided into seven regions: Black Sea, Marmara, Aegean, Mediterranean, Central Anatolia, East Anatolia, and Southeastern Anatolia. The country exhibits a climatic variation from a mild climate in the coastal regions (Black Sea, Marmara, Aegean, and Mediterranean regions) to hot summers and cold winters with limited precipitation in the inland Anatolia regions. Most of the precipitation, which ranges from 300 mm to 700 mm on average, falls in the winter and spring.

The land use situation of Turkey in 1990 is summarized below:

Land Use	Area (million ha)	Proportion (%)
Agricultural land	27.7	36
Cereals and field crops	(18.3)	(23)
Fodder crop	(0.5)	(1)
Vegetables	(0.6)	(1)
Fallow land	(5.3)	(7)
Tree crops	(3.0)	(4)
Grassland and pasture	20.7	27
Forest and scrub	20.2	26
Other lands	9.3	12
Total	77.9	100

Around 36% of the land or 27.7 million ha is classified into agricultural land including 5.3 million ha of fallow land. The area of fallow land decreased from 8.2 million ha in 1980 to 5.3 million ha in 1990 due to the introduction of the proper crop rotation system implemented under the Fallow Land Reduction Project, while agricultural land also decreased from 28.2 million ha in 1980 to 27.7 million ha in 1990. Around 9.3 million ha of other lands are built-up areas, riverbeds, marsh areas and lakes, etc.

As of 1990, the total population of Turkey was estimated at 56.5 million and it is forecasted to be 69.7 million in 2000, applying a growth rate of 2.17% per annum. Of the total population, 23.2 million or 41% lived in rural areas and the remaining 33.3 million or 59% in urban areas. The population density was estimated to be 73 persons/km^2 in 1990. The population growth rates are 0.67% per annum in rural areas and 3.59% in urban areas. The high increase of population in the urban areas is due to rural-to-urban migration. This situation accelerates the economic imbalance between rural and urban areas.

1.2.2 National Economy

(1) General

Since the early 1960s, industrialization by means of import substitution has been initiated in the basic framework of the national economic development policy. This policy led to the high economic growth of 7% per annum in terms of the GDP until the early 1970s. Afterwards, the worldwide recession brought crisis to the economy due to the deterioration of the trade balance. In the 1980s, the economic growth gradually recovered, accompanied with a higher inflation rate. This situation still exists. The economy recorded an annual average growth rate of 9.4% in 1990. However, the growth rate fell to 0.4% in 1991 due to political uncertainties caused by the Gulf War and the general election. This growth rate rose again to 6.4% in 1992 and 7.6% in 1993 owing to an acceleration of the activities in the industry and the services sectors. The GDP attained US$ 158,200 million at the current price basis in 1992, and US$ 172,600 million in 1993, which corresponded to a per-capita GDP of US$ 2,700 in 1992 and US$ 2,883 in 1993.

Since the early 1960s, major structure changes have taken place in the Turkish economy due to the industrialization policy. Over the period of 1981 through 1993, the industrial sector grew at an annual rate of 6.6% under the market-oriented development program, while the agriculture and services sectors grew at annual rates of 2.7% and 4.7% respectively in the same period. Consequently, the share of the agricultural sector, including agriculture, forestry and fishing, in the GDP fell from 42% in 1960 to 14% in 1993, while the share of industry rose from 16% to 24.5% in the same period.

Despite the high economic growth as descried above, a high unemployment rate, which was 7% in 1993, is a major problem for the country. The main reason is the difficulty in generating sufficient employment opportunities for the rapidly growing population. Around 44% of the total work force was still in the agricultural sector in 1992, while those of the industry, construction and services sectors were 15%, 5% and 36% respectively.

The high inflation rate is also a problem in the national economy. The consumer price inflation recorded 60.4% in 1990 and 71.1% in 1993. This high inflation rate has brought about a budget deficit in the public sector. In addition, the shortage of meat, fruits and vegetables accelerated the inflation rate in 1993.

(2) Foreign Trade

Since the early 1980s, GOT has taken actions for the devaluation of the currency, creation of the commercial foreign currency market, and implementation of the outward-oriented economic policy. As a result, the export value increased from US$ 2,910 million in 1980 to US$ 15,300 million in 1993. The imports, especially consumer goods, also grew dramatically from US$ 7,910 million in 1980 to US$ 29,400 million in 1993, resulting in a trade deficit of US$ 14,083 in 1993. The recent exports, imports and their balances are summarized below:

(Unit: US$ million)

Items	1990	1991	1992	1993
Export	12,959	13,593	14,715	15,345
Import	22,302	21,047	22,871	29,428
Balance of trade	-9,343	-7,454	-8,156	-14,083

Since the 1980s, the composition of exports has drastically changed from agricultural products to industrial products due to the promotion of industrialization following the Governmental policy. Agricultural goods accounted for 76% of total exports in 1965. This share, however, fell to 47% by 1981, and 16% by 1993, while the share of manufactures rose from 20% in 1965, to 40% in 1981, and 83% in 1993, though a large portion of exports was occupied by processed agricultural raw materials. As for imports, industrial and agricultural goods accounted for 84% and 10% respectively of the total imports in 1993.

(3) National Development Plan

Since 1963, Five-Year Development Plans have been implemented with an aim to strengthen the economy. The Sixth Five-Year Development Plan covering the period of 1990 through 1994 was issued by the State Planning Organization (SPO), but this plan was extended to the end of 1995. The objectives of the development plan were mainly: (i) to enhance the nation's welfare in line with the principles of an open and competitive market; (ii) to increase efficiency and productivity through the operation of industry at the optimal capacity and the acceleration of investment; (iii) to achieve a free competitive market with the maximum use of the private sector; and (iv) to liberalize and simplify foreign trade.

In succession to the Sixth Plan, the Seventh Five-Year Development Plan covering the period of 1996 through 2000 was issued by the State Planning Organization (SPO) in July 1995. This plan emphasizes: (i) to establish an industry-oriented and information-oriented society in order to cope with the expected change of the social environment in the coming century; (ii) to develop high technology and industry supported by intensive capital in order to produce value-added goods and services which should be competitive in the international market; (iii) to develop human resources through improvement of the education system to cope with the above-mentioned targets; and (iv) to promote the privatization of state economic enterprises and to reduce subsidies to private sectors in order to lessen the financial burden of the Government.

1.2.3 Agriculture

Although agriculture has become a less significant sector in the national accounts, it is still an important sector in the national economy, because it still accounts for 14% of the total output. In addition, about 41% of the population lives in rural areas where the main economic activity is agriculture, and 44% of the total work force is in agriculture.

The family-owned farm is the basic unit of agriculture production. Other types such as tenant farming and share-cropping are limited. According to the 1990 Agricultural Census, around 60% of farms have less than 5.0 ha of land, and the national average size of farm holdings is 5.3 ha. The degree of fragmentation in farm holding is high. Single-plot holdings

account for only 15% of the total number of holdings and around 60% are highly fragmented, consisting of four or more plots.

In addition to the above farm holding system, family members provide most of the farm labor. According to the OECD report in 1994, children, under 16 years old constitute an important part of seasonal labor in agriculture. Therefore, low educational levels of farm labor become a major problem in the rural area. The agricultural sector plays an important role to absorb the labor force.

Cereals are the dominant field crops in Turkey. Next major crops by cultivated area are pulses, followed by industrial crops, oilseeds, tree crops and horticulture. The production level shows a wide regional difference between high yields in the coastal area and low yields in the central and eastern areas. The production of major cereals, i.e., wheat, barely and maize, fell to 22.7 million tons in 1989 due to the severe drought. However, the production rose again to around 30 million tons from 1990 to 1993. Cotton, sugar beet and tobacco are not only industrial crops but also the most important commercial crops. The production of sugar beet and tobacco increased under the policy of price support, while the production of cotton tended to decline in recent years. The export amount of horticultural products such as fresh vegetables and fruits has been expanding recently, reaching more than 800,000 tons, or over 10% of the total agricultural export value in 1992.

More than 90% of farmers practice mixed farming with both crop and livestock production. The most important livestock products are cow milk, sheep meat and beef. The number of cattle decreased from 70 million in 1989 to 61 million in 1993. The production of meat also decreased around 20% during the same period, while milk production increased 8.0% due to the introduction of hybrid breeds.

1.2.4 Agricultural Development Policy and Strategy

The agricultural policy has been implemented based on the Five-Year Development Plans. The basic objectives of the plans are: (i) to meet the nutritional needs of the growing population; (ii) to increase the crop yield and production; (iii) to reduce the vulnerability of production under adverse climatic conditions; (iv) to develop the export potential of agricultural commodities; and (v) to develop rural areas .

The rapid population growth rate requires an increasing supply of agricultural products in order to maintain self-sufficiency. In addition, the Government is eager to raise the level of animal protein consumption closer to European countries in the long term, because Turkish people still largely depend on grains, fruits and vegetables for nutrition.

As cultivated lands have reached the limits, further growth of agricultural production needs to be achieved mainly by reducing fallow land and increasing yield. The target annual growth rate of agricultural production was set at 4.2%, consisting of 3.7% for crops and 4.9% for animal husbandry, during the Sixth Five-Year Development Plan. For crop production, the Government aimed to increase crop yields by promoting greater use of hybrid seeds,

pesticides, chemical fertilizers, and irrigation. For animal husbandry, expansion of fodder crops and introduction of hybrid breeds were promoted.

Irrigation is the most useful means for reducing the vulnerability of production under adverse climatic conditions. The Government has set a specific target for the expansion of the irrigation area since the First Five-Year Development Plan was adopted in 1961. The target was to expand the irrigation area to 53.4% of the total irrigable area by the end of the Sixth Five-Year Development Plan.

The Government also set targets for exports of both raw and processed agricultural commodities. The Sixth Five-Year Development Plan aimed to increase exports of agricultural products at an annual rate of 2.8% for crops, 6.3% for livestock and livestock products, and 11.7% for processed food.

The rural development policy has aimed essentially at upgrading the economic and social infrastructure in rural areas in order to raise the living standards and to reduce the rate of migration to urban areas. The policy was also focused on the upgrading of transport and telecommunication facilities and improvement of Government services including education, health care and sanitation.

The Government also put a main emphasis on the support of producer price and the subsidization of farm inputs in its development policy in order to enhance agricultural productivity.

1.2.5 Irrigation Development and Services

(1) Past Achievements in Irrigation Development

Water is a major limiting factor for agriculture in many parts of Turkey, and therefore the successful development and management of irrigation infrastructure is of great importance for the future development of Turkey's agriculture. According to a World Bank report (1993), the average value added per unit irrigated area is 2.6 times that of a rainfed area, because annual precipitation is less than 500 mm in 70% of the country land.

In 1993, the total area equipped with irrigation facilities implemented by the Government was estimated at 3.2 million ha, which corresponded to an annual growth rate of 3.5% since 1970. In addition to this area, about 900,000 ha of land has been provided with irrigation facilities by farmers themselves. Thus, the total area equipped with irrigation facilities amounts to 4.1 million ha, which corresponds to 14.8% of the total agricultural land of 27.7 million ha in Turkey.

(2) Necessity of Irrigation Development

The above-mentioned total agricultural land is unlikely to increase due to topographical and geological limitations and the awareness of the need to protect watersheds of rivers with forest cover. Considering these limitations on the future extension of agricultural land, therefore, agricultural GDP should be enhanced by increasing the productivity per hectare

mainly through irrigation development. This would contribute to the deceleration of the rate at which workers leave their villages in pursuit of non-agricultural jobs in urban areas. According to DSİ estimate, about 8.5 million ha could be irrigated by using both surface water and groundwater.

(3) Government Policy of Irrigation Development

The basic objectives of irrigation development in the Government policy are to:

(i) increase agricultural production through the application of irrigation technologies appropriate to diverse climatic and soil conditions and with the minimum detrimental effects to the environment;

(ii) enhance the credibility of the irrigation system through improvement in the management of the existing irrigation system;

(iii) provide irrigation facilities for the maximum area of land by implementing economically, technically and environmentally sustainable projects with the participation of farmers; and

(iv) reduce the Government's involvement in construction, maintenance and operation of irrigation schemes by gradually increasing the participation of organized users without having an adverse impact on the effectiveness of the different stages of the implementation of irrigation development.

1.2.6 Governmental Agencies Related to The Project

(1) General Directorate of State Hydraulic Works

The General Directorate of Hydraulic Works (DSİ) was established under the Ministry of Public Works and Settlement in 1954. DSİ has 15 Departments in its organization and 25 Regional Directorates, one of which is the DSİ Second Regional Directorate located at İzmir (Figures 1.2.1 and 1.2.2). This organization is responsible for the planning, design, implementation and operation of water resources development for the purposes of large-scale irrigation, hydro-power, domestic and industrial water, river training and flood control, and is also responsible for the allocation of surface water to the respective sectors and licensing for groundwater development.

DSİ has 25,400 staff in total, of which 4,300 people are technical staff. During the summer time, the total number of staff increases to about 40,000 because of the employment of seasonal workers. The total budget of DSİ for the investment program in the last 4 years is as shown in Table 1.2.1 and summarized below.

Year	Budget	
	(TL billion)	(US$ million equiv.)
1992	7,583	1,105
1993	13,405	1,222
1994	24,380	822
1995	22,543	526

Source: Investment Program (Yatırım Programı), SPO

(2) General Directorate of Rural Services

The General Directorate of Rural Services (GDRS) was formerly established under the Ministry of Agriculture and Rural Affairs incorporating the existing governmental agencies of the Soil Conservation and Irrigation Organization (TOPRAKSU), the Rural Settlement Organization (TOPRAK-ISKAN) and the Rural Roads, Water and Electricity Organization (YOL SU ELEKTRIK). However, this Directorate is now under the Prime Ministry.

This organization, having 13 Departments and 22 Regional Directorates (Figure 1.2.3 and 1.2.4), is responsible for rural roads, drinking water supply to rural area, communal buildings, small reservoirs and small scale irrigation schemes supplying less than 500 lit/sec of irrigation water or irrigating less than 1,000 ha, land consolidation and on-farm development.

The total budget of GDRS for the investment program in the last 4 years is as shown in Table 1.2.1 and summarized below.

Year	Budget	
	(TL.billion)	(US$ million equiv.)
1992	3,928	572
1993	6,824	622
1994	13,149	443
1995	7,924	185

Source: Investment Program (Yatırım Programı), SPO

(3) Ministry of Agriculture and Rural Affairs

The Ministry of Agriculture and Rural Affairs (MARA) has four principal general directorates; G.D. of the Development of Agricultural Production (GDDAP), G.D. of Protection and Control (GDPC), G.D. of Organization and Support (GDOS), and G.D.of Agricultural Research (GDAR) and is responsible for assistance in the elaboration and implementation of agricultural policies.

GDDAP is responsible for the planning, coordination and evaluation of agricultural research and project supervising, and helping the improvement of crop production, livestock production and fishery production, agricultural inputs, etc. GDPC is responsible for establishing and enforcing rules regulating the import, manufacture, sale and utilization of agro-chemicals, carrying out the necessary inspections and quarantine, etc. GDOS is responsible for assisting in the procurement, supply and distribution of all agricultural inputs and in the organization of farmers' cooperatives, farmers' education and training, etc. GDAR is responsible for carrying out research for technology improvement of farming practices, plant protection, veterinary and livestock feeding, etc.

In addition to the above general directorates, there is the Department of Foreign Affairs and EC which is in charge of international coordination in the agricultural field, and two affiliated units of G.D. of Agricultural Reform and Directorate of Atatürk Farm. Under the above central office, there is the provincial organization in each province. The Provincial Office headed by the provincial director consists of mainly 6 divisions for (i) statistics, (ii) crop protection, (iii) livestock health, (iv) farmers training and extension, (v) supporting of farmers'

association, farm inputs procurement, and (vi) control of food and agro-industries, and district offices. The organization charts of MARA and Provincial Office of İzmir are shown in Figure 1.2.5 and Figure 1.2.6 respectively.

The total budget of MARA for the investment program in the last 4 years is as shown in Table 1.2.1 and summarized below.

Year	Budget	
	(TL. billion)	(US$ million equiv.)
1992	480	70
1993	719	66
1994	1,237	42
1995	1,835	43

Source: Investment Program (Yatırım Programı), SPO

PART - II

MASTER PLAN FOR THE KÜÇÜK MENDERES RIVER BASIN

2.1 Present Condition of the Küçük Menderes River Basin

2.1.1 Location and Administration

The Küçük Menderes river basin covers 3,510 km^2 located mainly in the Aegean Region of western Turkey, within North latitudes 37° 53' - 38° 23' and East longitudes 27° 10' - 28° 23'.

The river basin mainly extends in seven districts: Beydağ, Kiraz, Ödemiş, Tire, Bayındır, Torbalı and Selçuk of İzmir province. These districts cover 92% of the river basin, and the remaining area of 8% is partly included in the Menderes district (3%), the Kemalpaşa district (3%) in the İzmir province, Manisa province (1%), and Aydın province (1%). The seven districts cover 262 municipalities and villages in total as detailed in Annex-F, and summarized below.

District	Total Area of Districts	River Basin		No. of Villages**
	(km^2)	(km^2)	(share)	(numbers)
Beydağ	167	144	4%	19
Kiraz	586	384	11%	38
Ödemiş	1,079	811	23%	72
Tire	802	586	17%	49
Bayındır	588	541	15%	40
Torbalı	600	566	16%	36
Selçuk	295	214	6%	8
Sub-total	4,117	3,245	92%	262
(Others*)		265	8%	
Total		3,510	100%	

*: The Menderes and Kemalpaşa districts and Manisa and Aydın provinces.
**: Number of municipalities and villages in the basin.
Source: The river basin is measured by the Study Team. The total area of districts and number of villages are derived from the 1990 Population Census.

2.1.2 Population and Labor Force

According to the latest 1990 Population Census, the total population in İzmir province was 2,695,000 with an average annual growth rate of 3.0% since 1985. About 79% of the total population, 2,135,000 persons, stayed in urban areas, showing a high growth rate of 3.4% per annum. On the other hand, the rural population was 21% or 560,000, showing a low growth rate of 1.6% per annum. Those rates are higher than the national averages for both urban and rural areas. It is considered that the main factor behind this higher growth rate is internal migration from eastern Turkey. The population in the river basin was estimated to be about 428,000 in 1995. The main indicators of the 1990 Population Census are summarized below (Annex-F):

	Indicators	Turkey		Izmir		River basin***	
Total	Population	56,473,000		2,695,000		407,000	
	Annual growth rate*	2.17%		3.01%		1.0%	
- Urban**	Population	33,326,000	(59%)	2,135,000	(79%)	158,000	(39%)
	Annual growth rate*	2.18%		3.40%		1.4%	
- Rural**	Population	23,147,000	(41%)	560,000	(21%)	249,000	(61%)
	Annual growth rate *	-0.56%		1.60%		0.7%	

*: Average annual growth rate during 1985 to 1990.
**: Urban areas include province centers and district centers; rural areas include municipalities/villages in the districts and sub-districts.
***: Total in 7 districts of Beydağ, Kiraz, Ödemiş, Tire, Bayındır, Torbalı and Selçuk.
Source: 1985 and 1990 Population Census, SIS.

The total population in the river basin was 407,000 in 1990, composed of 158,000 (39%) in urban areas and 249,000 (61%) in rural areas. The average annual growth rate during the 1985 - 1990 period was 1.0% in the whole river basin. The population density was 99 people/km^2, ranging from 70 people/km^2 in Kiraz to 119 people/km^2 in Ödemiş and Torbalı.

The average family sizes at the level of main municipalities (province centers), district centers and sub-districts/villages in İzmir province are as shown below. It may be inferred that the average size of a household is 4.00 in the river basin.

	Whole Province	Main Municipalities	District Centers	Sub-districts & Villages
Total Resident Population	2,512,000	1,673,000	329,100	509,700
Total Number of Household	650,400	434,300	88,200	127,900
Average Size of Household	3.86	3.85	3.73	4.00

Source: 1990 Population Census (Social and Economic Characteristics of Population), SIS.

According to the population by age group in İzmir province shown in Annex-F, the population in the age group of 20 to 44 shows a decrease in rural areas and an increase in urban areas. It indicates that this generation migrates from rural areas to urban areas.

According to the employment status of the population of more than 12 years old shown in Annex-F, the employment rate in rural areas is 99%, which is significantly high compared with 92% in urban areas. About 80% of the economic active population is engaged in agriculture, and the remainder may be engaged in activities related to agriculture, such as processing of agricultural products, merchants and workers for agricultural businesses.

2.1.3 Natural Conditions

(1) Topography

The Küçük Menderes river basin narrowly extends almost in the East-West direction. Its length is about 110 km and the average width is 30 km ranging from 15 km to 50 km. The basin is surrounded by high mountains ranging from EL.400 m to EL.2,200 m. The slopes of the mountains in the northern side of the basin are rather gentle and provide good pockets for the storage dam construction along the tributaries, while those of the mountains on the southern

side of the basin are very steep and hardly provide the possibility of storage dam construction, except some tributaries.

In the central part of the river basin, there extends a flat plain, most of which is being used as farmlands. This plain is mainly occupied by undulating terraces along the skirts of the mountains, Piedmont alluvial plains in a large part of the plain, and alluvial plains on both banks of the Küçük Menderes river. The plain slopes down towards the Ktiçük Menderes river at an average gradient of 0.3 ~ 0.5% on the right bank and 0.5 ~ 1.0% on the left bank, and also slopes down westwards at an average gradient of 0.1%.

In the downstream part of the plain, there exist a wetland and a swamp: the Eleman wetland (1,500 ha) and the Belevi swamp (30 ha). The Eleman wetland is located near the Küçük Menderes river mouth and is affected by the intrusion of flood water as well as sea water due to its low topography. The swamp is located near Belevi and used to be flooded by the water collected from the narrow strip bounded by the mountains and the Belevi - Tire road. After the Kurutma canal connecting the swamp to the Küçük Menderes river was constructed, the swamp could be dried in the dry season but still is in a swampy condition in the rainy season.

(2) Climate

The Küçük Menderes river basin is located in the Aegean Climatic Zone. It is hot and dry in summer and warm and rainy in winter. Mean annual precipitation in the catchment area of the Küçük Menderes river is estimated at 705 mm, taking an average of rainfall data in concerned stations. About 80% of rainfall has been recorded in the period from November to April (Annex-A).

Monthly mean temperature varies from 6.9 °C in January to 27.6 °C in August (at the Ödemiş station). The extreme maximum temperature has been recorded at 46.6 °C in July. Relative humidity is high in winter and low in summer, ranging from 50% in July to 76% in December. Pan-evaporation (ETpan) data is available from the Ödemiş, Bayındır, Tire and Selçuk stations in the river basin. Annual evaporation in the river basin is estimated at 1,560 mm. Wind direction of WS is frequent in winter, and the direction of NE excels in summer. Wind velocity in the river basin seems to be influenced by the topographic condition. The highest wind velocity of 26.7 m/sec has been observed in Ödemiş.

Meteorological data of the three representative stations in the river basin are summarized in Table 2.1.1. The locations of the meteorological stations used in the Study and their observation periods are as shown in Annex-A.

(3) Hydrology

The Küçük Menderes river basin is a depression surrounded by high mountains and affected by floods mainly caused by heavy rains generally falling within a 4 to 5 month period between November and April.

In order to estimate the water potential of the Küçük Menderes river, some stream gauging stations have been established within the river basin at various dates. The locations of these stations, observation periods and some other characteristics are shown in Annex-A. The observation records of the stream gauging stations of 6-01 (Köprüsü) with a catchment area of 444 km^2, and 601 (Selçuk) with a catchment area of 3,255 km^2 are used for the estimate of the monthly mean discharge of the river basin.

The monthly mean discharge values at the stream gauging stations of 6-01 and 601 and the whole river basin, which has a catchment area of 3,510 km^2 at the outfall point to the Aegean Sea, are given in the following table, and the discharge values at the tributaries of the Küçük Menderes river, on which storage dam sites are identified, are shown in Table 2.1.2 (Annex-A).

(m^3/sec)

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Annual Average
6-01 (Köprüsü)	0.61	1.15	3.45	5.49	5.76	5.44	3.78	2.06	0.64	0.26	0.18	0.29	2.43
601 (Selçuk)	1.58	4.02	15.38	27.92	32.00	26.38	15.98	8.73	3.90	0.92	0.17	0.61	11.47
Whole river basin	1.70	4.33	16.58	30.10	34.50	28.44	17.23	9.41	4.20	0.99	0.18	0.66	12.36

Table 2.1.2 also shows the floods with various recurrence intervals and sediment loads at all the identified dam sites.

(4) Geology

The base rocks of the Küçük Menderes river basin are composed mainly of a highly metamorphosed rock complex called Menderes Massif, which was formed mostly by the Alpidic Tectogenesis. Mesozoic limestone and neogene conglomerate, limestone and silt stone overlie the Menderes Massif and are distributed along the Aegean Coast. The area was fractured into blocks by west to southwest striking faults causing horsts' and grabens' morphological shapes where grabens are filled by alluvial sediments (Figure 2.1.1).

The Menderes Massif was formed by dome-shaped uplift, where, in the case of the Küçük Menderes river basin the core part is located in the inner land and some parts in the coastal area. The core of the massif is highly metamorphosed gneiss and leptite surrounded mostly by mica schist. They are further surrounded by less metamorphosed rocks of marble in most parts and phyllite in some parts.

Stratigraphy and their general lithology in the Study Area are shown in the following table with their distributing areas (Annex-B):

Strata		Lithology	Distributing Area
Fan Deposit		Gravel, Sand, Silt, Clay	develops at the mouth of river from the mountainous area to the plain area. The scale of the northern mountain foot is larger than that of the southern foot according to their river scales, especially that distributing at the foot of Bozdağ mountain develops very well.
Alluvial Deposit		Gravel, Sand, Silt, Clay	forms Plain areas from Kiraz,Beydağ, Ödemiş, Tire, Bayındır or from Pancar, Torbalı to Belevi, Selçuk.
Neogene Deposit		Siltstone, Conglomerate, Limestone	forms the northern & western hilly areas from Torbalı to Pancar, Menderes.
Menderes Massif	Upper part	Marble	forms the southern and western mountainous areas from Tire to Selçuk and Değirmendere.
	Lower part	Phyllite, Mica-Quartz Schist, Mica Schist	Northern side: forms the mountains located in the northern direction of Ödemiş and the mountains of northern side from Bayındır to Torbalı. Southern side: forms the mountains of southern side from around Beydağ to around Tire.
	Mantle	Mica Schist (Mainly Biotite Schist)	forms the mountains around Bozdağ and the side of mountains from Ödemiş to Bayındır.
	Intrusive rocks	Granite, Amphibolite, Serpentine	forms the side of mountains located in the northern direction of Birgi. Serpentines are around Tire and Belevi.
	Core	Gneiss, Leptite	forms the mountainous area around Kiraz.

(5) Hydrogeology

Hydrogeologically, the strata in the Küçük Menderes river basin may be largely divided into four formations: metamorphosed rocks, marble, neogene sediment, and alluvium.

The main aquifer in the basin is of the alluvium spreading widely along the Küçük Menderes river, though the groundwater within fissures or cavities in marble or neogene sediments can not be ignored. The metamorphosed rocks, marble and neogene sediments are hydrogeologically aquiclude or aquitard, and the alluvium, which lies very thickly and fills in morphologically very deep underground valleys of rock basement, forms a large scale of aquifer in the basin.

The groundwater basins in the area are divided into the following six basins from their distributions (Annex C).

Area	Basements (Aquiclude, Aquitard)	Aquifer
1. Kiraz	The Core Part of the Menderes Massif	Alluvium
2. Ödemiş- Tire	The Mantle Part of the Menderes Massif	Alluvium
3. Bayındır - Torbalı	The Lower Level (Schist) to Upper Level (Marble) of the Outer Part of the Menderes Massif	Alluvium
4. Pancar - Torbalı	The Upper Level of the Outer Part of the Menderes Massif (Marble), Neogene Sediment	Alluvium, Neogene, Marble
5. Tire - Belevi	Mainly the Upper Level of the Outer Part of the Menderes Massif (Marble)	Alluvium, Marble
6. Selçuk	Mainly the Upper Level of the Outer Part of the Menderes Massif (Marble)	Alluvium, Marble

Among them, two plains (Ödemiş-Tire and Bayındır-Torbalı) are composed of very thick alluvium (maximum thickness: 240 to more than 300m), which forms natural

underground dams and, as a result, the groundwater in the area seems to gather mostly into these two basins.

The hydrogeologic properties of the above two plains are summarized as follows:

Alluvial basins	Composition of surface layers	Composition of aquifer	Permeability		Thickness of alluvium	Depth of deepest bottom of Alluvium
Ödemiş - Tire	Fan Deposit distributes at the mouth of the stream from the northern & southern mountains (width is approx.6~7 km). The deposits along other mountain foots and flood deposits along the main channel are composed mainly of sands to fine soil.	The layer of the mountain side is composed of a mixture of gravel and fine soils. There are more gravel layers nearer the center of the basin.	Tire Kahrat, around	(approx. 1E-1cm/s)	from 70 to over 300m	lower than - 250m
			Beydağ~Ödemiş, Yeniçeköy	(1~5E-2cm/s)		
			Gökçen~Adagide, mountain foot	(E-4cm/s order)		
			Gökçen,around	(5~9E-3cm/s)		
			Ödemiş~Tire, mountain side	(1~5E-3cm/s)		
Bayındır - Torbalı	The approx. 3km wide stretch along the northern mountain foot consists mainly of gravel of Fan deposits. The southern side of the above consists mainly of sand to fine soils of flood deposits and so on.	The eastern mountain foot and the center of the basin consist mainly of gravel. On the other hand, the northern and southern mountain feet and the western side consist of a mixture of gravel and fine soils.	Bayındır Yösuflu, Buruncuk, around	(5~9E-2cm/s)	from 30 to a little more than 240m	lower than - 200m
			Bayındır Elifli, Torbalı Çaybaş, around	(E-4cm/s order)		
			Main channel, along	(1~5E-2cm/s)		
			Canlıköy~Torbalı, mountain foot	(5~9E-3cm/s)		
			Southern hills, mainly along	(1~5E-3cm/s)		

Based on the data of 1992, the mean hydraulic gradient along the main channel is as follows:

From Kiraz to just downstream of Beydağ:	usually (5.7~7.4) x 1/1,000
The Ödemiş-Tire area:	(2.0~2.2) x 1/1,000
The upstream side of the Bayındır- Torbalı area:	(1.7~1.8) x 1/1,000
The downstream side of the Bayındır- Torbalı area:	(0.3~0.6) x 1/1,000
The Selçuk area:	(0.1~0.2) x 1/1,000

(6) Soil and Irrigation Suitability of Land

(a) Soil

Various governmental organizations and authorities have conducted studies for soil classification in the Küçük Menderes river basin or İzmir province. The following soil classification maps and reports are available through these studies:

- Provincial soil map on a scale of 1:100,000, GDRS (1974),
- Provincial soil map on a scale of 1:25,000, GDRS (1982),

- Soil classification map on a scale of 1:100,000 in the Küçük Menderes River Basin Area, Department of Tropical Soil Science, Agricultural University, the Netherlands (1972), and
- Soil classification map on a scale of 1:25,000 of the Ödemiş Area, DSİ-II (1971).

The provincial soil maps were prepared by GDRS at the reconnaissance level on the basis of topographical maps and aerial photographic interpretation. The detailed soil classification map prepared by DSİ-II is limited to the Ödemiş area. The soil classification map prepared by the Netherlands is at a semi-detailed level, including results of field investigation and laboratory analysis of the soil profile, and covers the whole river basin. Based on the soil classification map prepared by the Netherlands, therefore, the soil units in the river basin were confirmed with some additional information collected through the field survey conducted under the Study.

The soil units are physiographically defined by their geomorphology, parent materials and soil texture. In total, 31 soil units were identified in the river basin. The characteristics of soil units and their relationship with the soil classification system of Soil Taxonomy of the USDA are shown in Annex-D. The soil classification map thus prepared is illustrated in Figure 2.1.2.

(b) Irrigation Suitability

Based on the result of the above soil classification, the irrigation suitability classification was carried out in order to assess the land resources potential for irrigation in the river basin. According to the irrigation suitability classification by the US Bureau of Reclamation (USBR) system, the classification criteria is defined as follows:

Irrigation Suitability		Definition
Class I:	Irrigable	Lands are highly suitable for irrigation farming, being capable of producing sustained and relatively high yields in a wide range of climatically suited crops at reasonable cost.
Class II:	Irrigable	Lands are moderately suitable for irrigation farming, being measurably lower than Class I in productive capacity, adapted to a somewhat narrower range of crops, more expensive to prepare the land for irrigation or more costly to farm.
Class III:	Irrigable	Lands are marginally suitable for irrigation farming, being of distinctly restricted suitability because of more extreme deficiencies in the soil, topographic or drainage characteristics than described for Class II.
Class IV:	Irrigable for Special Crops	Lands are suitable for irrigation farming to only a very limited range of crops such as rice or fodder crops. The irrigation suitability is evaluated for various crops in this Study. This class is, therefore, not included in this Study.

(to be continued)

	Irrigation Suitability	Definition
Class V	Provisionally non-irrigable	Lands are temporarily not suitable for irrigation farming due to specific limitations in soils, topography or drainage condition. The land in this class are necessary to be improved for the use of irrigated agriculture.
Class VI:	Non-irrigable	Lands are not suitable for irrigation farming due to excessive severe limitations in soils, topography or drainage condition. The class is non-arable under the existing or projected economic condition.

The water holding capacity, soil texture, erosion hazard, rock content, topographic condition, soil depth, drainage condition and soil fertility are taken into consideration as the specifications for the land classification, referring to the soil classification report prepared by the Netherlands (1972). The specifications for land classification are shown in Annex-D. Based on these specifications, the irrigation suitability classification is evaluated as shown in Table 2.1.3 and illustrated in Figure 2.1.3. The result is summarized below:

Suitability Class	Area (ha)	Proportion(%)
Class I	28,100	8
Class II	28,200	8
Class III	51,700	15
Class IV	-	-
Class V	20,200	6
Class VI	217,800	62
Built-up Area	5,000	1
Total	351,000	100

Of the classified 351,000 ha, around 108,000 ha, or 31%, which are included in Class I to III, are suitable for irrigation farming in the Küçük Menderes river basin. Most of the soils in mountainous or hilly areas are not suitable for agriculture except tree crops plantation, due to shallow soil and steep slope, while most of the soils in flat to gently sloping areas are suitable for irrigated agriculture. Problem soils, such as salinity or sodic soil, are not found in the river basin except the wetland near Selçuk, which is located in the western most part of the river basin.

(7) Flooding Conditions

According to the Flood Year Book published by DSİ, remarkable flood damage has occurred 7 times in the period from 1945 to 1954. Under such flooding conditions in the basin, DSİ has been making efforts to implement flood protection and drainage improvement works. These works have effectively been working and have much improved the drainage conditions in the basin. Actually no flood damage was reported in the basin for the period from 1955 until now, except in December 1981 when a big flood occurred along the Küçük Menderes river and its tributaries.

The flooding started from 14th December 1981 and continued for 4 days. Total rainfall recorded in these 4 days was 102 mm at Beydağ, 81 mm at Kiraz, 137 mm at Ödemiş, 105 mm at Bayındır, and 111 mm at Tire. This rainfall caused the peak flood of 240 m^3/sec at Beydağ

and 690 m^3/sec near Selçuk, which covered about 30,000 ha of farmlands along the Küçük Menderes river and its tributaries.

Other than the above-mentioned floods, there is occasional flooding in small spots along the Küçük Menderes river and its tributaries such as the Kiraz, Uladı and Rahmanlar rivers almost every year, but these do not seriously affect the riparian people and farmlands.

2.1.4 Rural Infrastructure

(1) Roads

The road network in Turkey is well developed as a whole. İzmir, the capital of İzmir province, is connected to Ankara by the Highways E90 and E96 via Afyon, of which the total length is 560 km. İzmir is also accessible by other highways via Bursa or Konya. In the Küçük Menderes river basin also, the road network is well developed as listed below.

(Unit : km)

Kind of Road	Bayındır District	Beydağ District	Kiraz District	Ödemiş District	Selçuk District	Tire District	Torbalı District
- Asphalt	81	28	55	204	34	112	121
- Gravel	59	37	221	71	0	75	20
- Earth	105	80	338	208	3	202	29
Total	245	145	614	483	37	389	170

(2) Air Routes

A domestic/international airport is located in İzmir. Two to four flights are available daily between İzmir and Ankara. In addition to these flights, six to eight flights between İzmir and İstanbul and one flight in two days between İzmir and Adana is also available.

(3) Electricity

Rural electrification is highly developed in the river basin and almost all houses are electrified at a high standard.

(4) Telecommunications

A telephone system is available in every village in the river basin and it is estimated that more than 60% of houses are equipped with telephone facilities.

(5) Domestic Water Supply

In both urban and village areas in the river basin, domestic water is supplied by means of tube wells, dug wells, springs and others. At present, there is no water supplying problems in the river basin, but in the future, rapid urbanization will worsen the water shortage in urban areas, particularly in Bayındır, Ödemiş and Tire. The number of the present water supply facilities in the river basin are as follows:

(Unit : numbers)

Kind of Water Sources	Bayındır District	Beydağ District	Kiraz District	Ödemiş District	Selçuk District	Tire District	Torbalı District
Tube well	18	7	13	30	3	18	17
Dug well	2	1	20	6	1	5	3
Spring	26	28	81	52	4	58	15
Others	6	15	119	30	0	26	2

(6) Other Public Facilities

The existing educational and medical facilities are shown below.

(Unit : numbers)

Kind of Facilities	Bayındır District	Beydağ District	Kiraz District	Ödemiş District	Selçuk District	Tire District	Torbalı District
Schools							
Pre-school	0	1	0	10	4	10	3
Primary school	50	28	71	96	14	77	46
Junior high school	3	1	4	11	5	7	9
Senior high school	5	1	1	3	3	7	6
University & College	0	0	0	1	0	1	1
Medical facilities							
Hospital	1	0	1	1	1	1	1
Health center	0	1	1	0	0	0	0
Health house	5	1	4	14	2	7	10

2.1.5 Agriculture

(1) Land-holding and Land Tenure

There are 66,600 farm households in total within the seven districts in the Küçük Menderes river basin as shown below (Annex-E).

(Unit : number of households)

Farm size(ha)	Beydağ	Kiraz	Ödemiş	Tire	Bayındır	Torbalı	Selçuk	Total
0 - 0.9	1,991	5,108	13,037	3,139	1,870	1,225	394	26,764
1.0 - 1.9	940	2,064	7,786	2,493	2,615	1,738	384	18,020
2.0 - 4.9	695	615	3,414	2,493	2,905	2,732	938	13,792
5.0 - 9.9	195	135	903	1,650	1,635	1,123	722	6,363
10.0 - 19.9	33	0	94	308	333	355	224	1,347
20.0 - 49.9	3	0	0	82	38	116	39	278
50.0 <	0	0	0	25	0	19	4	48
Total	3,857	7,922	25,234	10,190	9,396	7,308	2,705	66,612
Farm land (ha)	5,584	9,863	38,825	36,210	30,919	32,790	14,586	168,777
Average size (ha)	1.4	1.2	1.5	3.6	3.3	4.5	5.4	2.5

Source: "Agricultural Structure and Production", 1993 , Provincial office of MARA, İzmir , SIS.

The average farm size in the river basin is estimated at about 2.5 ha, which is far smaller than that of the national average (5.2 ha/household). About 40% of farm households are cultivating less than 1.0 ha. Only 12% of the total households have a farm size of more than 5.0 ha, but they occupy more than 45% of the total farmland in the river basin. The average farm size tends to be larger towards the lower reaches of the Küçük Menderes river because of the geographical position along the respective reaches of the river. The average farm size in Beydağ, Kiraz and Ödemiş, located along the upstream reaches, where the area is predominantly covered by mountains, is less than 2.0 ha, while it is 3.5 and 3.3 ha

respectively in Tire and Bayındır, located along the middle reaches. In the flat areas along the lower reaches including Torbalı and Selçuk areas, the average farm size comes to 4.5 to 5.4 ha.

Farm households may be categorized into three farming types as shown in the following table.

(Unit: number of households)

Farming Type	Beydağ	Kiraz	Ödemiş	Tire	Bayındır	Torbalı	Selçuk	Total
Crops	452	4,597	11,463	5,426	8,060	4,634	1,760	36,392 (55%)
Crops & Livestock	3,297	3,325	13,550	4,316	1,315	2,477	937	29,217 (44%)
Livestock	108	0	221	448	21	197	8	1,003 (1%)
Total	3,857	7,922	25,234	10,190	9,396	7,308	2,705	66,612

Source: "Agricultural Structure and Production", 1993, Provincial office of MARA, İzmir, SIS.

As shown in the above table, about 55% of farm households cultivate crops only, and about 44% are engaged in both crop and livestock production. The rate of households engaged in livestock production only is as small as 1%. As for Bayındır, the farming type involving crop cultivation only is predominant (85.8%), while crop cultivation combined with livestock production is the major farming type (85.5%) practiced in Beydağ.

According to the agricultural census in 1991, the current land tenure situation in İzmir province shows that 84% of farm households are owner farmers and 4% are tenant farmers. The remaining 12% include the farmers who cultivate both their own and rented lands and share croppers as shown in the following table.

Farm size	Total		Operating own land		Renting land, not on lease		Operating only rented land		Share croppers		Other tenure types	
(ha)	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area
0.5>	9,683	2,673	9,058	2,431	342	137	283	1,050	0	0	0	0
0.5 - 0.9	14,973	9,646	13,391	8,629	481	337	930	5,951	0	0	171	86
1.0 - 1.9	26,852	37,854	22,902	32,401	1,239	1,986	2,443	30,817	168	385	0	0
2.0 - 4.9	43,691	127,611	36,981	106,249	5,777	18,142	933	32,211	0	0	0	0
5.0 - 9.9	17,007	113,060	13,348	91,003	3,243	19,100	416	29,566	0	0	0	0
10.0 - 19.9	5,212	67,488	2,607	33,465	2,605	34,023	0	0	0	0	0	0
20.0 - 49.9	1,619	42,399	1,282	34,791	288	6,530	0	0	49	1,078	0	0
50.0 - 99.9	3	169	3	169	0	0	0	0	0	0	0	0
100.0 - 249.9	4	580	4	580	0	0	0	0	0	0	0	0
250.0 - 499.9	2	726	2	726	0	0	0	0	0	0	0	0
500.0<	0	0	0	0	0	0	0	0	0	0	0	0
Total	119,046	402,204	99,578	310,443	13,975	80,254	5,005	9,960	317	1,463	171	86
(%)	100.0		83.6		11.7		4.2		0.3		0.1	

Remarks; No.:number of holdings. Source: Agricultural Census, 1990, SIS.

This proportion may be similar to that in the whole river basin. The problem of land tenure in the river basin is that ownership has been divided into small parcels through the succession of land heritage by generation changes. This situation may continue in the future, if no countermeasure is taken.

(2) Land Use

A soil classification map on a scale of 1:25,000 was prepared by GDRS (1982) based on the topographical map and aerial photographic interpretation. This soil map includes

various information concerning soil types, land use, slope classification, erosion hazard, and land capability.

In the Study, the present land use in the Küçük Menderes river basin has been clarified based on this soil map. The distribution of land use pattern has been further confirmed through the field survey and analysis of statistic data from the Ministry of Agriculture and Rural Affairs (MARA). In total, eight land use categories are identified in the river basin. 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 yard	Area cultivated with tree crops under irrigation or rainfed condition	-
Pasture and grassland	Area covered with grasses for grazing livestock	-
Bushes	Area covered with scrubs	-
Forest	Area covered with forest	-
Urban and village yards	-	Small isolated houses are not included.
Others	Rivers, seasonal streams, major road, etc.	-

On the basis of the above definitions, the present land use map is illustrated in Figure 2.1.4 and the respective land use areas are estimated as follows (Annex D):

Land Use Category	Area (ha)	Proportion (%)
Agricultural land		
- Annual crops	129,600	37
- Tree crops	57,400	16
Pasture and grassland	23,400	7
Bushes	82,200	23
Forest	48,300	14
Urban and village yards	5,000	1
Others	5,100	1
Total	351,000	100

Of the total area of 351,000 ha, some 210,400 ha or 60% are used for agricultural production including livestock grazing in the river basin. Most of the annual cropping areas have been developed in flat to gentle sloping lands, including the alluvial plain and non-dissected fans, while the tree crops are grown in gently sloping to hilly lands. Pasture, grassland, bushes and forest, which occupy about 153,900 ha or 44% of the river basin, mainly extend in the higher lands, i.e. mountainous areas and hilly lands. From the above, it is understood that the present land use pattern is highly coincident with the physiographical conditions in the river basin.

(3) Cropping Pattern and Agricultural Production

The Mediterranean climate, which covers the Küçük Menderes river basin, allows the cultivation of a wide range of crops including cereals, potato, pulses, cotton, tobacco, oil

seeds, forage crops, vegetables and tree crops as well. The average cropped area for each crop is estimated by district for the recent five years as shown in Table 2.1.4.

Cotton is cultivated in the largest area, accounting for 18% of the total farmland, followed by wheat (14%), watermelons (6%), tobacco (5%), potatoes (4%). Forage crops (3%) are also important field crops in the river basin. Among the horticultural crops, watermelons, which is generally differentiated as "Bostan" together with melons from the other fruit-bearing vegetables, is the most popular fruit-bearing vegetables, and its planted area is predominant (49%) followed by cucumbers (13%), tomatoes (6%) and peppers (6%). By district, wheat is the main crop in Torbalı and Tire, while cotton is predominant in Tire, Torbalı, Ödemiş and Bayındır, tobacco in Tire and Ödemiş, potatoes in Ödemiş, and watermelons in Tire and Ödemiş.

As for tree crops, olive trees are grown predominantly (22% of the farmland) especially in Bayındır, Tire, Torbalı, and Selçuk. The total area cultivated with fruit trees, including figs, grapes, peaches and apples, is about 11%, of which 5% is for figs grown mainly in Ödemiş, Tire and Kiraz. Figure 2.1.5 presents the average cropping pattern of the main crops in the river basin, which is prepared based on the data provided by the Provincial Office of MARA and the information obtained through the farmers' household survey.

Irrigation is generally practiced for cultivation of summer crops, i.e. cotton, potatoes and most vegetables. Tobacco is usually grown under rainfed conditions. Such winter crops as wheat, barley, alfalfa and tree crops are, in most cases, grown under the rainfed condition, while in some areas where irrigation water is available, supplemental irrigation is also applied to these crops. Through the farmers' household survey, it is confirmed that most farmers have complained of a shortage of irrigation water.

The present cropping intensity is estimated at about 103% as shown in Table 2.1.4, varying from 100% in rain-fed areas, to 109% in irrigated areas including cultivation of green manure (called " Hasil") and some vegetables in the off-season of irrigation.

The average crop production in the river basin for the period of 1990 - 1994 is given in Table 2.1.5. The production of cotton accounts for more than half of the provincial production. Potatoes, watermelons, cucumbers and figs share about 70% to 90% of the provincial production. The crop production does not much fluctuate in general, but the annual production of olive and figs considerably fluctuates year by year, due to the alternate bearing.

The following table presents the average unit yields of major crops in the river basin. The yields of annual crops are generally higher than the national averages except for tobacco. The unit yields of vegetables and fruits are recognized to be moderate.

(Unit: ton/ha)

Field crops		Vegetables		Tree crops*	
Wheat	3.8	Watermelon	29.2	Olive	1.8
Barley	2.8	Melon	18.6	Figs	6.1
Cotton	2.7	Tomato	28.1	Grapes	9.4
Tobacco	0.8	Eggplant	26.2	Peach	10.8
Potato	26.2	Pepper	19.9	Apples	12.3
Alfalfa	13.4	Cucumber**	14.3	Pears	9.5
Maize	7.3	Cabbage	41.0	Mandarins	12.7
		Spinach	8.9	Chestnuts	8.7
		Beans	8.7		
		Others	7.9		

Remark *: Except olive and grapes, unit yields per hectare are estimated on the basis of the yield per tree with average production in the basin, because statistical data do not show the normal level.

**: Including those for pickles.

Source: "Agricultural Structure and Production" from 1990 to 1994, Provincial Office of MARA, İzmir.

(4) Farm Inputs and Labor Use

(a) Seeds and Seedlings

Sale of uncertified seeds and seedlings is legally prohibited in Turkey. Therefore, farmers regularly use certified seeds and seedlings for their crop production. Very few farmers use their own seeds (uncertified seeds) in the river basin. According to the Provincial Office of MARA in İzmir province, 107 farmers have received permission for seed retail by the end of 1992. Hybrid seeds have been widely used for some vegetables and field crop production since 1983. It is certified that the seedlings of fruit trees prepared in İzmir province have sufficiently high quality for plantation. More than one million seedlings are produced for 17 kinds of fruits every year. The nursery farms in Ödemiş supply 66% of vine seedlings required in the province.

(b) Fertilizers

The fertilizers predominantly used in the river basin are 15-15-15 compound, ammonia nitrate, ammonia sulphate, urea, etc. The total consumption of fertilizers in the province gradually tends to decrease, because of the frequent occurrence of drought in recent years and the decrease of government subsidies, though a large quantity of fertilizers is still applied in the river basin (Table 2.1.6). At present, the extension workers instruct proper dosage and fertilizer application technologies to farmers. Organic manure is applied at a rate of 30 to 40 tons per hectare every 2-3 years following the recommendation made by the extension workers. This dosage is, however, not sufficient to maintain soil fertilization.

(c) Agro-chemicals

Based on the record of total supply of agro-chemicals and the annual total cultivated area in 1994, the average dosage of agro-chemicals is estimated at 4.3 kg/ha in total, comprising 1.1kg/ha of insecticide, 1.3 kg/ha of fungicide, 0.9 kg/ha of herbicide, and 1.0 kg/ha of other products in İzmir province (Table 2.1.6). This dosage is very high as compared with those specified in other countries. It is considered that farmers tend to apply agro-chemicals on cotton and vegetables intensively. To prevent excessive use of agro-chemicals,

the extension workers prepare the specific application program every year and instruct farmers to use the proper amount of agro-chemicals.

(d) Agricultural Machinery

Tractors are widely used for cultivation as well as for transportation in the river basin. There are about 11,000 tractors, of which 80% are of more than 35 HP class. This means that the average farm land per tractor is about 15 ha. Farmers who hold larger farmlands have their own tractors. Small holder farmers usually ask those tractor owners to cultivate their farmlands. Tractor operation is charged at TL540,000/ha for ploughing and harrowing. There are no special agencies who contract such tractor operation.

Attachments for tractors mainly consist of disk plow, bottom plow, ridger and disk harrow. Farmers are also using such equipment as fertilizer applicators, sprayers, seed broadcasters, motor pumps for irrigation, etc. (Annex-E).

(e) Farm Labor Use

In the river basin, farm operations are practiced by farm families. Based on the census of population and agriculture in İzmir province, it is roughly estimated that an average family labor force is 2.3 persons in İzmir province. During busy farming seasons, some farmers help each other within their village. For planting and harvesting cotton, tobacco and summer vegetables, most farmers hire seasonal farm labors from outside of the village. Especially for cotton harvesting, many cotton pickers are hired from the eastern parts of the country.

(5) Livestock and Fishery Production

Livestock breeding is one of the essential economic activities in the river basin. Many farmers get income from livestock production and some farmers also use them for animal power in such works as transportation and cultivation. Table 2.1.7 presents the livestock population by district in the recent five years. The major livestocks in the basin are cattle, sheep, goats, and poultry, totaling about 110,000 heads, 172,000 heads, 36,000 heads, and 776,000 heads, respectively.

Some 85% of cattle bred in the river basin are pure-blooded and/or hybrid. This figure is far higher than the national average (45%), and indicates that the Küçük Menderes river basin is the most advanced area in cattle breeding in Turkey. Almost 80% of cattle breeders are, however, small and at the side-business level, holding only 1 to 2 heads/annum. In the case of major cattle producing areas like Ödemiş and Tire districts, the size of cattle breeding is as large as 10 to 50 heads per household. Most sheep and goats are of indigenous breeds.

Farmers graze their animals in their farmlands as well as communal grasslands of villages. Farmers grow forage crops like alfalfa, vetches and cereals as fodder crops applying the rotational cultivation system for annual crops. Some farmers graze their calves, sheep and goats in the grasslands located at higher mountainous areas during summer.

In general, forage production is not enough for feeding their own animals, and the meadows and pastures are also not adequate for successful and effective grazing. The communal meadows and pastures are heavily utilized, and therefore, overgrazing is bringing a serious degeneration of effective vegetation in these grasslands. Meadows and pastures used for sheep and goat grazing are shared at the rate of only 0.49 ha/head at present.

Major livestock products are cow milk, meat, fat, cheese and wool in the basin. Honey production is also popular especially in Bayındır, Tire and Torbalı districts. According to the provincial statistics in İzmir province in 1994, milk and cheese production are predominant, accounting for 50% and 60% of the total production in the basin, respectively (Table 2.1.7). The present higher cost for feeding against lower prices of livestock products is one of the economic constraints on livestock farming in this area.

There are a few inland fish such as carp and catfish in the lower reaches of the Küçük Menderes river, mainly in Selçuk district, but due to lack of available water bodies, inland fishery is hardly observed in other districts in the river basin. The fish catch in Selçuk district was 1,500 kg of carp and 500 kg of catfish in 1994.

2.1.6 Irrigation

(1) Irrigated Area and Existing Irrigation System

(a) Irrigated Area

In the Küçük Menderes river basin, irrigation is of great importance for the cultivation of crops particularly in the dry season from April to October due to the scarcity of rainfall in this period. There are two categories of irrigated areas depending upon the manner of organization for irrigation practice. One is the area irrigated by using groundwater, stream flow, and spring under the control of the irrigation cooperatives. Such irrigated area is estimated at 11,600 ha in total, consisting of 7,630 ha by groundwater, 2,260 ha by stream flow, and 1,710 ha by spring, as shown in Table 2.1.8 and Figure 2.1.6. The other is the area privately irrigated by using groundwater. The area in this category has been increasing because of the recent dry spell starting from 1986. The total irrigated area in this category is estimated at about 41,400 ha based on the statistics of agricultural products, results of reconnaissance, and the estimated number of wells constructed by farmers themselves. The irrigated areas thus estimated are summarized below:

Category	Number of Systems	Irrigated Area
1. Irrigation Cooperatives		
by groundwater	42 *	7,630 ha
by stream flow	32 *	2,260 ha
by spring	11 *	1,710 ha
Sub-total		11,600 ha
2. Private system	approx. 6,500**	41,400 ha
Total		approx. 53,000 ha

Note *: Irrigated area of each system varies year to year. These figures are taken from the "Küçük Menderes Havzasi Tesisleri" of DSİ-II.

** : The number of private irrigation systems and their irrigated areas are estimated based on the number of wells shown on the topographic map on a scale of 1/25,000 and the result obtained through the inventory survey on the existing wells.

The groundwater table has been lowering at an accelerated pace in the river basin. This adverse condition of groundwater might be caused by not only the recent scarcity of rainfall but also over-pumping of groundwater mainly for irrigation purposes.

(b) Irrigation Facilities

There is no irrigation system using surface water from the dam reservoir in the river basin. On the contrary, a lot of wells have been constructed by DSİ-II. Until now 208 wells have been dug by DSİ-II as the water sources for the irrigation schemes being operated by the irrigation cooperatives, and the demand for new well construction is increasing year by year.

The legal procedure for the construction of a well is that, upon the farmers request through GDRS, DSİ will start planning and hydrogeological investigation at its own expense, and the investigation results will be reported to GDRS. Then, the construction of the well will be started, if it is considered economically and technically justifiable. Before submitting their official request to DSİ for the well construction, the farmers have to show their intention to definitely organize an irrigation cooperative under the guidance of GDRS, before the completion of the well construction work. DSİ will construct a well and power supply system and hand them over to the irrigation cooperative after concluding an agreement between them. This agreement obligates the irrigation cooperative to pay the total investment cost within 25 years with a grace period of 5 years. GDRS will construct a main delivery system down to the tertiary canal system free of charge. The on-farm facilities will be constructed by the farmers themselves.

In addition to the above DSİ/GDRS-assisted wells, farmers have, at their own cost, constructed around 6,500 wells in the river basin, some of which have been constructed without reporting to DSİ. Other than these wells, GDRS, municipality/village offices or farmers have constructed 32 irrigation systems using stream flow and 11 systems using springs as water sources.

(2) Present Irrigation Practices

(a) Irrigation Method

In the river basin, two types of surface irrigation, furrow irrigation and border irrigation, are widely practiced except in a few areas where sprinkler and drip irrigation

methods are applied. Depending on the cultivated crops and soil characteristics, farmers select the appropriate irrigation method. According to the result of the irrigation survey conducted under the Study, the border irrigation method is partly applied for the cultivation of potatos, watermelons and poplar, while the furrow irrigation method is mainly applied for the cultivation of cucumbers, vegetables and other crops.

(b) Irrigation Efficiency

The present irrigation efficiencies were estimated for various crops based on the results of interviews of farmers on the quantity of irrigation water applied and the estimated water requirements. The irrigation efficiencies thus estimated are as shown below.

Crops	Irrigation Period	Irrigation Water Depth (mm)	Estimated Water Requirements (mm) *	Irrigation Efficiency (%)
Potato	Jul. - Oct.	755.0	395.6	52.4
Peach	Jun. - Oct.	822.9	656.9	(79.8)
Alfalfa	May - Oct.	1,074.0	702.6	65.4
Vegetables	Apr. - Oct.	848.3	558.3	65.8
Figs	Apr. - Jun.	169.3	-	-
Corn	Apr. - Oct.	986.2	-	-
Cotton	May - Sep.	980.8	493.4	50.3
Poplar	May - Oct.	1,238.4	656.7	53.0
Wheat	- May	306.0	159.1	52.0
Peas	- May	439.5	-	-

* : The water requirements are derived from the values given in this feasibility study.

The above-mentioned values are deemed to be the field application efficiencies, because the canal lengths in these irrigation areas are short and, therefore, the conveyance losses in these canals are deemed to be negligible. Considering the fact that the surface irrigation method is applied in the surveyed area, the values ranging from 50.3% to 65.8% seem reasonable and comparable with the DSİ's standard values of 50% to 60% for the surface irrigation method.

(c) Water Management

In the river basin, farmers are applying the rotational irrigation system in order to save water. In most of the irrigation cooperatives, the irrigation rotation is basically decided based on the farmers' request. In case the requests are made on the same day by more than two farmers, the pump operator adjusts their turn and gets their consent to the adjusted irrigation schedule. According to the result of interview surveys on the actual irrigation condition, the irrigation interval varies considerably from 4 to 18 days depending on the cultivated crops, soil characteristics, and availability of water.

As mentioned above, the farmers are maintaining a reasonable irrigation efficiency and managing the irrigation system in a satisfactory manner. From these facts, it is judged that there would be no difficulty in introducing a modernized irrigation system to the river basin in the future.

(3) Operation and Maintenance

(a) Organization

In the river basin, the most common and systematized irrigation organization is the irrigation cooperative which is established in the DSİ/GDRS-supported well irrigation area. The establishment of the irrigation cooperative is a prerequisite for the construction of the well by DSİ. This cooperative should consist of more than 50% of the farmers in the area to be irrigated by the well, and should be registered in the GDRS Regional Office before the completion of the well construction by DSİ. The cooperative thus established should be responsible for all water management and O&M activities. Technical advice is given by DSİ and GDRS when necessary.

In general, the board of a cooperative consists of a president, a vice president, a treasurer, and two members. The board members are generally elected in the general meeting which is usually held once a year, but in some cooperatives, the election is conducted once in 2 years (Annex I).

(b) Performance of Operation and Maintenance

The duties of the board of a cooperative are to conduct all necessary operations including evaluation and fixing of water charge at the commencement of their term of service, operation and maintenance of the irrigation facilities, collection of water charge based on the records of pump operation hours, settlement of disputes among farmers and holding of meetings for statement of accounts by the board.

(c) Water Charge and Financial Status

The rate of water charge applied in 1994 was in the range of TL 25,000 ~ 50,000 per hour depending upon the capacity of pumps and the number of members. In some cooperatives, the farmers are subsidized for water charges by the cooperative from the benefit earned by the cooperative through selling commodities. The water charge includes the electricity charge for pump operation, repair and maintenance cost, salary for the board members and pump operators, and repayment of the initial investment made by DSİ for the construction of wells and installation of pumps and electric supply facilities.

Average collection rate of the water charge in cooperatives is deemed to be less than 70% according to survey results. The deficit in the budget in cooperatives due to a small collection rate of water charge is appropriated from other incomes such as bank interests or side jobs.

(d) Difficulties in Management of Cooperatives

There are more or less difficulties in managing cooperatives depending on their conditions. However, the difficulty in collecting water charge is common to all the cooperatives. Since 1986, the groundwater table has been lowering in most of the wells in the

river basin. This adverse condition compels farmers to re-construct the wells or to pay more electric charge for pump operation, because a larger pumping head than before is required.

2.1.7 Agricultural Support Services and Farmers' Organizations

(1) Agricultural Research

The General Directorate of Agricultural Research (GDAR) has overall responsibility for all agricultural research activities of the 52 agricultural research institutes, 9 plant protection research institutes, 30 veterinary institutes and laboratories, and 6 foodstuff and food processing and preservation research institutes. In addition, GDRS has 11 soil and water research institutes.

Agricultural research covering the provinces in the Aegean Region is carried out by 5 research institutes, namely the Aegean Agricultural Research Institute, Olive Cultivation Research Institute, Agricultural Control and Protection Research Institute, Menemen Rural Services Research Institute, and Animal Inoculation Control Center (Annex E).

A close cooperation has been established between the research institutes and the agricultural extension offices. The staff of the above agricultural research institutes attend monthly liaison meetings held in the Provincial Office of MARA, İzmir, to have discussions with the agricultural extension staff in the Aegean Region. The research findings reached at the end of certain activities carried out in the institutes are distributed to farmers through an agricultural extension system.

(2) Agricultural Extension and Farmers' Training

Agricultural extension and farmers' training in İzmir province are under the responsibility of the Provincial Office of MARA. Since 1985, the "Agricultural Extension and Applied Research Project (AEARP)" (called TYUAP in Turkish), assisted by the World Bank, has been carried out to improve the agricultural extension service system. Thanks to this, the extension service system in the province has been reformed considerably.

The organization of the Provincial Office of MARA is shown in Figure 1.2.6, and the division of "Farmers' training" is directly responsible for the tasks. This division has 8 sections which are staffed by 40 agricultural engineers, 18 agricultural technicians; and other staff. Other divisions which include the division of plant protection, veterinary and agricultural supports, cooperate with this division (Figure 2.1.7).

In each district there is a District Branch Office which has some agricultural engineers, and agricultural technicians, some of whom work as Village Group Technicians (VGTs). This system was established in 1993, aiming to strengthen the close relationship between extension workers and farmers. The number of extension workers by district are as shown below.

Staff	Beydağ	Kiraz	Ödemiş	Tire	Bayındır	Torbalı	Selçuk	Total
Director	1	1	1	1	1	1	1	7
Staff in the District Office*	9	6	20	17	5	31	13	101
VGTs	0	2	9	10	7	5	3	36
Total	10	9	30	28	13	37	17	144

Remark*: Agricultural engineers, Agricultural technician, Veterinarian, Home economic technician etc.
Source : Provincial and District Offices of MARA, İzmir.

In the province, there are four bases of technical supervisors' groups, each of which consists of four experts in charge of field crops, fruits, livestock, and plant protection. Two groups are located in Ödemiş and Torbalı districts respectively and cover the whole basin. The group members technically supervise and consult with the extension workers in their respective districts.

VGTs contact farmers directly. They live in villages to maintain frequent contact with some Leader Farmers who are selected by them from the village groups consisting of about 5 to 10 villages. The Leader Farmers are informed of and trained by VGTs on the government policies, new agricultural technologies, several on-farm management techniques, etc. through meetings and practices in demonstration farms by VGT. Finally the Leader Farmers transfer the knowledge they obtained to other village farmers.

As mentioned above, the extension and training system itself seems to be very functional and practicable, but it is said that the arrangement or ability of staff is not necessarily adequate for farmers, and that the farmers don't respond actively to extension and training and have little interests in getting new technologies.

(3) Farmers' Organizations

Main farmers' organizations are the chamber of agriculture (Ziraat Odaş) and agricultural cooperatives. In each district there is a district chamber of agriculture organized by farmers themselves. The purposes of the chamber are to assist farmers' activities and to promote farmers' welfare. The main activities of the chamber are to register farmers in a legal status and to issue the certificate for payment of tax and duty. Farmers can receive subsidy from the government based on this procedure. The chamber is operated and managed by the delegates elected by member farmers and the bureau members.

In the basin, there are three types of cooperatives concerning farmers, namely agricultural development cooperatives (which are further sub-divided into three types: village development cooperatives, irrigation cooperatives, and fishery cooperatives), agricultural credit cooperatives, and agricultural sales cooperatives. The agricultural development cooperatives and the agricultural credit cooperatives are composed of only farmers, while the agricultural sales cooperatives have a president appointed by the Government. The former two types of cooperatives are under the supervision of MARA, while the last type is supervised by the Ministry of Industry and Commerce.

The village development cooperatives were established for better agricultural production and sales of products in rural villages. The irrigation cooperatives were organized for effective water management, and operation and maintenance of the irrigation facilities by beneficiaries of irrigation schemes. The agricultural credit cooperatives were established for financing with low interests and the supply of cheaper farm inputs to the member farmers. The agricultural sales cooperatives were established for evaluation and advantageous marketing of economically important agricultural products. These three types of cooperatives were established in accordance with separate special laws. According to the general agricultural census in 1990, about 30% of the villages in İzmir province have some kind of cooperatives. The number of these cooperatives in the basin is as shown below.

Type of cooperative	Beydağ	Kiraz	Ödemiş	Tire	Bayındır	Torbalı	Selçuk	Total
A-Coop.	2	6	19	17	20	24	3	91
V-Coop.	2	4	10	11	8	13	0	48
I-Coop.	0	2	9	6	12	11	1	41
W-Coop.	0	0	0	0	0	0	2	2
C-Coop.	2	3	12	11	6	9	0	43
M-Coop.	0	0	3	3	2	4	3	15

Remark : 1) Agricultural development cooperatives, a) Village development cooperatives, b) Irrigation cooperatives, c) Water products cooperatives, 2) Agricultural credit cooperatives, 3) Agricultural sales cooperatives

The activities and number of member farmers of the existing agricultural development cooperatives vary from cooperative to cooperative. At present the maximum number of members is more than 900 and the minimum is less than 20. In many villages, there are no cooperatives. According to the farmers' household survey, very few farmers join the village development cooperatives and most farmers sell their farm products to the merchants who visit them, or directly to consumers at the local markets, though a considerable number of farmers sell cotton, tobacco, etc. to the marketing cooperatives or the Tobacco, Tobacco Products, Salt and Alcohol Industry (TEKEL).

Generally the aim of the agricultural sales cooperatives is to evaluate the products of their associates in the best way, to return the highest share of the retail prices to the farmers, to regulate the market prices of products, and to stabilize prices both for the producers and the consumers. The agricultural marketing cooperatives have mainly concentrated on sales services, and also perform activities dealing with purchase from the producers, and evaluating various agricultural products such as cotton, olives, figs, raisins, fresh fruits and vegetables, tobacco, milk and milk products, etc. The agricultural marketing cooperatives in the basin deal with only cotton, olives and figs. Each cooperative handles only one kind of product for its producer farmers, and therefore a farmer can join several agricultural marketing cooperatives depending on his products. Recently these cooperatives are likely to face a shortage of basic and operating capitals.

(4) Agricultural Credit

Agricultural credit cooperatives were established for the purpose of providing loans to their associates at low interests. These cooperatives, whose members are generally small and

average farmers, obtain credit at lower interests which they are not able to obtain elsewhere. The agricultural credit cooperatives are the largest and most extensive farmers' institutions providing services to 16 area unions, 1 central union and to 65% of the rural areas. These cooperatives also provide fertilizers, agro-chemicals, fodder, equipment and machines. In İzmir province, there are 97 agricultural credit cooperatives in total, of which 43 are located in the basin. Generally the number of member farmers is 500 to 1500 per cooperative.

The basic loan term for procuring fertilizers, agro-chemicals, seeds, animal feeds, transportation expenses, etc., is one year, but for agricultural machinery, livestock, etc., it can be extended up to three years. The upper limit of a loan is TL 120 million. Although the annual interest varies depending on the case, the basic interest is 43% per annum. The funds are financed by the Agricultural Bank (T.C. Ziraat Bankası). The limit of loan per farmer is not so high for big size farmers who get money directly from the Agricultural Bank whose loan interest is generally 60% per annum. Besides, the agricultural sales cooperatives loan to their members who don't join the agricultural credit cooperatives under similar terms that are applied by the credit cooperatives.

(5) Farm Inputs Distribution

The inputs such as seeds, fertilizers, agro-chemicals, agricultural machinery and other farm inputs required by farmers are provided partly from public establishments and partly from private establishments.

A part of seeds and seedlings are supplied by public establishments for agricultural equipment, and the remaining by either producers' own seeds or by private firms. The Provincial Office of MARA supervises private seed companies, checks import seeds, procures and distributes some seeds and seedlings to farmers, and informs seedling requirement by farmers to private firms. The Provincial Nursery Garden established in Selçuk in 1987 supplies various types of healthy and good quality fruit seedlings to the farmers in the province. The Ödemiş Fruit Culture Production Station Directorate produces vine seedlings and distributes them to the farmers.

Most farmers purchase fertilizers through the agricultural credit cooperatives. These cooperatives have fertilizer producing factories which produce 51% of fertilizers consumed in Turkey and sell fertilizers at a discount rate of 30% of the retail price. Alternatively, if farmers purchase fertilizers from retailers, they can get a refund of 30% by the Government upon presentation of the receipts concerned. Farmers also can purchase agro-chemicals at a discount rate of 20% through the agricultural credit cooperatives, or they can get a refund of 20% in the same way as for fertilizers.

There are 55 producers of agricultural tools and devices in the province, mainly in the central cities like Ödemiş and Tire. They produce trailers, hoe machines, cotton seeding drills, and other machinery for various purposes. Most of these products are marketed in the Aegean Region.

2.1.8 Market and Prices

(1) Marketing

Agricultural products can be broadly classified into three categories according to the purpose and marketing destination. The first category includes the products for local demand within the area nearby the production places. The second category includes the products to be supplied to the regional market outside the local area and the domestic market in Turkey, for both processing and fresh consumption. The products included in the third category are for export to Europe and the Gulf area.

The local demand depends on the consumption of foodstuffs by inhabitants and the requirement for livestock feed. Those include cereal crops (wheat, barley, oat, maize), pulses and legumes (except fresh green), fodder crops (alfalfa and vetches), and livestock products. Wheat and pulses are mainly for consumption by farm households. Other cereals and fodder are fed to the farmers' and/or neighbor breeders' livestock. Although such crops as potatoes, vegetables and fruits and milk are consumed by the local habitants, their amounts are small compared to the marketable surplus.

The industrial crops are cotton and tobacco. Most fresh vegetables are marketed to both regional and domestic markets in İzmir and large cities outside the province. Large amounts of potatoes and watermelons are sent to Ankara and İstanbul. The export crops are fresh and processed vegetables and fruits, olive oil, and dried figs.

The marketing channels of agricultural products are broadly categorized into two; the channel handled by the private sector and the channel handled by the governmental sector. The latter category is further divided into two; the channel handled by State Economic Enterprises (SEEs) and the channel handled by the Agricultural Sales Cooperative Unions (ASCUs), namely TARİŞ. Besides, the İzmir Commodity Exchange, which is one of the 84 organizations existing in Turkey, plays an important role for the transaction of several commodities such as cotton, dried fruits and vegetable oil. This organization deals with about 11% of the total transactions dealt with by the said 84 organizations, and handles more than 90% of cotton in the Aegean region.

Fresh vegetables and fruits are sold mainly to merchants and the market operated by İzmir municipality. Farmers also sell their products at weekly markets in municipalities. Watermelons are sold at seasonal markets in Ödemiş and Gökçen that open daily in the harvest season from June to September. Merchants buy watermelons either at these markets or at farm by negotiating directly with the farmers. Watermelons purchased here are mainly sold to İzmir and other cities such as Ankara and İstanbul and exported to European and Gulf countries. The İzmir Commodity Exchange deals with various kinds of processed products such as dried figs, dried raisins, vegetable oil and cereals. These products transacted here are distributed to other domestic markets and also exported to European and Gulf countries.

Farmers sell seed cotton to private ginneries or TARİŞ ginneries. Lint cotton is distributed to the domestic market through the İzmir Commodity Exchange and exported to European countries mainly in the form of textile products.

The road connection is one of the main means to transport farm products to the markets. The major market flow of products from the river basin is generally towards İzmir and Ankara. However, after 1991 when the trunk road was opened, the majority of fresh vegetables produced in Kiraz are transported to Aydın, Denizli and Antalya.

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

There exist many small-scale agro-processing facilities for cotton ginning and olive oil extraction. These factories are operated by privates and cooperatives (TARİS) and functioned as marketing agencies. Several factories are operated for the preservation of vegetables (cucumbers pickles, tomato paste, green peppers) on a large scale. However, large-scaled factories are mainly located in İzmir for the convenience of collecting materials from the whole province or regions due to their marketing positions. These are oil refineries and wineries. Dairy factories are located in Kiraz and Tire. For local consumption, there are many processing facilities such as wheat flour mills, and "mandra" for dairy products.

(3) Prices of Crops and Farm Inputs

Farmers are generally price takers in the transaction, because the farmers cannot participate in marketing and also do not have sufficient marketing information. As a result, they have to sell their products at relatively low prices. Farmers tend to select the crops according to the price of the previous year. This results in an excess supply of one particular product in the following year and accordingly causes the price of the product to fall.

The government support prices are applied through SEEs and ASCs to the purchase of cereals, cotton, dried figs, raisins, olive oils, and tobacco in the river basin. Those crops are purchased by SEEs and ASCU's from farmers at higher prices than the market prices.

The prices of farm products and inputs fluctuate depending on the seasonal fluctuations of production, market demand, and the rate of inflation. The prices in the İzmir Commodity Exchange reflect the floor prices or farmgate prices. These prices and the seasonal price fluctuations are shown in Annex-F.

2.1.9 Farm Economy

(1) Crop Budget

The typical crop budget per hectare is estimated for the main crops on the basis of the data related to the river basin and surrounding areas.

Crops	Yield (kg/ha)	Gross Value (10^3 TL/ha)	Cost (10^3 TL/ha)	Net Value (10^3 TL/ha)
Wheat, irrigated	4,500	18,500	7,300	11,200
Barley, rainfed	2,800	11,000	5,740	5,260
Barley, irrigated	8,000	28,000	17,500	10,500
Tomato, irrigated	40,000	100,000	35,600	64,400
Cucumber, irrigated	20,000	80,000	50,000	30,000
Watermelon, irrigated	35,000	70,000	27,000	43,000
Potato, irrigated	28,000	84,000	45,400	38,600
Cotton, irrigated	2,700	48,600	18,300	30,300
Anise beans, rainfed	500	17,000	9,900	7,100
Beans green, irrigated	8,000	64,000	29,100	34,900

Note: The gross value includes the value of main products and by-products. Costs do not include land rent and transportation to market.

Cereal grains and legumes such as wheat, barley and anise beans are not so profitable, even under irrigated conditions, compared with vegetables, potatoes and cotton, all of which are generally irrigated.

(2) Farm Household Budget

The farm household budget of typical farmers is estimated from the results of the household survey as shown in the following table.

District	Kiraz	Beydağ	Ödemiş	Tire	Bayındır	Torbalı	Selçuk
Farm Size (ha)	2.8	3.2	3.2	11.6	9.3	6.9	6.2
Household Size (person)	5.6	6.9	5.2	5.3	5.0	5.7	5.4
Gross Income (TL million)	208.0	233.9	253.2	936.0	462.1	663.3	301.9
Farm Income	195.7	191.4	241.2	932.4	455.1	650.1	295.9
Crops	168.9	174.1	227.7	917.9	438.9	646.1	290.1
Livestock	26.8	17.3	13.5	14.5	16.1	4.0	5.8
Off-farm Income	12.3	42.5	12.0	3.7	7.0	13.2	6.0
Expenditure (TL million)	178.2	231.1	221.4	565.4	341.7	446.9	272.0
Production Cost	67.6	69.6	91.1	367.2	175.6	258.4	118.4
Living Expenses	110.6	161.5	130.3	198.2	166.1	188.5	153.6
Food	53.0	76.9	63.2	93.1	73.5	78.0	60.0
Education	4.8	34.2	14.3	22.1	12.6	18.8	18.8
Others	52.7	50.4	52.8	83.0	80.0	91.7	74.8
Net Reserve (TL million)	29.8	2.8	31.8	370.6	120.4	216.4	29.9

The results show the following features:

(i) Gross income is mainly generated by crop production in the river basin. The livestock product is mainly for home consumption to sustain household members, and negligibly small amounts are sold.

(ii) In the Beydağ district, where the farm size is small and farm income is low, about 18% of income is from off-farm activities to supplement the farm income.

(iii) The net reserve is proportionate to the farm size. Smaller farm households in Beydağ and Ödemiş districts have no or little funds to improve their farming and living conditions.